Adjustment Dynamics of Countries' Specialization in the European Union

Abstract

We investigate the adjustment dynamics of countries' specialization patterns in terms of labor market participation in manufacturing industries for the European Union. Using co-integration and error correction modeling techniques, we find that imbalances in European countries' specialization are being set off at a rate of about 63 percent within the next period. Adjustment rates for Denmark, France, Germany, and Spain are lower than for the entire EU. These patterns deliver valuable information about labor market rigidities and the suitability of a common monetary union in the European Union.

Keywords:

New Economic Geography, Specialization, European Integration, Co-integration Analysis

JEL-Code: C50, F14, F15

1 Introduction

The European Union experienced several stages of integration over time, including the reduction of means of protectionism, the enforcement of the Single European Market Act in 1987 and the introduction of the common monetary union realized by the launch of the ECB in 1999. In the future, further steps of integration will involve the intake of new member countries to both the EU and the EMU. It remains to be seen whether ongoing integration exerts an influence on European countries' specialization and industrial agglomeration.[1]

It is important for many branches of European politics to be informed about and understand agglomeration and specialization processes in the EU. If a country's degree of specialization increases, it is said that asymmetric shocks might damage this country's economy 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 US states do. Also European countries' adjustment to aggregate shocks was slower than for the US.

Because of European common monetary policy, one important tool for smoothing crises has become absent, European countries are not able to conduct a monetary policy themselves, any more. In case of divergent economic developments across two countries, the common central bank might risk tolerating either inflationary pressures or unemployment in one of the countries (Mundell 1961). There is no possibility to adjust money supply or the exchange rate according to the countries' specific needs, any more. Furthermore, in the European Union the degree of labor mobility is known not to be very high, due to differences in languages, cultural habits and preferences. Consequently, another tool for reducing imbalances is absent. In fact, a higher degree of specialization and fewer labor mobility would make the European countries not good candidates for forming a currency union.

The effects of increasing trade liberalization on European business cycle synchro-

[1]Agglomeration refers to the dimension of industrial sectors. It is defined as the geographical localization of industrial activity. Specialization looks at the other side of the coin and refers to the dimension of space: it measures a region's industrial structure.

nization and the suitability of a common currency in the EU have been studied by Frankel and Rose (1998). The authors state that it is primarily intra-industrial trade which leads to equalized economic structures across countries and fosters business cycle synchronization. In fact, taking a look at recent developments, intra-industrial trade in the EU 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 (OECD STAN Indicators).[2] The constancy of intra-industrial trade, however, might indicate that in case of growing specialization, countries' economic structures become unequal to each other, making them subject to asymmetric shocks again.

Most studies in the field agree with growing agglomeration tendencies in the European Union (e.g. Brülhart 1998, 2001), and there are as well studies that find that specialization in the EU increased (Amiti (1998, 1999), Midelfart-Knarvik et al. (2000), Ezcurra et al. (2006)). However, the studies differ in terms of the time frame that advocates increasing specialization tendencies.

The reasons for countries' specialization follow a long tradition in economic theory, investigating why countries take up trading relationships with each other. Theory leads us to consider traditional trade theory (e.g. Heckscher-Ohlin, about relative factor abundance), new trade theory with its focus on scale economies in production, and the newer branch of new economic geography, with a focus on the proximity of production and input-output linkages among firms. The literature finds that industrial structures of France, Germany, and the UK, for example, are characterized by strong economies of scale, a high technology level and highly educated workers (Midelfart-Knarvik et al. 2000). Greece and Portugal, for example, however, are characterized by low technology, low returns to scale and low-educated workers. This would give evidence for lower-skilled cheaper labor in Southern European countries. One would conclude from their study's results, that Heckscher-Ohlin type arguments or new trade theory would be favored for the explanation of countries' specialization.

[2]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.

In our analysis, we investigate the development of countries' specialization in the European Union from 1970 to 2005 and examine the driving factors of specialization. What we can show in our study is that specialization remains rather rigid for several countries: adjustments to the long-run equilibrium of specialization (as measured by employment shares) are for some countries slower than for the European Union on average. As a novelty to literature, our analysis allows us to quantify the degree of adjustment rates to the long-run equilibrium. That way one can gain information about how quickly economic structures can change, about how much employment and as such the labor market adjust to deviations from the long-run equilibrium. To the best of our knowledge this is the first study that explicitly considers non-stationarity properties of regression variables in studying agglomeration issues. In regard of the ongoing process of integration in the European Union this study gives insights into the evolution of industrial structures in Europe.

2 Empirical Analysis

2.1 Measuring Countries' Specialization

In accordance with the common procedure of Krugman (1991 a) and Amiti (1998, 1999) Gini coefficients are used for measuring specialization. The Gini coefficients are calculated as follows. First compute the Balassa index

$$B^S_{ic,t} = \frac{\frac{e_{ic,t}}{e_{c,t}}}{\frac{e_{i,t}}{E_t}}. \tag{1}$$

$e_{ic,t}$ 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. If an industry's employment has a low magnitude in total EU employment (small value of denominator) but a high magnitude relative to a country's employment, the Balassa index will show up a high value indicating a country's strong specialization in the given industry.

The Gini coefficient is calculated by first ranking the Balassa index in descending order. Then one constructs a contraction 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 industries). The Gini coefficient is equal to twice the area within a 45 degree line and the contraction curve. This procedure yields a Gini coefficient for one point in time and one country c. If the Gini coefficient equals zero, specialization will be low. The Gini coefficient approaches one, the more the Balassa indexes differ from one, countries' specialization then will be high.

2.2 Data Issues

The data are 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. We 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*. In accordance with the literature we used employment data since data on value added or exports, for example, are subject to measurement errors or deteriorating exchange rate influences. 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 we could make use of 20 industries. A further disaggregation of industries was prevented by lack of data. The data were available for the period from 1970 to 2005. For the measurement of explanatory variables we extracted data on value added, output and compensation (of labor, capital and intermediate goods) from the EU KLEMS database. Furthermore, an openness index was taken from Penn World Table (2006).

Since data on explanatory variables for Italy (labor compensation, capital compensation, intermediate inputs, value added, gross output as volume and as value) were missing in the EU KLEMS database, we decided to take data for explanatory variables for Italy from the OECD STAN database. Furthermore, 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 (according to ECB exchange rate statistics). 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 was prevented by lack of data.

2.3 Countries' Specialization Patterns

The Gini coefficients displayed in table 1 demonstrate that it is France, Germany, Greece, Italy, Ireland, Portugal, and the UK that show a significant increase in specialization for the time period from 1970 to 2005. 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 (France, Germany, UK). Viewing it from another perspective, countries lying in the periphery of Europe like Ireland, Greece and Portugal and important European core countries, namely France, Germany, and the UK 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.

2.4 Explaining Countries' Specialization

For the regression analysis, we employ variables capturing effects of traditional trade theory, new trade theory and the new economic geography, respectively. We make use of the operationalization of variables for traditional trade theory and new economic geography from Amiti (1999) and take a new measure for scale economies. Furthermore, we include a measure of a country's degree of openness in the regression framework.

The measures capturing elements of different trade theories are defined as follows:

$$fact_{ct} = |\frac{w_{ct}L_{ct}}{VA_{ct}} - \frac{\overline{w_t L_t}}{\overline{VA_t}}|. \tag{2}$$

$$scale_{ct} = \frac{\frac{w_{ct}L_{ct}+Cap_{ct}+Int_{ct}}{Q_{ct}}}{Q_{ct}}. \quad (3)$$

$$intermediate_{ct} = \frac{P_{ct}Q_{ct} - VA_{ct}}{P_{ct}Q_{ct}}. \quad (4)$$

$w_{ct}L_{ct}$ denotes labor compensation in millions of euros in country c at time point t, VA_{ct} is gross value added in country c at current basic prices in millions of euros at time t, Cap_{ct} is capital compensation in millions of euros, Int_{ct} is intermediate inputs at current purchasers' prices in millions of euros, Q_{ct} is gross output as a volume index (1995=100), $P_{ct}Q_{ct}$ denotes gross output at current basic prices in millions of euros.

The measure *fact* shall cover aspects of traditional trade theory, namely Heckscher-Ohlin theory: countries will specialize in producing and exporting a good that they produce relatively intensively with the abundant factor. The measure consists of the deviation of the share of labor compensation in value added to countries' share of average labor compensation in average value added. The absolute value of this measure is taken. The idea behind is that countries exhibiting either a high labor or a high capital intensity (represented by either high or low labor compensation compared to the European average) will display a high level of specialization. Thus a positive influence of *fact* on countries' specialization can be expected.

New trade theory postulates the relevance of scale economies. The measure *scale* 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. We had to use another measure for scale economies than Amiti (she uses the share of employment over number of firms), because data on the number of firms were having several gaps. One has to consider two different cases, though: thinking about a homogeneous good, countries will specialize in the good they have the higher market share in, initially. Further integration, thereby seizing international trade, will 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, will seize intra-industrial trade, leading to equalized industrial structures across countries.

New economic geography's influence is represented by the measure *intermediate*. 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)). According to Krugman/ Venables (1995) in case of 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). A higher level of intermediate inputs shall represent a higher degree of input-output linkages among firms. Therefore a positive relationship between specialization and intermediate goods intensity can be expected.

An openness index is taken from the Penn World Table (2006) and defined as a country c's total trade (imports plus exports) divided by GDP (real value, base year 2000) at time t. A positive relationship between openness and countries' specialization can be expected, liberalization of markets, thus more trade, should go hand in hand with a higher level of specialization.

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

$$\begin{aligned} lngini_{ct} = \alpha + \beta_1 lnfact_{ct} + \beta_2 lnscale_{ct} + \beta_3 lnintermediate_{ct} \\ + \beta_4 lnopen_{ct} + \gamma_c + \delta_t + u_{ct}. \end{aligned} \tag{5}$$

The Gini coefficient $lngini_{ct}$ is regressed on factor abundance $lnfact_{ct}$, scale economies $lnscale_{ct}$, intermediate goods intensity $lnintermediate_{ct}$, openness $lnopen_{ct}$, time dummies ψ_t and country dummies γ_c, u_{ct} is the disturbance term. Time dummies ψ_t are taken relative to 1970, country dummies γ_c are taken relative to Germany. Further, logs of variables are taken. [3]

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

Results in table 2 suggest that new economic geography explains countries' specialization in the EU best. Intermediate goods intensity is the main driving factor of specialization. Heckscher-Ohlin theory is important only to a slight extent, the coefficient for factor intensity is very small. 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.

Averaging variables over all European countries and looking for time series properties we get the following results shown in the last two columns in table 2. Results indicate that all of the variables are significant. Openness enters the regression equation with a positive sign. Still, new economic geography can explain specialization best. A trouble becomes evident looking at Durbin Watson statistics. Autocorrelation of error terms might be an important point in explaining the results here.

2.5 Dynamic Econometric Analysis

The Durbin-Watson statistics of the regressions indicate that we will have to consider non-stationarity properties of variables. The idea behind is that if non-stationary variables are regressed on each other we might obtain significant results that are not meaningful, however. It's a spurious regression only. In order to handle this problem we have 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, we will be able to estimate an error correction model. This will enable us 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. Establishing a co-integration relationship also means that no important regression variable has been omitted from the regression framework, otherwise no co-integration would be detected.

For the entire EU, in a first step we 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 3. All of the tested variables are I(1), that is differencing the variable one time makes it become stationary. This enabled us to check for a co-integration relationship in a second step. For checking co-integration, we run ADF tests and used MacKinnon's critical values for co-integration tests (MacKinnon (2010)). The regression function including openness in addition to the three trade theory variables appeared to be co-integrated. So in a third step we conducted an error correction model estimation using the following equation:

$$Dlngini_{ct} = \alpha + \beta_k D\mathbf{X} + \tau Dlngini_{c(t-1)} + \delta resid_{c(t-1)} + u_{ct}. \tag{6}$$

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 $lnfact_{ct}$, $lnscale_{ct}$, $lnintermediate_{ct}$, $lnopen_{ct}$. u_{ct} is the disturbance and δ is the error correction term.

As can be seen in table 3, new economic geography serves as the best explanatory force, being highly significant. In the short-run intermediate goods intensity exerts an influence of about 0.26 to 0.28 percent on countries' specialization. These values are lower than those we estimated before for the long-run using a simple OLS procedure, only. The error correction term is highly significant and shows that deviations from the long-run equilibrium state of specialization in the entire EU are being set off by about 63 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 we could establish for Belgium, France, Germany, Ireland, Italy, Spain, Sweden and the UK only: all of the tested variables appeared to be I(1). Co-integration could be established for Denmark, France, Germany, and Spain (only these countries' results are further shown in table 3).[4] In summary,

[4] For the other countries, establishing no co-integration relationship could either mean that other explanatory variables for specialization exist which are not controlled for in the current regression framework, or there is no long-term equilibrium relationship between the non-stationary variables existent.

investigations show that adjustments for Denmark, France, Germany, and Spain are slower than for the entire EU. This means if specialization is higher/ lower than the levels of factor abundance, scale economies, intermediate goods' flows and openness would suggest, it will be corrected within one year to a lower extent than it would be in case of the entire EU. The speed returning to equilibrium after a deviation occurred is lower for Denmark, France, Germany, and Spain than for the EU on average. Specialization is not able to change that quickly!

These results offer important insights for regional, economic and social politics in the EU. Given that the common monetary union is already at work, economic disequilibria in the countries of Denmark, France, Germany and Spain are slower to be solved by labor market adjustments compared to the European average. In fact, our results are backed by research on labor market rigidities in Europe (see Nickell (1997) and OECD (2008)). France, Germany, and Spain score higher than the average in the OECD's employment protection index, for example, indicating strong regulations of hiring and firing being present. Consequently, employment might not change that quickly in these countries. Denmark on the other hand, possesses a strong system of labor unions which will serve as a force of employment protection, also being able to make the employment structure more stable in this country.

3 Conclusion

This study appears to be the first one in the New Economic Geography literature that considers non-stationarity properties of variables for explaining industrial specialization patterns in the European Union. We could deliver new insights into the change of economic structures in the EU. The use of co-integration and error correction modeling techniques enabled us to shed light on different European countries' adjustment dynamics in terms of their degree of manufacturing specialization. In fact, as a novelty to the literature, we were able to exactly quantify the degree of adjustment to the long-run equilibrium state of specialization for the entire EU and across different European countries. For the entire EU we could disentangle the quantitative effect of adjusting to the long-run equilibrium state of specialization which amounts to about 63 percent within the next period. We could establish further valid co-integration relationships and error correction modeling frameworks for Denmark, France, Germany, and Spain. The results indicate that adjustments rates to the long-run equilibrium for these countries are lower than for the entire EU. Specialization adjusts more slowly in these countries. These tendencies are backed by evidence on labor market rigidities in the European Union. Slower adjustments of the employment structure, in turn, are not favorable for a common monetary union. Consequently, in these countries other mechanisms like price adjustments or financial transfers would have to work adequately in order to smooth out economic disequilibria.

We could further show that peripheral European countries like Ireland, Greece, Portugal and the core European countries, namely France, Germany, and the UK exhibited high increases in specialization over 1970-2005. The effects due to intermediate goods' flows are highly significant which gives evidence for the validity of New Economic Geography models.

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Tables

Table 1: Countries' specialization

	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. The change of specialization over 1970-2005 and a linear trend test for significance of changes are shown.

Table 2: Regression results for countries' specialization

Dependent variable *ln(gini)*	**Pooled OLS**		**Average EU OLS**	
constant	-1.3956**	-1.635**	-1.0369**	-1.5859**
ln(fact)	0.023**	0.0235**	0.0539**	0.0547**
ln(scale)	-0.0102	0.0003	-0.0509**	0.037*
ln(intermediate)	0.7218**	0.7104**	0.3172**	0.3752**
ln(open)		0.0545		0.0669**
country effects	yes	yes		
time effects	yes	yes		
N	490	490	35	35
R^2	0.977	0.977	0.803	0.863
F-Stat	374.859	368.463	42.212	47.252
DW			1.123	1.532

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.

Note: ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken. OLS regression with the log of the Gini coefficient as dependent variable, in the last two columns averaged over all countries.

Table 3: Co-integration test and error correction modeling

		Aggregated EU	Denmark Model I	Denmark Model II	France	Germany Model I	Germany Model II	Spain
Unit root test	ln(gini)	I(1)	I(1)		I(2) PP I(1)	I(1)		I(1)
	ln(fact)	I(1)	I(0) PP I(1)		I(1)	I(1)		I(1) PP I(2)
	ln(scale)	I(1)	I(0) PP I(1)		I(1)	I(0) PP I(1)		I(1) PP I(2)
	ln(intermediate)	I(1)	I(1)		I(1)	I(1)		I(1)
	ln(open)	I(1)	I(1)		I(1)	I(1)		I(1)
Co-integration test	co-integrated	yes*	yes*	yes*	yes*	yes**	yes*	yes*
Error correction model	D(ln(fact))	0.0096		0.024**				
	D(ln(scale))	0.0182	0.2507**	0.2733**	0.4863**	-0.2293**	-0.2996*	0.1878*
	D(ln(intermediate))	0.2774**				-0.9133**	-0.9956**	
	D(ln(open))	-0.0146			0.5091**			
	$D(ln(gini_{t-1}))$	-0.0875						
	$Resid_{t-1}$	-0.6281**	-0.5944**	-0.5842**	-0.1652**	-0.388**	-0.4004**	-0.3583*
	const	0.0019						
	N	35 (33)	35 (33)	35 (33)	35 (33)	35 (33)	35 (33)	35 (33)
	R^2	0.418	0.355	0.41	0.454	0.461	0.468	0.255
	DW	1.741	1.841	1.824	2.21	1.98	1.861	1.998

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.

Note: ** 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. For the unit root tests we run ADF and Phillips-Perron tests. For checking co-integration, we run ADF tests and used MacKinnon's critical values for co-integration tests (MacKinnon (2010)).