Global Value Chains and Structural Change

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Abstract

There is growing evidence that manufacturing activity in the EU is increasingly concentrated in a Central European (CE) manufacturing core implying divergent paths of structural change within the EU. This agglomeration of manufacturing activity coincides with deepening economic integration within Europe in general and the emergence of global value chains in particular. Focusing on the manufacturing sector this paper investigates the relationship between structural change and integration into global value chains (GVCs) in EU Member States over the period 1995-2011. The empirical findings suggest a non-linear relationship between two phenomena: Members of the CE manufacturing core benefit from participation in GVCs in terms of structural change towards manufacturing, whereas for the remaining EU Member States, GVC participation is found to accelerate the 'deindustrialisation process' which has been taking place in many countries. This sheds doubt on the widespread belief among policy makers that integration in GVCs will unambiguously strengthen the manufacturing competitiveness of EU Member States.

Keywords: *global value chains, structural change, manufacturing*

JEL Codes: *L16, F15, F62*

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Global Value Chains and Structural Change

1 Introduction

There is growing evidence that manufacturing activity in the EU is increasingly concentrated in a Central European (CE) manufacturing core centred on Germany and comprising Austria as well as the four Viségrad countries, i.e. the Czech Republic, Hungary, Poland and Slovakia[1]. Providing descriptive evidence, the IMF (2013) links the issue of agglomeration of manufacturing activity within the CE-region with international production integration by arguing that a German-Central European supply chain has evolved which is producing and exporting manufacturing goods to the rest of the world.[2] Supposedly, this new European manufacturing core partly replaces, partly supplements the traditional metropolitan axis known as the 'blue banana' (Roger, 1989) in Europe running from London to Milan (Hospers, 2003). This study takes up the issue of integration into global value chains (GVCs) and structural change, focusing on the development of the manufacturing sector, and subjects it to an econometric analysis.

The concentration of European manufacturing activity in a CE manufacturing core implies that its members have embarked on a distinct path of structural change when compared to other EU Member States. As a result, the structural shift out of manufacturing was much less pronounced or entirely absent in the former while quite strong in other parts of the EU leading to the observation that some countries experienced a 'de-industrialisation' process. The obvious candidate explanation for these divergent developments in the EU manufacturing sector in open economies such as EU Member States is specialisation according to comparative advantages. According to Ricardian trade models, if the CE manufacturing core countries were relatively more productive in producing manufacturing goods than the rest of the EU, they are supposed to specialise in the production of manufacturing goods and import services while the opposite holds true for the other EU Member States. Hence, in a comparative static trade analysis such an agglomeration of manufacturing activity in a certain part of the EU is the natural consequence of specialisation and as such not a reason for concern. In fact, gains from trade are very much based on the idea that countries specialise in producing in what they are good at. Despite this clear-cut result from workhorse trade models, several arguments have been brought forward, why manufacturing matters for the economic performance of countries (e.g. McKinsey, 2012; Reiner, 2012; Helper et al., 2012; Stöllinger et al., 2013; Rodrik, 2013). This paper does not address the big question of why manufacturing may be special but without providing new evidence (or repeating existing arguments) simply side with the pro-manufacturing camp and assumes that for the long-run growth trajectory the structure of the economy in general and the share of manufacturing in particular is important[3]. Therefore a structural

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[1] Arguably the European manufacturing core also includes the Northern part of Italy and the Netherlands as well as Romania. For the purpose of this study I concentrate on the countries mentioned in the main text.

[2] For an earlier contribution on the emergence of a leading Central and Eastern European region see for example Kooij and Pellenberg (1994).

[3] One very obvious reason for the different views on the role of manufacturing is that trade theory is strongly dominated by static models which emphasise the reallocation effects and potential efficiency gains from

shift out of manufacturing is considered to be an unfavourable structural change, whereas an increase in the relative share of manufacturing is regarded as positive structural change. The rate of structural change defined as the change in the relative share of manufacturing in domestic value added is the variable of interest in this paper.

The question this paper tries to answer is whether there exists a relationship between countries' involvement in GVCs and the manufacturing–related structural changes in EU Member States. Given the divergent structural developments in EU Member States, the econometric specification employed allows for different effects of GVC participation on structural change in the CE manufacturing core and other EU Member States. Despite the widespread view, especially among policy makers, that the emergence of GVCs is bound to foster the EU's competitiveness in the manufacturing sector and consequently spurring growth and employment opportunities in this sector, I find quite distinct structural effects resulting from international production sharing.

The paper is structured as follows: Section 2 explains the methodology and variables used in the empirical exercise and provides information on the main data sources. Section 3 offers some descriptive evidence on the concentration of European manufacturing activity in the CE manufacturing core, structural change and the development of international integration of production. In section 4, the econometric model and the results are discussed followed by some robustness checks offered in Section 5. Section 6 concludes with the main policy implications.

2 Methodology and data

The research question necessitates the definition of structural change as well as the indicator for integration in GVCs.

The definition of structural change is straightforward. The rate of structural change in country *c* in period *t* is simply the change in the share of nominal domestic manufacturing value added in nominal GDP[4]. For the main explanatory variable, the degree of GVC integration, two measures are used. The first measure is the foreign value added in trade (FVAiT). The FVAiT concept was developed by Hummels, Ishii and Yi (2001) and – as its name suggests – refers to the foreign value added embodied in a country's exports where this foreign value added is often expressed as a percentage of that country's gross exports. The calculation of the FVAiT requires international input-output tables which are obtained from the World Input-Output Database (WIOD) because it requires tracing back the value added contents in gross exports to its ultimate source.

Three components are needed to calculate the foreign (and domestic) value added in trade. For any country *r*, these components are the value added requirements per unit of gross output, $\boldsymbol{v_r}$; the Leontief inverse of the global input-output matrix, $\boldsymbol{L}$; and the export vector $\boldsymbol{x_r}$. Both vectors as well

trade specialisation. In contrast, growth effects do not exist in these models. The effects of trade in open economy growth models very much depend on the assumptions. They can easily feature "bad equilibria" in which a country's growth prospects can be curtailed by unfavourable specialisation (e.g. Lucas, 1988) but also huge growth effects (e.g. Rivera-Batiz and Romer, 1991).

4 Robustness checks with employment shares of the manufacturing sector and the sector's share in real value added is envisaged for future work.

as the Leontief inverse have an industry dimension i. The industry index is omitted in order to facilitate the exposition.

Country *r*'s value added requirement is defined as $v_r = \frac{value\ added_r}{gross\ output_r}$. For each country a diagonal matrix $\boldsymbol{diag(v_r)}$ which is of dimension 1435 (40 countries x 35 industries) and has only the value added coefficients of country *r* in its diagonal and zeros otherwise is constructed.

The second element is the Leontief inverse of the global input-output matrix, $\boldsymbol{L} = (\boldsymbol{I} - \boldsymbol{A})^{-1}$ where $\boldsymbol{A}$ denotes the coefficient matrix. In the WIOT the coefficient matrix (and hence the Leontief matrix) is of dimension 1435 × 1435 which contains the technological input coefficients of country *r* in the diagonal elements and the technological input coefficients of country *r's* imports (from a column perspective) and exports (from a row perspective) in the off-diagonal elements.

Finally, country *r*'s trade vector is needed. This vector contains country *r*'s exports to all its trading partners (i.e. aggregate exports) in each of the industries. The remaining entries potentially contain country *r*'s bilateral imports in each industry. However, since I am only interested in decomposing the export vector into its components these import values are set to zero yielding the export vector $\boldsymbol{x_r}$. For the calculation I use again the diagonal matrix, $\boldsymbol{diag(x_r)}$, constructed on the basis of country *r*'s export vector and which is also of dimension 1435.

With these three elements country *r*'s gross exports can be decomposed into domestic and foreign value added shares by calculating a VAiT matrix of dimension 1435x1435:

(1) $$VAiT_r = diag(v_r) \cdot L \cdot diag(x_r)$$

To illustrate this, let's look at these matrices in the three countries–one sector case, where country *r* acts as our model country. Equation (1) then has the following form:

$$\begin{pmatrix} VAiT^{r,r} & 0 & 0 \\ VAiT^{2,r} & 0 & 0 \\ VAiT^{3,r} & 0 & 0 \end{pmatrix} = \begin{pmatrix} v^r \cdot l^{r,r} \cdot x^{r,*} & 0 & 0 \\ v^2 \cdot l^{2,r} \cdot x^{r,*} & 0 & 0 \\ v^3 \cdot l^{3,r} \cdot x^{r,*} & 0 & 0 \end{pmatrix} = \begin{pmatrix} v^r & 0 & 0 \\ 0 & v^2 & 0 \\ 0 & 0 & v^3 \end{pmatrix} \cdot \begin{pmatrix} l^{r,r} & l^{r,2} & l^{r,3} \\ l^{2,r} & l^{2,2} & l^{2,3} \\ l^{3,r} & l^{3,2} & l^{3,3} \end{pmatrix} \cdot \begin{pmatrix} x^{r,*} \\ 0 \\ 0 \end{pmatrix}$$

The coefficients in the Leontief matrix represent the total direct and indirect input requirements of any country in order to produce one dollar worth of output for final demand. For example, the coefficient $l^{r,r}$ indicates country r's input requirement from itself in order to produce one unit of output. Likewise the coefficient $l^{2,r}$ indicates country *r*'s input requirement supplied by country 2 in order for country *r* to produce one unit of output.

In the trade vector, the elements $x^{r,*}$ represent country *r*'s exports to all countries.

Equation (1) therefore yields the total value added in country *r*'s exports. More precisely, $VAiT^{r,r}$ is the domestic content of country *r's* exports, i.e. the amount of value added embodied in country *r's* exports originating from country *r* itself. $VAiT^{2,r}$ and $VAiT^{3,r}$ are the foreign value added contents of country *r*'s exports *(FVAiT)* which originate from country 2 and country 3 respectively. The total *FVAiT* of country *r* is obtained by summing up over all *FVAiTs* from all partner countries.

The foreign value added in trade is an indicator for a country's *backward production integration*, as it measures the amount of foreign value added in a country's gross exports.

Since my interest in this paper is with the manufacturing sector I do not use the economy-wide *FVAiT* measure but restrict the analysis to the value added generated by manufacturing industries. Hence, the *FVAIT* of country *r* is calculated as the value added generated by foreign manufacturing industries irrespective of which industry is responsible for the export of this value added. Accordingly, this foreign value added is expressed as a percentage of the value added supplied by manufacturing industries that is exported by country *r*[5].

The second indicator for production integration used is the GVC participation (see Koopman et al., 2011). The GVC participation combines a country's foreign value added in its exports just described (i.e. backward production integration) and the part of a country's domestic value added in its exports which consequently enters another country's exports. The latter is a measure for *forward production integration* which will also be referred to as a country's value added contributions to foreign exports (*VACFE*). A country's value added contributions to foreign exports consist of indirect value added exports (comprising the domestic value added embodied in other countries' gross exports not returning back home) and as such can be retrieved from the calculations of the FVAiT. More specifically, to get country *r's* VACFE, the foreign value added contents originating from country *r* across all partner countries FVAiT matrices are collected. In the three countries-one sector case, country *r's* VACFE would be the sum of country *r*'s value added contributions to the exports of country 2 ($VAiT^{r,2}$) and to the exports of country 3 ($VAiT^{r,3}$). These two elements are shown in bold in the *VAIT*-matrices of the three countries shown below.

$$VAIT\ country\ r\begin{pmatrix} VAiT^{r,r} & 0 & 0 \\ VAiT^{2,r} & 0 & 0 \\ VAiT^{3,r} & 0 & 0 \end{pmatrix} \qquad VAIT\ country\ 2\begin{pmatrix} 0 & \boldsymbol{VAiT^{r,2}} & 0 \\ 0 & VAiT^{2,2} & 0 \\ 0 & VAiT^{3,2} & 0 \end{pmatrix} \qquad VAIT\ country\ 3\begin{pmatrix} 0 & 0 & \boldsymbol{VAiT^{r,3}} \\ 0 & 0 & VAiT^{2,3} \\ 0 & 0 & VAiT^{3,3} \end{pmatrix}$$

In line with the approach followed for the *FVAiT*, also for the VACFE measure, the analysis will be confined to the value added supplied by the manufacturing sector. This means that only country *r*'s value added contributions originating from its manufacturing industries that are embodied in other countries' exports will be considered (again, irrespective of which industry is responsible for exporting this manufacturing value added).

The measures for backward production integration (*FVAiT*) and forward production integration (*VACFE*) can be combined, i.e. added up, to get an indicator for a country's participation in global supply chains (GVC) which is often argued to be a more comprehensive measure of production integration (e.g. OECD, 2013; UNCTAD, 2013). As mentioned above, both the *FVAiT* and the *GVC* participation indicator are often expressed in per cent of gross exports – or in my case the exported value added supplied by manufacturing industries – of the country where the value added is generated. This convention will be followed in the empirical specification.

For the calculation of all production integration indicators as well as for the structural change variable, information from the World Input-Output Database (WIOD), and in particular the World Input-Output Tables, will be used. The period of analysis is 1995 to 2011.

The data for the control variables (labour cost, GDP per capita) come from Eurostat and the AMECO database (real exchange rate). Population data, which is used as an instrument in the robustness

[5] This is the reason why the calculation of the FVAiT was performed using the diagonalised value added coefficients and export vectors since this allows to single out the individual value added contributions of each single partner country and industry.

checks, as well as information on the industry share in EU Member States' total employment which will be used as an alternative measure for structural change (i.e. as an alternative dependent variable) in the robustness checks, are also taken from the Eurostat database.

3 Descriptive evidence for the Central European manufacturing core

Descriptive evidence for the existence of the Central European manufacturing core is provided by looking at *(i)* the comparative developments of the manufacturing sector in Member States proxied by the share of manufacturing in total value added and *(ii)* the share of this country group in the EU's total manufacturing value added exports (Johnson and Noguera, 2012).

Most advanced economies experienced a structural shift away from the manufacturing sector and towards services. The EU is no exception to this respect. There are a number of factors contributing to the declining importance of manufacturing which also reinforce each other. These factors include the relative productivity developments across sectors, demand elasticities and international organisation of production.

Firstly, with regard to productivity developments, there is broad consensus that the manufacturing sector is the major source of technological progress (Baumol, 1967; Kaldor, 1968; UNIDO, 2002; Aiginger and Sieber, 2006; Helper et al., 2012).[6] While this does not automatically imply that total factor productivity growth is also higher in manufacturing than in the rest of the economy, empirically this turns out to be the case (see e.g. Peneder, 2014; Stöllinger et al., 2013). As a consequence, prices of manufactures have declined relative to those of services, resulting in a relative decline of value added generated in the manufacturing sector (above all in nominal terms). Secondly, current demand structures play against the expansion of the manufacturing sector. Low price elasticities of demand, coupled with high income elasticities for several services (e.g. education, tourism, health, cultural activities), will tilt the structure of production towards services industries as per capita incomes rise to the detriment of manufactures (Baumol, 1967). The third point is related to the organisation of production and the ever more granular specialisation in production. As firms optimise their organisation of production, they may find it profitable to locate different parts of the production process (or more generally of its business functions) in different countries. This phenomenon of ever more granular specialisation was made possible by the information-technology-communication (ICT) revolution in the 1990s (Baldwin, 2011). Improved communication possibilities made it possible to locate production in different parts of the world according to comparative advantages; existing cost (and in particular wage) differentials made it profitable.

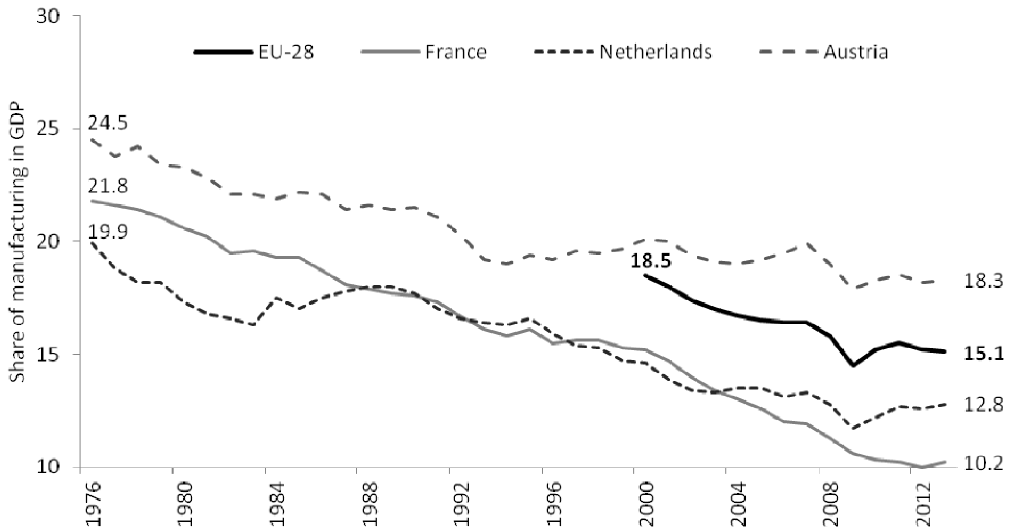
For advanced economies this 'second unbundling' (Baldwin, 2011) and the associated fragmentation of production implies that parts of the value added chain of the production process are shifted – or 'offshored' – to foreign (low-cost) countries. Naturally, offshoring of parts of the value added chain (also referred to as 'tasks') reduces the value added generated in the offshoring economy. This obviously is a partial equilibrium effect. The general equilibrium effect of offshoring activities may be

[6] An important question in this context is whether it is necessary to have actual manufacturing production taking place in a country in order to achieve technological progress or whether it is sufficient to control strategic business functions along the value chains such as R&D.

that value added generated in the offshoring country is increased due to efficiency gains because of resulting lower prices and induced additional demand of these lower prices.

The combined effect of these factors (relative productivity developments, changes in demand structures and the international organisation of production) on the manufacturing sector's share in selected EU Member States is shown in Figure 3.1. The figure illustrates the long-term structural shift out of manufacturing for France, Austria and the Netherlands, since the mid-1970s[7]. The shorter time series for the EU-28 suggests that there is a common negative trend at least since the year 2000.

Figure 3.1: Long term changes in the share of manufacturing in valued added (in %), selected EU Member States



Note: Based on NACE Rev.2. classification and nominal values.

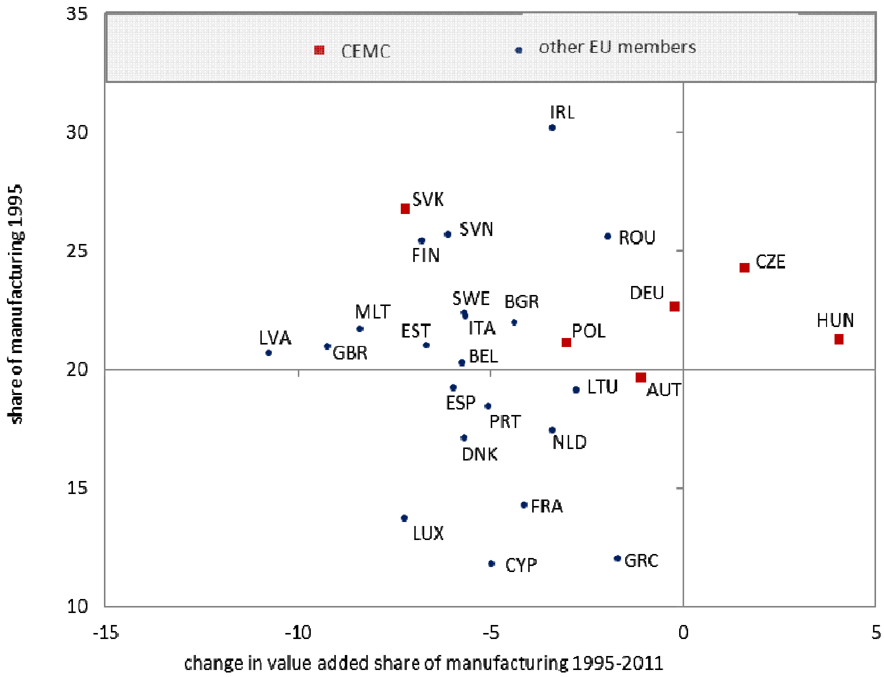
Source: Eurostat.

Figure 3.2 focuses on the period of investigation of this paper, i.e. 1995-2011, showing the changes in the manufacturing share on the horizontal axis and the share of manufacturing in 1995 on the vertical axis. This figure highlights that despite the common negative trend of the manufacturing share (in nominal terms it declined in all but two Member States which are Hungary and the Czech Republic), the magnitude of this structural shift was very different across Member States. It was very pronounced for example in Latvia, the UK or Spain but less so in Germany, Austria or Romania. Certainly, when considering these structural changes, the initial importance of manufacturing in Member States' economies needs to be taken into account (this is shown on the vertical axis in Figure 3.2). In 1995, the share of manufacturing in domestic value added was highest in Ireland – a fact that can be attributed to Ireland's successful strategy to attract foreign multinational companies (MNCs) including manufacturing MNCs –, Slovakia and Slovenia. In the latter two, the share of manufacturing declined considerably between 1995 and 2011 but both remain among the countries with the largest value added shares of the manufacturing sectors.

From Figure 3.2. it is easily discernible that the countries of the CE manufacturing core, marked with red squares, experienced only rather modest declines (or even increases) in the share of manufacturing – with the exception of Slovakia – and they are also among the countries where the manufacturing sector remained relatively important with a share in value added close to 20%.

[7] The selection of Member States was simply made on the basis of data availability in Eurostat.

Figure 3.2: Share of manufacturing in valued added 1995 (in %) and changes in shares 1995-2011 (in p.p.)



Note: CEMC = Central European manufacturing core.

Source: WIOD, own calculations.

These structural developments points towards increasing concentration of EU manufacturing production in the CE manufacturing core which must be expected to be related to international competitiveness. I chose Member States' shares in total EU manufacturing exports on a value added basis as an indicator for the Member States' international competitiveness. Table 3.1 shows the share in value added exports – that is the value added exported by a country absorbed by other countries (Johnson and Noguera, 2012) – of various groups of Member States. For the countries forming the CE manufacturing core these export shares are also shown individually. A first observation is that, amounting to more than a third, the CE manufacturing core's share in manufacturing value added exports was already high in 1995. Until 2011 this share grew to 42.6%, an impressive increase of 8 percentage points. Note that this positive development of export market shares in manufacturing industries is found in each single member of the CE manufacturing core. Given their economic size, Germany and Poland contributed most strongly to this development with gains in market shares amounting to 2.4 and 1.9 percentage points respectively.

The flip side of this agglomeration of manufacturing activities in the CE manufacturing core is a significant decline in the share of EU manufacturing value added exports in other EU Member States, in particular in high-income countries including the Nordic and the Benelux countries and above all France and the United Kingdom.

Table 3.1 Shares in EU manufacturing value added exports by groups of Member States, 1995-2011

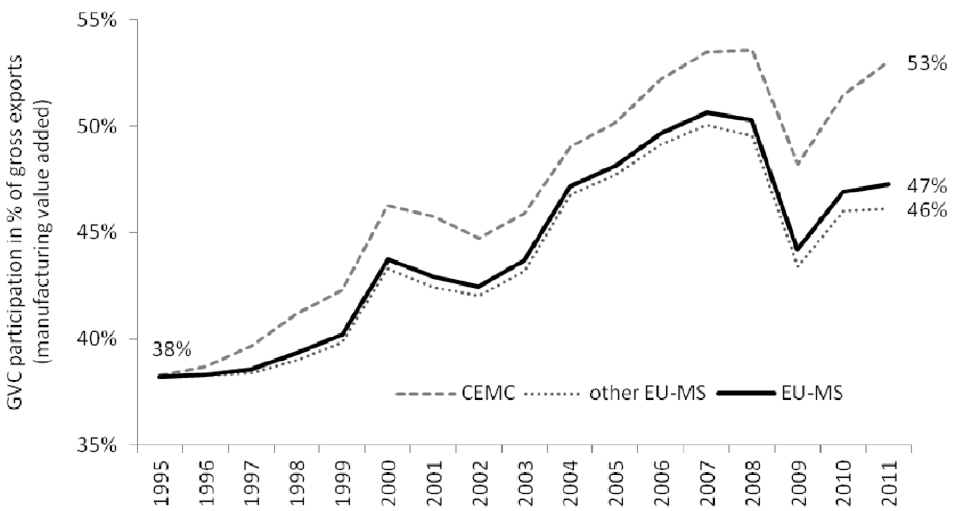
	1995	2000	2005	2008	2011	change 1995-2011 (in p.p.)	change 2008-2011 (in p.p.)
CE manufacturing core	34.5%	33.8%	38.9%	41.6%	42.6%	8.1	1.0
Germany	*29.0%*	*27.1%*	*29.8%*	*30.8%*	*31.4%*	2.4	0.6
Austria	*2.6%*	*2.8%*	*3.1%*	*3.2%*	*3.1%*	0.5	-0.1
Czech Republic	*0.8%*	*1.1%*	*1.8%*	*2.3%*	*2.4%*	1.6	0.1
Hungary	*0.4%*	*0.8%*	*1.2%*	*1.4%*	*1.5%*	1.1	0.1
Poland	*1.3%*	*1.6%*	*2.3%*	*3.1%*	*3.2%*	1.9	0.1
Slovakia	*0.4%*	*0.4%*	*0.7%*	*1.0%*	*0.9%*	0.5	-0.1
Benelux	11.8%	9.8%	9.5%	9.4%	9.7%	-2.1	0.3
Nordic countries	8.7%	8.5%	7.8%	7.4%	6.9%	-1.8	-0.5
France	12.0%	12.8%	11.3%	10.4%	9.5%	-2.5	-0.9
Italy	11.8%	11.3%	10.7%	10.8%	10.5%	-1.3	-0.3
United Kingdom	12.6%	13.1%	10.3%	8.9%	9.1%	-3.5	0.2
Southern EU	5.8%	6.6%	6.9%	6.9%	6.9%	1.1	0.0
Other EU-MS	2.7%	4.1%	4.5%	4.6%	4.7%	2.0	0.1

Note: Nordic countries = Denmark, Sweden, Finland; Southern EU = Spain, Portugal, Greece, Malta, Cyprus; Other EU-MS = Bulgaria, Romania, Latvia, Estonia, Lithuania and Ireland. Manufacturing industries based on NACE Rev. 1 industry classification.

Source: WIOD, own calculations.

The second important aspect for the empirical analysis is the emergence of global value chains. Therefore, a short descriptive investigation of the major trend for the international production integration is expedient. Figure 3.3 shows the development of the GVC participation rate based on manufacturing value added contributions in percent of manufacturing value added exports as described in the previous section.

Figure 3.3: Development of global value chain participation in the EU, 1995-2011



Source: WIOD, own calculations.

The picture that emerges is straightforward: there is a clear upward trend in GVC participation over the period 1995-2011 throughout the whole EU with only a short crisis-related set-back in the year 2009. In the EU as a whole, the GVC participation rate was 53% of exported manufacturing value added in 2011, a 15 percentage points increase relative to 1995. The developments for the members of the CE manufacturing core and the other EU Member States are very similar with identical degrees of production integration in 1995 but a somewhat greater increase in GVC participation in the CE manufacturing core in the second half of the 1990s. Hence, one can note that the growing international production integration is a common feature of EU Member States and not specific to the CE manufacturing core.

In the next section I try to put the descriptive pieces of evidence for quite distinct structural shifts within the EU on the one hand and the increasing importance of international production integration within Europe together.

4 Econometric Model and Results

The evidence put forward in favour of the emergence of a manufacturing core so far leaves open the question what role integration in GVCs has played in the divergent structural developments in the EU. I turn to regression analysis in order to investigate the relationship between EU Member States' integration in GVCs and changes in their economic structure.

In this, change of the share of manufacturing in the economy will serve as the dependent variable. While a highly imperfect indicator for the importance of the manufacturing sector in an economy and its performance, it still shows whether resources are – relatively speaking – attracted to or drawn from the manufacturing sector in an economy.

The working hypothesis is that international production integration affects EU Member States' economic structures differently thereby contributing to the differentiated trends in the manufacturing share. In particular it is hypothesised that the development of the manufacturing sector was different for the countries forming the CE manufacturing core ($CEMC$) and that this difference in development was partly due to international production integration. This hypothesis is tested empirically with a panel regression model that tries to explain structural change with, alternatively, the countries' foreign value added in trade (FVAiT) and global value chain (GVC) participation rate explained in Section 2. In the discussion I will focus on the specification with the GVC participation rate (Koopman et al., 2011) as the main explanatory variable as this is arguably the more comprehensive proxy for international production integration which has also become popular in policy reports (e.g. OECD, 2013; UNCTAD, 2013). In order to allow for a different experience of the CE manufacturing core as compared to other EU Member States following production integration, a dummy variable that takes the value one for the CE manufacturing core countries and 0 for the other EU countries is added – directly and with an interaction term. In addition a number of control variables (X) is included. The resulting regression model takes the following form:

$$\Delta sh_{c,t}^{manuf} = \alpha + \beta_1 \cdot initial\ sh_{c,t}^{manuf} + \beta_2 \cdot GVC\ participation_{c,t} + \beta_3 \cdot CEMC_c + \gamma \cdot \left(GVC\ participation_{c,t} \times CEMC_c\right) + X_{c,t} \cdot \varphi + \delta_t + \varepsilon_{c,t}. \quad (1)$$

where $\Delta sh_{c,t}^{manuf}$ is the change in the nominal share of manufacturing in GDP of country *c* in period *t*. For this purpose I subdivide the time span running from 1995 to 2011 into 4-year periods.[8] Therefore $\Delta sh_{c,t}^{manuf}$ represents differences of 4-year periods where these differences are based on period averages.

The variable $initial\ sh_{c,t}^{manuf}$ represents each country's share of manufacturing at the beginning of each period and is used to control for potential level effects as countries with initially higher manufacturing shares may also be more prone to 'de-industrialise'. Moreover, the convergence hypothesis, which Rodrik (2013) has recently shown to hold unconditionally for manufacturing industries at the global level, would suggest that the initial share of manufacturing is negatively correlated with the change in the manufacturing share. Put differently, countries with initially low shares of manufacturing in GDP should see the relative size of the sector increase by more (or decrease by less) than countries which initially had higher shares – if this type of convergence hypothesis holds true.

My main interest is with the coefficients of the GVC participation rate, $GVC\ participiation_{c,t}$, and the $CORE_c$ variable. In a variant to equation (1) the foreign value added in trade, $foreign\ VAiT_{c,t}$ is used as a proxy for international production instead of the GVC participation.

If the proxies for international production integration turn out to have a negative coefficient, this would suggest that vertical specialisation and the integration in international supply chains have a negative effect on the share of manufacturing in the economy. For the high-income countries ('offshoring countries') this may be due to the loss of manufacturing value added because a part of the manufacturing activities that previously have been undertaken domestically are moved to another country in the process of international production sharing. For the relatively low-income countries among the EU Member States, a negative effect from vertical specialisation may arise due to unfavourable specialisation in low value added parts of the value chain.

Conversely, both groups of countries may benefit from such deep economic integration due to efficiency gains and in the case of the lower-income Member States due to the attraction of additional value added activities in the manufacturing sector.

Belonging to the CE manufacturing core, $CEMC_c$, is expected to yield a positive coefficient indicating that on average the structural change to the detriment of manufacturing was less pronounced in the CE manufacturing core economies. As a reminder, by including an interaction term between $GVC\ participiation_{c,t}$ (respectively the $foreign\ VAiT_{c,t}$) and $CEMC_c$, equation (1) also opens up the possibility that the effect of the former on structural change is different for the CE manufacturing countries and the other EU Member States.

Equation (1) also includes a set of time fixed effects, δ_t, as well as a number of control variables. These control variables are the log of the initial level of real GDP per capita, $initial\ GDPcap_{c,t}$, the change in the average labour compensation in the manufacturing sector (in log form), $\Delta labour\ cost_{c,t}$, and the change of the real effective exchange rate (in log form), $\Delta real\ FX_{c,t}$. The real GDP per capita is also included in quadratic form.

[8] I divide the 17 years of observations into 5 sub-periods (treating 1995 as a period in itself) in order to maintain a sufficient number of observations, on the one hand, but also have at least medium-term changes in industry structure (i.e. 4-year periods) as the dependent variable, on the other hand. Differences are based on averages of the 4-year periods.

I expect the coefficient of $initial\ GDPcap_{c,t}$ to have a negative sign as suggested by Baumol's de-industrialisation hypothesis (see e.g. Montresor and Marzetti, 2011). The quadratic $initial\ GDPcap_{c,t}$ term would capture a situation where the impact of real GDP per capita on structural change was different for countries with different income levels. Finally, the effect of a rising exchange rate is expected to hurt the manufacturing sector because it is the main tradables sector and therefore a negative coefficient is expected.

The estimation results of equation (1) are summarised in Table 4.1. Since the two sets of regressions using the *FVAiT* and the *GVC participation* as proxy for production integration respectively yield the same qualitative results (and very similar quantitiative results) I focus on the OLS-specifications of the latter proxy (specifications 4-5)[9].

Table 4.1: The effect of production integration on structural change, 1995-2011

Dependent variable:	Δ manufacturing share			Δ manufacturing share		
Production integration measure:	foreign VAiT			GVC participation		
	pooled	pooled	country RE	pooled	pooled	country RE
	(1)	(2)	(3)	(4)	(5)	(6)
initial manuf share	0.0026	-0.0121	-0.0123	0.0043	-0.0057	-0.0057
	(0.042)	(0.044)	(0.024)	(0.039)	(0.040)	(0.021)
initial GDPcap	-0.0217	-0.0512	-0.0519	-0.0284	-0.0602	-0.0605
	(0.045)	(0.049)	(0.057)	(0.050)	(0.054)	(0.061)
initial GDPcap - sq	0.0010	0.0025	0.0026	0.0013	0.0030	0.0030
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
foreign VAiT	-0.0112	-0.029 *	-0.0301 *			
	(0.015)	(0.018)	(0.018)			
foreign VAiT x CEMC		0.0633 **	0.0646 *			
		(0.030)	(0.034)			
CEMC	0.0070 *	0.0070 **	0.0069 **	0.0076 **	0.0060 *	0.0059
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
GVC participation				-0.0158	-0.0335 *	-0.0341 **
				(0.018)	(0.020)	(0.017)
GVC participation x CEMC					0.0644 **	0.0653 *
					(0.031)	(0.035)
Δlabour costs	0.0319	0.0378 *	0.0381 **	0.0334	0.0387 *	0.0390 **
	(0.020)	(0.021)	(0.019)	(0.020)	(0.021)	(0.018)
Δreal FX	-0.0713 **	-0.0840 **	-0.0852 **	-0.0726 **	-0.0852 **	-0.0866 **
	(0.031)	(0.034)	(0.038)	(0.031)	(0.033)	(0.038)
time fixed effects	yes	yes	yes	yes	yes	yes
F-test	3.398	3.857		3.766	4.388	
R^2	0.236	0.258		0.238	0.260	
R^2-adj	0.153	0.168		0.156	0.170	
R^2-overall			0.258			0.260
obs.	103	103	103	103	103	103

Note: RE=Random Effects. All regressions include a constant and time fixed effects. Δ manufacturing share are 4-year differences. Specifications including interaction terms are estimated using centred values (with zero mean) of the variables forming the interaction terms. ***,** and * indicate statistical significance at the 1%, 5% and 10% level respectively. Standard errors in parentheses. All regressions estimated with STATA.

9 Table 4.1 also reports random effects (RE) results. The RE estimation are almost identical to the pooled OLS regression. The conventional Hausman test to decide between a random and a fixed effects model fails because the error structure seems to be that of a pooled OLS model. This is evidence for the appropriateness of the pooled OLS approach.

A first observation is that the simple regression including just the $GVC\ participiation$ as explanatory variable leads to very disappointing results (specification 4). Without any differentiation among EU Member States, the degree of international production integration does not seem to be (linearly) related to changes in the value added share of manufacturing. In the entire regression just the real foreign exchange rate and the dummy variable for the group of CE manufacturing core countries turn out to be statistically significant. The situation, however, changes considerably when the interaction term between the $GVC\ participiation$ and the $CEMC$ dummy is included (specification 5). The estimated coefficient is negative and now statistically significant (at least at the 10% level), indicating that, on average a higher $GVC\ participiation$ is associated with a stronger decline in the share of manufacturing in the economy. Next, the positive coefficient of the $CEMC$ dummy (0.0060) in the regression suggests that the decline of the manufacturing sector was milder in the CE manufacturing core countries than in the other EU Member States confirming the findings in Section 3. Most importantly, the interaction between the $GVC\ participiation$ and the $CEMC$ dummy is positive and statistically significant. With a magnitude of 0.0644 it is also larger than the coefficient of the main effect of the $GVC\ participiation$ variable. This implies that the effect of international integration of production on structural change is in fact positive for the members of the CE manufacturing core.[10]

Remains the question whether these estimated effects are also economically relevant. To assess the economic relevance it is useful to first note that the average rate of structural change is -1.1 percentage points, i.e. the share of manufacturing declined on average by 1.1 percentage points in each period.[11] Now, the coefficient of the CEMC dummy means that for CE manufacturing countries the rate of structural change was 0.6 percentage points higher meaning that, given the negative rate of structural change, the negative structural change was less pronounced than in the other EU Member States. This is a noticeable difference given the average rate of structural change. With regard to the effect of international production integration, the result suggests that a 10 percentage point higher $GVC\ participiation$ accelerates the negative rate of structural change of the average EU Member States *not* belonging to the CE manufacturing core by 0.34 percentage points. However, for the CEMC countries a 10 percentage point higher $GVC\ participiation$ has a different effect: it slows down the negative rate of structural change by 0.31 percentage points ([-0.0335 + 0.0644] x 10).

These results are evidence for a differentiated impact of integration into global supply chain on Member States' economic structures. Hence, the Members of the CE manufacturing core see their manufacturing sector strengthened by this development, for the others it accelerates the 'de-industrialisation' process. This differentiated structural effect of production integration must therefore be expected to have contributed to the concentration of manufacturing activities in the CE manufacturing core that was reported in the previous sections. On the one hand this result is not entirely surprising because international production integration is just a more intensive and granular exploitation of comparative advantages leading to further specialisation. On the other hand, it is worthwhile emphasising this asymmetric impact of global value chains within Europe because integration in global value chains is also propagated as a general tool to boost the development and

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[10] The effect of $GVC\ participiation$ on the change in the value added share of manufacturing of the CE manufacturing core countries is obtained by adding the coefficients of the $GVC\ participiation$ and of the interaction term yielding a value of 0.03083 in the OLS specification.

[11] Remember that these rates of structural change refer to 4-year periods.

the competitiveness of Member States' manufacturing sectors which as such does not seem to be the case.

With regard to the control variables, the regression results suggest that changes in the real effective exchange rate are negatively correlated with changes in the manufacturing sector, which is as expected. An interesting finding is the positive coefficient of labour cost variable which suggests that low labour costs per se do not trigger manufacturing development. The initial share of the manufacturing sector is not statistically significant, suggesting that it is not a good predictor of the future development therefore also running counter the idea of a general convergence of manufacturing capacities across Member States. Finally, neither the initial GDP nor the squared initial GDP turn out to be statistically significant across Member States.

5 Robustness checks

Structural change may be measured by shifts in value added across sectors (or industries) or by shifts in employment. Therefore the pooled OLS model presented in the previous model is re-estimated using the employment share of the manufacturing sector as the dependent variable.

Table 5.1: The effect of production integration on structural change in terms of employment, 1995-2011

Dependent variable:	Δ manufacturing share	
Production integration measure:	foreign VAiT	GVC participation
	OLS	OLS
initial manuf share	-0.0353	-0.0231
	(0.031)	(0.029)
initial GDPcap	-0.0779	-0.0778
	(0.057)	(0.064)
initial GDPcap - sq	0.0039	0.0039
	(0.003)	(0.003)
foreign VAiT	-0.0382 *	
	(0.023)	
foreign VAiT x CEMC	0.0782 **	
	(0.037)	
CEMC	0.0021	0.0004
	(0.003)	(0.003)
GVC participation		-0.0317
		(0.026)
GVC participation x CEMC		0.0737 *
		(0.039)
Δlabour costs	0.0250	0.0224
	(0.023)	(0.024)
Δreal FX	-0.0466 **	-0.0458 *
	(0.022)	(0.023)
time fixed effects	yes	yes
F-test	2.635	2.494
R^2	0.246	0.234
R^2-adj	0.154	0.142
obs.	103	103

Note: All regressions include a constant and time fixed effects. Δ manufacturing share are 4-year differences. Specifications including interaction terms are estimated using centred values (with zero mean) of the variables forming the interaction terms. ***,** and * indicate statistical significance at the 1%, 5% and 10% level respectively. Standard errors in parentheses. All regressions estimated with STATA.

The results of this robustness check are shown in Table 5.1. The results from the baseline regression are fully confirmed in the sense that I find the same pattern of coefficients for the $FVAiT$ and the $GVC\ participipiation$ variable as well as their interaction term with the CE manufacturing core dummy. In the specification using the $FVAiT$ as the proxy for production integration, the results are basically identical with both the coefficient of $FVAiT$ and of the $FVAiT \times CEMC$ being statistically significant and very similar in size. The only major difference is that the dummy variable for the CE manufacturing core itself is not statistically significant anymore. In the specification with the $GVC\ particip iation$ the statistical significance is slightly reduced compared to the baseline regressions with only the $FVAiT \times CEMC$ term remaining statistically significant at the 10% level. We assign this full lack of robustness to the relatively small number of observations and in particular the short time series which only consists of four periods. The relatively small number of observations also poses a challenge for the statistical significance of the instrumental variable (IV) regressions reported in Table 5.2 and Table 5.3.

Table 5.2: The effect of FVAiT on structural change, instrumental variable regression, 1995-2011

	First stage	*First stage*	*Second stage*
Dependent variable:	FVAiT	FVAiT x CEMC	Δ manufacturing share
Production integration measure:	FVAiT	FVAiT x CEMC	FVAiT
initial manuf share	-0.4014 ***	0.0447	-0.0161
	(0.114)	(0.042)	(0.047)
initial GDPcap	-0.2364	0.1573 **	-0.0550
	(0.172)	(0.074)	(0.046)
initial GDPcap - sq	0.0119	-0.0086 **	0.0027
	(0.009)	(0.004)	(0.002)
foreign VAiT			-0.0373 *
			(0.022)
foreign VAiT x CEMC			0.0587
			(0.048)
CEMC	0.0995 ***	0.0641 ***	0.0074
	(0.021)	(0.018)	(0.004)
Δlabour costs	0.0254	0.0085	0.0403 *
	(0.066)	(0.030)	(0.022)
Δreal FX	0.0286	0.0515	-0.0837 **
	(0.089)	(0.053)	(0.034)
pop	-0.0438 ***	0.0001	
	(0.004)	(0.001)	
pop x CEMC	-0.0285 **	-0.0682 ***	
	(0.011)	(0.010)	
time fixed efects	yes	yes	yes
F-test	28.83	11.56	2.92
R-sq.	0.692	0.633	0.532
obs-	103	103	103
AP F test (weak instruments):	117.22	47.92	
P-value	0.000	0.000	
AP Chi-sq (overidentification)	132.67	54.24	
P-value	0.000	0.000	
KM statistic (underidentification)			11.42
P-value			0.001
Cragg-Donald F statistic (weak instrument)			47.97
crirical value for 10% maximal IV size is 7.03)			
Hansen J statistic			0.000
(overidentification all instruments):			

Note: All regressions include a constant and time fixed effects. Δ manufacturing share are 4-year differences. Specifications including interaction terms are estimated using centred values (with zero mean) of the variables forming the interaction terms. AP=Angrist-Pischke; KM=Kleibergen-Paap. ***,** and * indicate statistical significance at the 1%, 5% and 10% level respectively. Standard errors in parentheses. All regressions estimated with STATA.

Table 5.3: The effect of GVC participation on structural change, instrumental variable regression, 1995-2011

	First stage	*First stage*	*Secondstage*
Dependent variable:	GVC	GVC	Δ manufacturing share
Production integration measure:	GVC	GVC	GVC
initial manuf share	-0.1745	0.0488	-0.0106
	(0.130)	(0.043)	(0.045)
initial GDPcap	-0.6068 ***	0.1269 **	-0.0758
	(0.210)	(0.067)	(0.053)
initial GDPcap - sq	0.0320 ***	-0.0069 *	0.0038
	(0.011)	(0.004)	(0.003)
GVC participation			-0.0486 *
			(0.029)
GVC participation x CEMC			0.0736
			(0.053)
CEMC	0.1220 ***	0.0919 ***	0.0067 *
	(0.018)	(0.015)	(0.004)
Δlabour costs	0.0960	0.0151	0.0434 *
	(0.072)	(0.030)	(0.023)
Δreal FX	-0.0876	0.0356	-0.0886 **
	(0.091)	(0.051)	(0.036)
pop	-0.0335 ***	0.0001	
	(0.005)	(0.001)	
pop x CEMC	-0.0406 ***	-0.0667 ***	
	(0.010)	(0.010)	
time fixed efects	yes	yes	yes
F-test	27.02	10.29	3.00
R-sq.	0.674	0.731	0.532
obs.	103	103	103
AP F test (weak instruments):	56.41	23.73	
P-value	0.000	0.000	
AP Chi-sq (overidentification)	48.55	51.05	
P-value	0.000	0.000	
KM statistic (underidentification)			17.412
P-value			0.000
Cragg-Donald F statistic (weak instrument) *crirical value for 10% maximal IV size is 7.03)*			26.69
Hansen J statistic *(overidentification all instruments):*			0.000

Note: All regressions include a constant and time fixed effects. Δ manufacturing share are 4-year differences. Specifications including interaction terms are estimated using centred values (with zero mean) of the variables forming the interaction terms. AP=Angrist-Pischke; KM=Kleibergen-Paap. ***,** and * indicate statistical significance at the 1%, 5% and 10% level respectively. Standard errors in parentheses. All regressions estimated with STATA.

While reverse causality may be less of an issue in my empirical model because first differences are used as the dependent variable, one may still argue that changes in the relative size of the manufacturing sector affects the degree of international production integration. Therefore I also re-estimate equation (1) with a 2-stage least square estimator using the log of population, pop, as instrument for $FVAiT$ and $GVC\ participiation$ respectively (as well as the interaction terms).

With only one instrument the exclusion restriction cannot be tested but it is fair to assume that country size as such is not a determinant of the relative size of the manufacturing sector and even less so for its rate of change. In contrast, country size affects the production integration proxies and so population turns out to be a relatively strong (negatively correlated) instrument.

Regarding the second stages of the IV regressions, it is first of all interesting to note that the size of the estimated coefficients is very similar to the OLS results (and obviously the sign is the same). However, since the IV estimator is less efficient the statistical significance of the coefficients is reduced and it is only possible to establish a negative effect of the $FVAiT$ and $GVC\ participipiation$ on structural change respectively which is statistically significant at least at the 10% level, but not for the interaction terms.

So obviously, the results of the IV regressions shown in Table 5.2 and Table 5.3 do not perfectly confirm the baseline results but again I attribute this lack of significance to the very short time period available for this empirical exercise.

6 Conclusions

This paper tried to link three empirical observations related to European manufacturing. Firstly, there was a continued EU-wide decline of the value added share of manufacturing. This decline, however, was significantly less pronounced in the CE manufacturing core countries than in the other EU Member States. Second, these differentiated structural trends are related to differences in EU Member States' international competitiveness (success as export markets) which caused the observable concentration of manufacturing activity in the CE manufacturing core. Third, international production sharing has increased markedly throughout the period 1995-2011.

This paper investigated empirically whether there is a link between these trends, in particular between the increasing participation in global value chains and the structural changes observed in EU Member States. My econometric results indeed suggest that the GVC participation had a significant but differentiated impact on structural change in Member States. In particular, it is found that in the average EU Member State, GVC participation has a negative structural impact in the sense that it contributed to the shift out of manufacturing. The opposite is found for the countries belonging to the CE manufacturing core whose manufacturing sectors have benefited from GVC participation. Hence, the structural impact of international production integration seems to be country-specific, strengthening the manufacturing sector in some, while accelerates the 'de-industrialisation' process in others.

This finding puts a question mark on one of the key priorities to support the competitiveness of European industry defined in the latest Industrial Policy Communication of the European Commission (2014). This Communication stresses the integration of EU firms in global value chains as one of the strategies to improve manufacturing competitiveness[12]. Our regression results show that this strategy is to be questioned because apparently integration in global value chains does not have the same effect on all EU Member States. It may still be true that a highly productive CE manufacturing core is supporting EU competitiveness vis-à-vis third countries but it does not necessarily support the development of the manufacturing sector in each single Member State. To the extent that the manufacturing sector is supporting the convergence process of middle-income countries (Rodrik, 2013), – though it could not be established in this paper in the EU context – these developments may

[12] The Communication mentions the *"integration of EU firms in global value chains to boost their competitiveness and ensure access to global markets on more favourable competitive conditions"* (European Commission, 2014, p. 23) as one of the priorities to be pursued to support the competitiveness of European industry.

run counter to the European objective of cohesion. In short, international production networks may imply a trade-off between efficiency and cohesion at the European level. With the European Commission becoming increasingly concerned with the external competitiveness of the EU, it may well be that the efficiency criterion will be given priority. The consequence of this will be a continued and unchecked agglomeration of industrial capacities in the CE manufacturing core countries.

While the general pattern of the empirical results is very stable, the relatively short sample period covered in this analysis implies that the statistical significance of the coefficients is not fully convincing in all specifications. This is particularly true in the IV specifications. An attempt to somehow expand the analysis back in time will have to be made, though the indicators for production integration would have to be estimated for the years before 1995. Another potential expansion is to perform the analysis at the industry level which would also be a possibility to increase the sample size.

Literature

Baldwin, R. (2011), 21st Century Regionalism: Filling the gap between 21st century trade and 20th century trade rules, CEPR Policy Insight, No. 56.

Baumol, W.J., (1967), 'Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis', American Economic Review, 57(3), pp. 415-426.

European Commission (2014a) For a European Industrial Renaissance, COM(2014)14final, 22 January 2014.

Hospers, G.-J. (2003), 'Beyond the Blue Banana? Structural Change in Europe's Geo-Economy', Intereconomics, March/April, pp. 76-85.

Hummels, D., J. Ishii and K.-M. Yi (2001), 'The nature and growth of vertical specialization in world trade', Journal of International Economics, Vol. 54, No. 1, pp. 75–96.

Helper, S., Krueger, T., and Wial, H., (2012), Why Does Manufacturing Matter? Which Manufacturing Matters? A Policy Framework, Brookings, February.

IMF (2013), IMF Multi-Country Report. German-Central European Supply Chain – Cluster Report, IMF Country Report No. 13/263, August.

Johnson, R.C. and G. Noguera (2012), 'Accounting for Intermediates: Production Sharing and Trade in Value Added', Journal of International Economics, Vol. 86, No. 2, pp. 224-236.

Kooij, P. and P. Pellenberg (1994), Regional Capitals: Past, Present, Prospects, Gorcum, Assen.

Koopman, R., W. Powers, Z. Wang and S.-J. Wei (2011), Give credit to where credit is due: tracing value added in global production chains, NBER Working Papers Series 16426, September 2010, revised September 2011.

Kaldor, N., (1968), 'Productivity and Growth in Manufacturing Industry: A Reply', Economica, 35(140), pp. 385-391.

Lucas, (1998) On the mechanics of economic development, ournal of Monetary Economics, 22(1), pp. 3-42.

McKinsey Global Institute, (2012), Manufacturing the future: The next era of global growth and innovation, November 2012.

Montresor, S. and G.V. Marzetti (2011), 'The deindustrialisation/tertiarisation hypothesis reconsidered: a subsystem application to the OECD 7', Cambridge Journal of Economics, Vol. 35, No. 2, pp. 401-421.

OECD (2013), Interconnected Economies: Benefiting from Global Value Chains, OECD Publishing.

Peneder, M. (2014), Warum die Neue Industriepolitik die Deindustrialisierung beschleunigen wird, FIW Policy Brief, No. 23, Februar.

Reiner, C., (2012), 'Play it again, Sam: die Renaissance der Industriepolitik in der Großen Rezession', Wirtschaft und Gesellschaft, 38(1), pp. 15-56.

Rodrik, D. (2013), 'Unconditional Convergence in Manufacturing', Quarterly Journal of Economics, Vol. 128, No. 1, pp. 165-204.

Roger, B. (1989), Les villes europeénnes: Rapport pour la DATAR (in French), RECLUS, Montpellier.

Rivera-Batiz, L.A. and Romer, P.M. (1991) Quarterly Journal of Economics, Vol. CVI, No. 425, pp. 531-555.

Stöllinger, R., Foster-McGregor, N., Holzner, M., Landesmann, M., Pöschl, J., Stehrer, S. (2013), A 'manufacturing imperative' in the EU – Europe's position in global manufacturing and the role of industrial policy, wiiw Research Report, No. 391, October 2013.

UNIDO, (2002), Industrial Development Report 2002/2003. Competing through Innovation and Learning.

UNCTAD (2013), Global Value Chains and Development. Investment and value added trade in the global economy.