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Structural Change and Global Value Chains in the EU

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Abstract

Manufacturing activity in the EU is increasingly concentrated in a Central European (CE) manufacturing core, implying divergent paths of structural change across Member States. This 'manufacturing divide' within Europe coincides with deepening economic integration in general and the emergence of global value chains (GVCs) in particular. Focusing on the manufacturing sector, this paper investigates the relationship between structural change and integration into GVCs in EU Member States over the period 1995-2011. The empirical findings suggest a non-linear relationship between the two phenomena: Members of the CE manufacturing core benefit from participation in GVCs in terms of structural change towards manufacturing, whereas in other EU Member States GVC participation, if anything, accelerates the deindustrialisation process.

Keywords: global value chains, structural change, manufacturing divide, European integration

JEL classification: L16, F15, F62

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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 Visegrád countries, i.e. the Czech Republic, Hungary, Poland and Slovakia[1]. 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. Such a concentration of European manufacturing activity in a CE manufacturing core implies that its members have embarked on a different path of structural change than other EU Member States. Notably, 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. These developments coincided with the growing importance of international production networks and global value chains (GVCs). They are the result of the 'second unbundling' (Baldwin, 2013) which refers to the fact that in a world of strongly reduced co-ordination costs, complex production processes do not need to take place in one location but can be geographically dispersed. This second unbundling, also referred to as fragmentation of production[2] (Jones, 2010), was made possible by advances in information and communication technologies (ICT) and was made profitable by international differences in wages (Baldwin, 2013).

In this paper we investigate to what extent the expansion of GVCs contributed to the diverging structural change with regards to manufacturing in EU Member States. In our empirical strategy we allow explicitly for the possibility that participation in GVCs may foster or impede de-industrialisation. To this end we rely on two measures for the involvement of countries in GVCs that are well established in the literature. These are the foreign value added in trade (Hummels et al., 2001) and the GVC participation rate (Koopman et al., 2011). The analysis of the relationship between the development of the manufacturing sector and global value chains is motivated by the widely held belief that participation in global value chains fosters the industrial sector. This is particularly clear in a European context where the latest Industrial Policy Communication of the European Commission (2014) stresses the integration of EU firms in global value chains as one of the strategies to improve Europe's manufacturing competitiveness[3]. The same Industrial Policy Communication also calls for a reindustrialisation effort across Europe and puts forward the objective of raising the contribution of industry to GDP to 20% until the year 2020.

We argue that the above research question is highly relevant for economic policy provided that *(i)* there is indeed a 'manufacturing divide' within the EU for which we will provide extensive empirical evidence and *(ii)* that a relative decline of the manufacturing sector constitutes an unfavourable structural shift.

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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 The phenomenon of geographically dispersed production has many other designations, including inter alia international fragmentation of production, production integration, production sharing and vertical integration.

3 For a more balanced view on GVCs and structural change see Sturgeon and Memedovic (2011).

While the latter is still the subject of intensive debate, we believe that there are a number of compelling arguments in favour of manufacturing playing a pivotal role in the economy. Firstly, technological progress emanates primarily from the manufacturing sector (Baumol, 1967; Kaldor, 1968; UNIDO, 2002; Aiginger and Sieber, 2006; Helper et al., 2012; UNIDO, 2016). The reason is that firms in the manufacturing sector account for the bulk of expenditures on research and development (R&D). In the EU roughly 70-80% of total R&D is undertaken by manufacturing firms (Stöllinger et al., 2013). The ratio of the manufacturing sector's R&D share to its share in value added is about four which is evidence for the very high R&D intensity of the sector compared to the rest of the economy (Stöllinger et al., 2013). Since R&D and resulting innovations are a key factor for technological progress and economic growth in advanced economies, a relative decline of manufacturing as the main R&D performing sector must be expected to hamper overall growth. A second common argument for the special role of manufacturing, which is strongly related to but still distinct from the innovation argument, is that productivity growth is higher in manufacturing than in the rest of the economy. The productivity argument is related to the innovation argument because R&D and innovation feed into technological progress and productivity growth. It is distinct, however, because the fact that technological progress spreads predominantly from the manufacturing to other parts of the economy does not automatically imply that manufacturing is also the sector that benefits most strongly from new technologies in terms of productivity growth. Since innovations also spread to (process innovation) and are used by other sectors (product innovations) of the economy, the R&D intensity of manufacturing also spurs productivity growth in the rest of the economy – potentially to a greater extent than in manufacturing itself. Empirically, however, this does not turn out to be the case (see e.g. Peneder, 2014; Stöllinger et al., 2013). Total factor productivity (TFP) growth in the manufacturing sector outperforms economy-wide TFP growth as well as TFP growth in business services across a sample of EU Member States apart from Italy and Spain[4]. A third important argument is that manufactures are highly tradable whereas the same is only true for a subset of services. Due to this structural feature manufacturing assumes an important 'carrier function' for services (see Stöllinger et al., 2013). This refers to the fact that many services by themselves are not easily tradable but can be exported indirectly as inputs into manufactured goods. The high tradability of manufactures combined with the carrier function it fulfils implies that a strong manufacturing sector can also be expected to improve the current account position and to reduce the risk of external imbalances[5].

Given these arguments we will consider a decline in the value added share of the manufacturing sector as an adverse structural shift for an economy. Such a development we will also denote as negative manufacturing structural change. Throughout the paper the phenomenon of manufacturing structural change will serve as the main proxy for structural change related to the manufacturing sector and we will explore how it was affected by the increasing GVC participation of EU Member States over the period 1995-2011.

The rest of this paper is structured as follows: Section 2 discusses some of the related literature and theoretical considerations relevant for our research question. Section 3 explains the methodology for deriving the GVC indicators and provides information on the main data sources. Section 4 offers some descriptive evidence on the concentration of European manufacturing activity and structural change in the EU as well as the development of international integration of production. In section 5 the econometric model and the results are presented. Section 6 concludes with some policy implications.

4 The comparison is based on EU KLEMS data. For details see Stöllinger et al. (2013).

5 For an analysis of the impact of tradability of output on the current account balance see Stöllinger (2015).

2. Related literature and theoretical background

This paper is related to two major strands of the literature which is the literature on structural change and the comparatively newer and rapidly expanding literature on global value chains and trade in value added.

In choosing the value added share of manufacturing, respectively changes thereof, as the main structural indicator, we follow a long-standing literature on structural change. One reason for the importance assigned to the share of the manufacturing sector or to individual manufacturing industries is that manufacturing acts as the main engine of growth because of the above mentioned higher productivity growth (e.g. Baumol, 1967; Squirin, 1988). Hence, as suggested by Baumol's disease, the reallocation of resources from the manufacturing to the services sector is expected to impose a 'structural change burden' (Szirmai and Verspagen, 2015) on the economy's growth prospects. The close connection between economic growth and structural change motivates the choice of the value added share of manufacturing as a performance indicator.

Closely related to our work is Chenery (1960) who links manufacturing value added per capita, i.e. manufacturing intensity, in several manufacturing industries to domestic supply and demand conditions which are proxied by income per capita. He finds a positive relationship between manufacturing intensity and income per capita for all industries[6]. In subsequent work Chenery and Syrquin (1975) expand this analysis by including, among other factors, the square of income per capita to control for the fact that the income elasticity of manufacturing declines with rising income. Moreover, they replace the manufacturing intensity with the share of manufacturing value added in total GDP. This is the base specification that we will use to explain manufacturing structural change.

In open economies, international trade must be considered as an additional important factor influencing economic structures. According to standard trade models comparative advantages drive specialisation and hence the trading economies' sector compositions. A country is predicted to specialise in the production of the good – respectively in the sector – where it has a comparative advantage. These comparative advantages may be ruled by relative differences in productivity (in Ricardian models) or factor abundance (Heckscher-Ohlin models). In this paper, however, we intend to investigate the structural implications a particular type of international trade which is trade in intermediates or 'tasks' that result from the international organisation of production and associated offshoring activities and global value chains.

One of the first models of offshoring was developed by Feenstra and Hanson (1996) which is similar to a Heckscher-Ohlin model with a continuum of goods (Dornbusch et al., 1980). The key difference is that instead of continuum goods there is a continuum of activities to be performed along the firms' value chain which are ordered according to their skill intensity. Importantly, firms can choose to locate some of the activities in the foreign country which is assumed to have a higher relative wage of skilled labour.

[6] Haraguchi and Rezonja (2011) use the conceptual framework of Chenery (1960) and repeat (and expand) their work with more recent data. They confirm the important role of income per capita.

Moreover, the home country industry has higher productivity. In this setting, the trade equilibrium will result in a within-industry specialisation pattern where the more skill-intensive activities are performed in the home country whereas the less skill-intensive activities are offshored to the foreign country. While this model was originally designed to explain the increasing wage gap between skilled and non-skilled labour which was witnessed both in the United States and in Mexico, it is also of relevance for our research question. Similar to the US-Mexico constellation, the international organisation of production has increased markedly in the EU where the higher income countries in the EU offshored parts of their production activities to the Central and Eastern European countries as predicted by the offshoring model. For example, within the CE manufacturing core we can expect German and Austrian firms to offshore certain activities to the Visegrad countries. This will induce structural change in both the countries whose firms make actively use of offshoring and the offshoring destinations. For one, it will affect the demand for skilled and unskilled labour but in a partial equilibrium analysis also changes in the sector composition are to be expected. That is, in the country that is offshoring, the manufacturing sector where offshoring is most common, will lose value added because parts of the value added that was previously created at home is offshored to countries where low-skilled labour is less expensive. Though based on the demand for labour instead of value added, this prediction is for example confirmed in Foster et al. (2013). These authors regress the demand for labour (imposing fixed capital and output) on the offshoring measure suggested by Feenstra and Hanson (1999) for a sample of 40 countries for labour according to three different skill levels and for several groups of industries. They find that the demand for labour declines due to offshoring and particularly so in manufacturing industries. With regard to the offshoring destinations, they will benefit from additional value added creating activities in the manufacturing sector which is therefore expected to expand.

These predictions for structural change resulting from offshoring reflect only the partial equilibrium effects. Taking the general equilibrium effects into account will change the picture significantly. In the Feenstra and Hanson (1996) model, the ultimate effect will be an increase in productivity and since there is full employment and it is only a one sector model, value added will increase. Additional insights into the impact of offshoring on structural change can be gained from the model by Grossman and Rossi-Hansberg (2008). They develop a two-sector model in which the sectors differ with regard to their skill-intensity. Within each sector goods production requires a continuum of tasks. As in Feenstra and Hanson (1996), tasks can be offshored and ‘production’ abroad of these tasks can make use of the (superior) technology of the domestic economy. The costs of offshoring – which arise from the necessity to coordinate internationally dispersed production – differ across tasks. While this model may yield a counter-intuitive result for the development of the unskilled wage, it features an interesting prediction for the relative sector developments in the offshoring country: the decrease in the demand for low-skilled labour induced by offshoring will cause an expansion of the less skill-intensive sector, an adjustment that is mandated by the full employment condition.[7]

The Grossman and Rossi-Hansberg (2008) model is general enough to allow for offshoring of high-skill tasks instead of low-skill tasks. In this case, the effects will go in the opposite direction. Hence, in this model, the impact of offshoring on the composition of output depends on *(i)* which type of activities (or tasks) are offshored and *(ii)* whether manufacturing is the relatively more skill-intensive sector. This is of particular relevance as our main hypothesis is that GVCs had different effects on manufacturing structural change in the CE manufacturing core and the rest of the EU, where both country groups

[7] This mechanism refers to the large country case.

comprise likely offshoring countries and likely offshoring destinations. Hence, one potential explanation for divergent structural impacts could be that the two groups of countries had different patterns of offshoring regarding the activities that where moved abroad. The results in the literature on what types of activities are most affected by offshoring are ambiguous. Goos et al. (2013) for example find that the medium-paid jobs requiring mainly routine tasks were most affected by offshoring, whereas Marin (2004) argues that the jobs being offshored from Germany and Austria to locations in Eastern Europe were predominantly high-skilled jobs.

In the offshoring destination the usual gains from trade will arise through an improvement in the allocation of resources. In the Grossman and Rossi-Hansberg (2008) model there will also be a direct productivity gain from the fact that (superior) foreign technology can be applied in the offshoring destination. In addition, one may note that offshoring and GVCs create new opportunities for fast technological learning and skill acquisition (see for example Sturgeon and Memedovic, 2011). However, even in the offshoring destination the effects may not be as clear-cut as predicted by the various models of offshoring.

The strand of the literature on global value chains that studies the details of GVCs (mainly based on case studies) and its impact on economic development still attributes a huge development potential to GVCs. Whittaker et al. (2010), for example, refer to this new and increased potential as ‘compressed development’, a term that should indicate that with the engagement with the world economy via global value chains a country’s catch-up process may take place in a significantly shorter period of time than it used to be the case. At the same time Sturgeon and Memedovic (2011, p. 3) note that *‘GVCs are not necessarily a panacea for development’*. On the negative side, it is argued that GVCs can create barriers to learning and drive uneven development (Kaplinsky, 2005) and lock-ins in low valued added activities (Kaplinsky and Farooki, 2010). One reason for this may be that the supplier firms in offshoring destinations are integrated mainly in what has been termed ‘captive’ value chains (Gereffi et al., 2005)[8]. In captive value chains, the lead firm of the GVCs has strong control over the participating suppliers which includes the knowledge it chooses to transfer. Typically the support by the lead firm in captive value chains is limited to a narrow range of tasks such as assembly. Therefore learning effects on the side of supplier firms in the offshoring destination can be expected to be limited and there is a risk of lock-ins in simple low value added tasks (Pietrobelli and Rabellotti, 2011). In such a constellation chances high rents accrue to the lead firms in the GVC (e.g. Chesbrough, 2001), while the suppliers that provide routine assembly tasks and low-skill-intensive services within GVCs have lower profit margins, pay lower wages and are more vulnerable to business cycles (Kawakami, 2011). In contrast, the transfer of knowledge and mutual learning is generally larger in modular GVCs and relational GVCs which also require a higher level of competencies on the side of the supplier for the value chain to function (Gereffi et al., 2005; Pietrobelli and Rabellotti, 2011). Integration in these types of value chains are more likely to lead to the positive outcomes predicted by models of offshoring. In addition, the success of and benefits arising from integration in GVCs may also depend on factors such as geographic proximity of the firms involved. Gereffi et al. (2005) argues that the spatial (but also the social) proximity matters especially in relational value chains which are prone to develop when complex transactions are involved, product specifications cannot be codified and the capabilities of the suppliers are high. In such an environment the co-ordination costs of offshoring, which *‘comprise the cost of organising tasks in different nations,*

8 The literature on GVCs distinguishes between various types of GVCs which differ with regard to the complexity of the activities involved, the capabilities required by the participating partners and also the expected knowledge flows (see Gereffi et al., 2005).

e.g. the cost of exchanging coordination information' (Baldwin and Robert-Nicoud, 2014, p. 54), are likely to vary with the geographical distance that has to be bridged. Empirically, geography also turns out to matter for the formation of GVCs. For example Cheng et al. (2015) and Stöllinger and Stehrer (2015) find that geographic distance between trading partners acts as a barrier to the integration in international production networks.

While our econometric approach does not allow us to incorporate all these details of global value chain participation, the case study literature on GVCs provide an explanation for diverging effects of GVCs on manufacturing structural change in different constellations.

3. Methodology and data

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

The definition of manufacturing-related structural change is straightforward. The rate of manufacturing structural change in country *c* in period *t* is simply the change in the share of nominal domestic manufacturing value added in nominal GDP between period *t* and period *t-1*. In the econometric analysis 4-year periods are used. For this purpose the sample period (1995 to 2011) is subdivided into non-overlapping 4-year periods.[9] Our measure for manufacturing structural change in country *c* at time *t*, $\Delta sh_{c,t}^{manuf}$, is the difference between the average manufacturing share in period *t* and *t-1*. Formally our measure of manufacturing structural change is: $\Delta sh_t^{manuf} = \overline{sh}_t^{manuf} - \overline{sh}_{t-1}^{manuf}$ where $\overline{sh}_t^{manuf}$ is the average manufacturing share of the four years *(y)* that make up period *t*, i.e. $\overline{sh}_t^{manuf} = \frac{1}{4} \cdot \sum_{y=1}^{4} sh_y^{manuf}$. The choice of 4-year intervals constitutes a compromise between choosing periods that are long enough to capture at least medium-term structural changes while at the same time retaining enough observations over time for a meaningful panel data analysis.

For the main explanatory variable, the degree of countries' integration in GVC, two measures are used. The first measure is the foreign value added in trade (FVAiT). The FVAiT concept was developed by Hummels et al. (2001) and – as its name suggests – refers to the foreign value added embodied in a country's exports where this foreign value added is expressed as a percentage of that country's gross exports. The calculation of the FVAiT has to rely on 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.

Following the expositions in Stehrer (2012) and Koopman et al. (2012), 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 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 coefficient is defined as $v_r = \frac{value\ added_r}{gross\ output_r}$. For each country a diagonal matrix $\boldsymbol{diag}(\boldsymbol{v_r})$ which is of dimension 1435 (40 countries x 35 industries) is constructed. This matrix contains (along the diagonal) the value added coefficients of country *r* (for industries 1-35) as well as the value added coefficients (again for industries 1-35) of its trading partners.

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 World Input-Output Tables (WIOT) of the WIOD 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

9 The 17 years of observations are divided into 5 sub-periods (treating 1995 as a period in itself). Since the dependent variable is defined in terms of changes this leaves us with 4 observations over time.

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 the calculation of the FVAiT only requires decomposing the export vector into its components these import values are set to zero yielding the export vector $\boldsymbol{x_r}$. For the calculation this export vector is transformed into a diagonal matrix, $\boldsymbol{diag}(\boldsymbol{x_r})$, 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:

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

To illustrate this, let's look at these matrices in the three countries–one sector case, where country *r* acts as the model country:

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

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 element $x^{r,*}$ represents country *r*'s exports to all partner countries.

The first column of the resulting *VAiT* matrix of country *r* contains 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[10].

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 the interest in this paper is with the manufacturing sector, it is not the economy-wide *FVAiT* measure that is used but an *FVAiT* measure that is restricted 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 (domestic) industry is responsible for the export of

[10] Alternatively, FVAiT can be retrieved directly by omitting country *r*'s own value added coefficients in the $\boldsymbol{diag}(\boldsymbol{v_r})$ matrix.

this value added. Accordingly, this foreign value added is expressed as a percentage of the value added supplied by manufacturing industries that ends up being exported by country *r*[11].

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.

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

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 added up to get an indicator for a country's GVC participation which is 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 typically expressed in per cent of gross exports of the reporting economy – or in this case the value added supplied by manufacturing industries that ends up in exports. This convention will be followed in the empirical specification.

For the calculation of all production integration indicators as well as for the manufacturing structural change variable, information from the World Input-Output Database (WIOD), and in particular the World Input-Output Tables, is 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). The exchange rate measure we use is the real effective exchange rate based on unit labour costs and trade with the 37 most important partner countries. We also rely on Eurostat for information on sector-level and total employment which is needed for the construction of an alternative, employment-based measure of manufacturing structural change that serves as the dependent variable in a robustness check.

11 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.

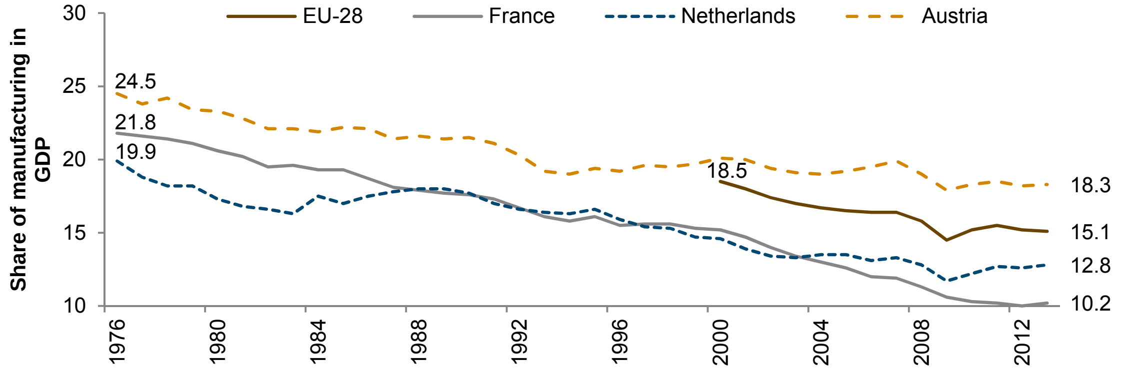
4. Descriptive evidence for the Central European manufacturing core

Descriptive evidence for the existence of the CE manufacturing core is provided by looking at *(i)* the comparative developments of the manufacturing sector in Member States and *(ii)* the share 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, i.e. a negative manufacturing structural change. The EU is no exception in this respect. There are a number of factors contributing to the declining importance of manufacturing which also reinforce each other. These factors include the interplay of relative productivity developments across sectors with low price elasticities of demand of manufactures, changes in the demand structures[12] and, most importantly for this investigation, the international organisation of production (see e.g. Sturgeon and Memedovic, 2011).

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 1. The figure illustrates the long-term structural shift out of manufacturing for France, Austria and the Netherlands, since the mid-1970s[13]. The shorter time series for the EU-28 suggests that there is a common negative trend at least since the year 2000.

Figure 1 / Long-term changes in the share of manufacturing in valued added (in %), selected EU Member States



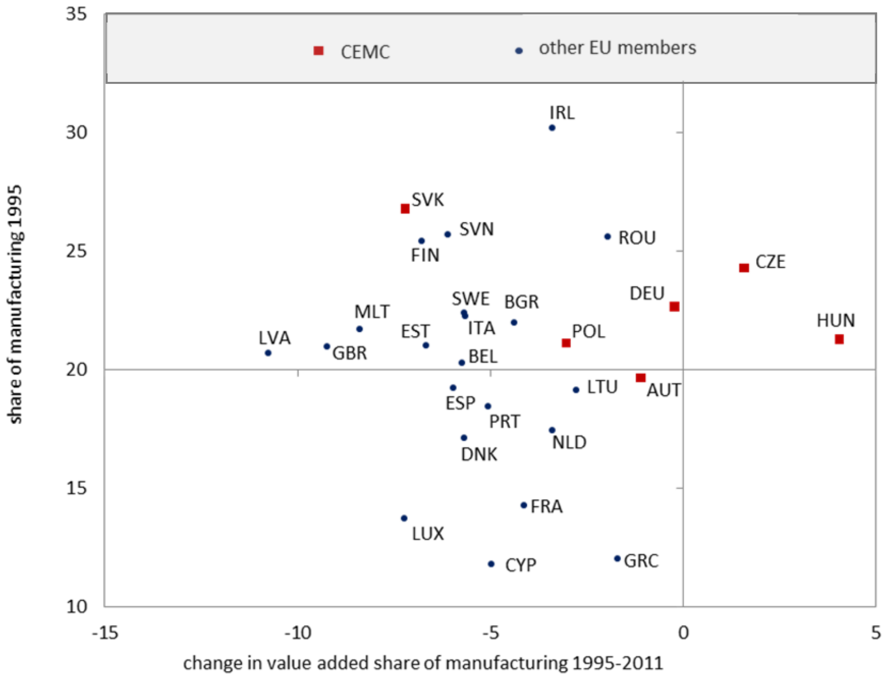
Note: Based on NACE Rev. 2 classification and nominal values.
Source: Eurostat.

12 As pointed out by Baumol (1967), if total factor productivity growth is higher in manufacturing than in the rest of the economy prices of manufactures decline relative to those of services. In combination with a low price elasticity of demand of manufactures this will result in a decline of the value added share of manufacturing. In addition, high income elasticities for several services (e.g. education, tourism, health, cultural activities) also play against the value added share of the manufacturing sector as per capita incomes rise.

13 The selection of Member States was made on the basis of data availability in Eurostat.

Figure 2 focuses on the sample period of the econometric exercise, i.e. 1995-2011, showing the change in the manufacturing share between the year 1995 and 2011 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[14], the magnitude of this structural shift varied considerably 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 manufacturing 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 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 in manufacturing. Figure 2 suggests that the countries of the CE manufacturing core, marked with red squares, experienced much more modest declines (or even increases) in the share of manufacturing – with the exception of Slovakia – and that they are also among the countries where the manufacturing sector remained relatively important with a share in value added close to 20%.

Figure 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 point towards increasing concentration of EU manufacturing production in the CE manufacturing core which should be related to comparative advantages in manufacturing.

[14] In nominal terms it declined in all but two Member States which are Hungary and the Czech Republic.

This assertion is confirmed when the share of the members of the CE manufacturing core in EU-wide manufacturing exports is considered. For this purpose it is useful to rely on the concept of value added exports (Johnson and Noguera, 2012). The value added exports is the amount of value added that is produced in one country but is absorbed by other countries. Since the value added exports can also be calculated at the sectoral level we focus on manufacturing value added exports. The figures in Table 1 show these manufacturing value added exports for each country, or group of countries, expressed in per cent of EU-wide manufacturing value added exports. A first observation here is that the CE manufacturing core's share in manufacturing value added exports was already high in 1995 (approximately 35%). 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 the manufacturing sector 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.

Table 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

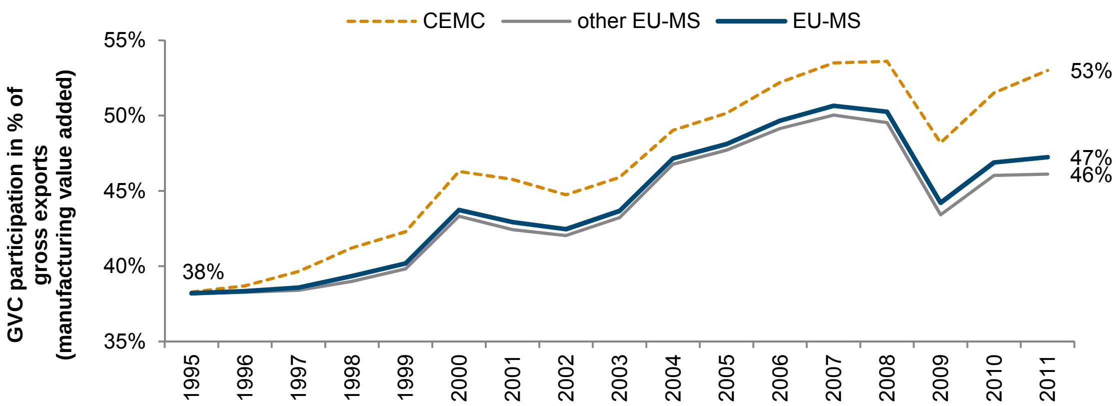
Note: Nordic countries = Denmark, Sweden, Finland; Southern EU = Spain, Portugal, Greece, Malta, Cyprus; Other EU-MS = Bulgaria, Romania, Latvia, Estonia, Lithuania and Ireland. Manufacturing industries based on NACE Rev. 1 industry classification.
Source: WIOD, own calculations.

The 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.

We close the descriptive analysis of the CE manufacturing core with a brief exploration of EU Member States' integration in global value chains. Figure 3 shows the development of the GVC participation rate as described in the previous section. This development is shown for the EU as a whole as well as for the CE manufacturing core and the remaining Member States separately.

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 47% of exported manufacturing value added in 2011, an increase by almost 10 percentage points relative to 1995. Figure 3 also reveals that the developments for the members of the CE manufacturing core and the other EU Member States with regard to GVC participation were very similar in the two groups of countries. Starting from identical degrees of production integration in 1995, both groups intensified their participation in GVCs with a somewhat greater increase in the CE manufacturing core in the second half of the 1990s. Hence, one can conclude that, despite the diverging manufacturing structural change in the two country groups, the growing international production integration is a common feature of all EU economies and not specific to the CE manufacturing core.

Figure 3 / Development of global value chain participation in the EU, 1995-2011



Source: WIOD, own calculations.

The next section investigates econometrically how this common trend in growing GVC participation affected manufacturing structural change in EU Member States.

5. Econometric model and results

We embed the hypothesis that the expansion of GVCs affects manufacturing structural change in a simple regression framework. Importantly, the regression approach is flexible enough to allow for differentiated impacts of GVCs across countries. This set-up is intended to capture the possibility that in both offshoring countries and offshoring destinations, GVCs may either foster de-industrialisation or an expansion of the manufacturing sector. Our strategy for including these potential asymmetries into the analysis is to allow for different effects of GVC integration for the countries belonging to the CE manufacturing core and the remaining EU Member States.

The dependent variable in our econometric model is the change in value added share of manufacturing in GDP which we also refer to as manufacturing structural change. Defining the dependent variable in terms of structural change follows McMillan and Rodrik (2011) and relates directly to our main research question, i.e. how GVCs affect manufacturing structural change. While we acknowledge that the share of manufacturing in GDP is 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 the respective economy.

The main explanatory variable is EU Member States' involvement in GVCs which we proxy alternatively by the foreign value added in trade ($FVAiT$) and their GVC participation rate (GVC). In the discussion we will focus on the specification with the GVC participation rate as this is the more comprehensive proxy for international production integration. In order to allow for heterogeneous structural developments in the CE manufacturing core on the one hand and other EU Member States on the other hand following production integration, a dummy variable, $CEMC$, that takes the value one for the CE manufacturing core countries and 0 for the other EU countries is added to the regression. This CE manufacturing core dummy enters the regression directly and also as part of an interaction term with the GVC measure. In addition a number of country and time specific control variables (X) is included. The resulting regression model takes the following form:

$$(1) \qquad \Delta sh_{c,t}^{manuf} = \alpha + INI_{c,t-1} \cdot \lambda + \beta_1 \cdot GVC_{c,t-1} + \beta_2 \cdot CEMC_c + \gamma \cdot \left(GVC_{c,t-1} \times CEMC_c\right) + \Delta X_{c,t} \cdot \varphi + \delta_t + \mu_c + \varepsilon_{c,t}.$$

where $\Delta sh_{c,t}^{manuf}$ is the change in the nominal value added share of manufacturing in GDP of country *c* between period *t* and *t-1*. The regression also includes a set of time fixed effects, δ_t, and some specifications will also include country-fixed effects, μ_c. $\varepsilon_{c,t}$ denotes the error term.

In a variant to equation (1) the foreign value added in trade, $FVAiT_{c,t-1}$ is used as a proxy for the integration in international production networks instead of the GVC participation rate, $GVC_{c,t-1}$. A negative coefficient of $GVC_{c,t-1}$ or $FVAiT_{c,t-1}$ would suggest that growing integration in GVCs results in negative manufacturing structural change, i.e. an accelerated decline in the share of manufacturing in GDP. The coefficient of the interaction term between $GVC_{c,t-1}$ (respectively $FVAiT_{c,t-1}$) and the $CEMC_c$ dummy indicates differences in the effect of integration in GVCs on manufacturing structural change between the CE manufacturing core countries and the other EU Member States. Regarding the $CEMC_c$ dummy itself the descriptive evidence suggests that the negative manufacturing structural change was less pronounced in the CE manufacturing core economies so that a positive coefficient is expected.

Equation (1) includes two sets of additional control variables. A first set of controls capture initial conditions $INI_{c,t-1}$. These initial conditions are countries' shares of manufacturing at the beginning of the respective period, $initial\ sh_{c,t-1}^{manuf}$ and the log of the initial level of real GDP per capita, $initial\ GDPcap_{c,t-1}$, which enters the regression model also in quadratic form. So in order to make sure that really initial conditions are captured, we take for both variables the value of the first year of the preceding period.[15]

The initial share of manufacturing is intended to control for potential level effects as countries with initially higher manufacturing shares may also be more prone to 'de-industrialise'. This type of 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 convergence hypothesis holds true.

Following Chenery (1960), Chenery and Syrquin (1975) and more recently Haraguchi and Rezonja (2011) we include the GDP per capita at the beginning, including a squared term, as a control for general demand conditions. In their regression related to the production structure in which they explain changes in the industry share[16], Chenery and Syrquin (1975) find a positive coefficient for GDP per capita and negative one for the squared term. This suggests that the higher demand associated with higher income supports structural change in favour of the industrial sector and that this effect weakens with higher level of incomes. However, there is also the de-industrialisation hypothesis (Clark, 1940), which suggests that with raising incomes, the economic structure will shift increasingly towards services to the detriment of the manufacturing sector. According to Baumol (1967), these de-industrialisation tendencies are due to faster productivity growth in manufacturing. According to the de-industrialisation hypothesis, the coefficient of the $initial\ GDPcap$ variable should have a negative sign, i.e. the opposite result obtained by Chenery and Syrquin (1975).

The second set of controls include to further variables which are 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 inclusion of the latter is in line with McMillan and Rodrik (2011) who also include a measure for the real exchange rate ($\Delta real\ FX$) in their regression explaining their measure of (economy-wide) structural change. In contrast to McMillan and Rodrik (2011) we do not use the overvaluation measure developed by Dollar (1992) but directly the changes in the index of the real effective exchange rate. In open economies, the real exchange rate is an important determinant of export competitiveness. Since the manufacturing sector is the main tradables-producing sector for EU economies, a raising real exchange rate can be expected to hamper exports and to result

15 We are grateful to an anonymous referee who suggested using lagged values of the initial conditions variables.

16 Chenery and Syrquin (1975) use changes in the share of industry and not changes in the manufacturing sector as dependent variable (see their regression 5b in Table 5, p. 38).

in negative manufacturing structural change. Therefore a negative coefficient for the real exchange rate is expected.

Finally, we include changes in the labour costs in the manufacturing sector. This variable is intended to capture the attractiveness of countries as a location for foreign direct investments. As noted by Baldwin (2011, 2013) the expansion of GVCs was made possible by the ICT revolution and the resulting reductions in co-ordination costs of a geographically dispersed production process. But the incentive for firms to make use of international production sharing stems from the massive differences in labour costs across countries. Hence, we hypothesise that countries with declining labour costs will, ceteris paribus, be more attractive locations for foreign direct investors. Moreover, changes in the labour costs in the manufacturing sector may also hurt the sector's export competitiveness. For both reasons we expect a negative coefficient of the changes in labour costs.

Another important aspect to control for would be agglomeration effects. However, here we face the problem that proxies for agglomeration effects common in regional studies such as the number of firms in an industry (e.g. Head et al., 1995, 1999) or the employment density (Ciccone and Hall, 1996; Ciccone, 2002) are not meaningful at the country-level. Hence, we cannot explicitly control for agglomeration factors apart from the initial share of manufacturing that might serve such a purpose though we rather interpret it the way described above.

Table 2 / Participation in GVCs and manufacturing-related structural change, 1995-2011

Dependent variable:	Δ manufacturing share (t)					
Production integration measure:	foreign VAiT					
	pooled		country RE		country FE	
	(1)	(2)	(3)	(4)	(5)	(6)
initial manuf share (t-1)	-0.0528	-0.0603	-0.0752***	-0.09274***	-0.6131***	-0.7279***
	(0.050)	(0.050)	(0.022)	(0.024)	(0.155)	(0.169)
initial GDPcap (t-1)	-0.0222	-0.0446	-0.0209	-0.0397	0.1257	0.1614**
	(0.045)	(0.048)	(0.053)	(0.057)	(0.080)	(0.069)
initial GDPcap - sq (t-1)	0.0010	0.0023	0.0009	0.0019	-0.0082*	-0.0010**
	(0.002)	(0.003)	(0.003)	(0.003)	(0.005)	(0.004)
GVC participation (t-1)	-0.0143	-0.0284*	-0.0136	-0.0287*	0.0597	-0.0932
	(0.016)	(0.016)	(0.018)	(0.016)	(0.060)	(0.080)
GVC participation x CEMC (t-1)		0.0542*		0.0551		0.1543**
		(0.032)		(0.034)		(0.061)
CEMC	0.0097***	0.0099***	0.0102**	0.0107***		
	(0.004)	(0.003)	(0.004)	(0.004)		
Δlabour costs (t)	0.03521*	0.03865*	0.0356*	0.0383**	-0.0017	-0.0002
	(0.020)	(0.020)	(0.020)	(0.020)	(0.026)	(0.025)
Δreal FX (t)	-0.0689**	-0.0767***	-0.0749**	-0.0800**	-0.0451**	-0.0330*
	(0.028)	(0.029)	(0.033)	(0.034)	(0.020)	(0.018)
time fixed effects	yes	yes	yes	yes	yes	yes
country fixed effects	no	no	no	no	yes	yes
F-test	3.21	4.25	126.17	110.26	12.86	11.66
R^2	0.259	0.278			0.667	0.700
R^2-adj	0.179	0.191			0.493	0.536
R^2-overall			0.256	0.271		
obs.	103	103	103	103	103	103

Note: RE=Random Effects. FE=Fixed 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. Robust standard errors in parentheses. All regressions estimated with STATA.

The estimation results of equation (1) are summarised in Table 2 and Table 3 using GVC participation rate and the *FVAiT* as measure for production integration respectively. The two sets of regressions yield the same qualitative (and very similar quantitative) results. Therefore the discussion will focus mainly on the former results (i.e. Table 2).

We start the exploration of the results with the effects found for the control variables in the linear OLS-specification of our model, i.e. the model without any interaction term (specification 1). In line with economic theory, changes in the real effective exchange rate are negatively correlated with manufacturing structural change. An interesting finding is the positive coefficient of labour cost variable which suggests that high labour costs per se do not trigger or accelerate negative manufacturing structural change . Moreover, the initial share of manufacturing does not turn out to be statistically significant, suggesting that it is not a good predictor of the sector's future development in our sample. Hence, this result would not support the idea of a general convergence of manufacturing capacities within the EU. Finally, neither for the initial GDP per capita nor the squared initial GDP per capita statistically significant coefficients are obtained.

Table 3 / Backward production integration (FVAiT) and manufacturing-related structural change, 1995-2011

Dependent variable:	Δ manufacturing share (t)					
Production integration measure:	foreign VAiT					
	Pooled		country RE		country FE	
	(1)	(2)	(3)	(4)	(5)	(6)
initial manuf share (t-1)	-0.0536	-0.0655	-0.0799***	-0.0982***	-0.6112***	-0.7027***
	(0.052)	(0.053)	(0.024)	(0.023)	(0.154)	(0.170)
initial GDPcap (t-1)	-0.0161	-0.0403	-0.0155	-0.0378	0.1167	0.1269
	(0.042)	(0.044)	(0.051)	(0.055)	(0.079)	(0.075)
initial GDPcap - sq (t-1)	0.0007	0.0020	0.0006	0.0018	-0.0075*	-0.0080*
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)
foreign VAiT (t-1)	-0.0078	-0.0247	-0.0070	-0.0269*	0.0940	-0.0388
	(0.015)	(0.016)	(0.019)	(0.016)	(0.035)	(0.079)
foreign VAiT x CEMC (t-1)		0.0650**		0.0702**		0.1542*
		(0.030)		(0.029)		(0.078)
CEMC	0.0091**	0.0104***	0.0097**	0.0113***		
	(0.004)	(0.004)	(0.004)	(0.004)		
Δlabour costs (t)	0.0333*	0.0370*	0.0341*	0.0368*	-0.0072	-0.0037
	(0.020)	(0.020)	(0.020)	(0.020)	(0.026)	(0.026)
Δreal FX (t)	-0.0684**	-0.0780***	-0.0750**	-0.0809**	-0.0447**	-0.0371*
	(0.028)	(0.029)	(0.033)	(0.034)	(0.020)	(0.019)
time fixed effects	yes	yes	yes	yes	yes	yes
country fixed effects	no	no	no	no	yes	yes
F-test	2.71	3.64	156.86	158.80	14.57	11.73
R^2	0.256	0.282			0.680	0.696
R^2-adj	0.175	0.196			0.513	0.530
R^2-overall			0.251	0.276		
obs.	103	103	103	103	103	103

Note: RE=Random Effects. FE=Fixed 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. Robust standard errors in parentheses. All regressions estimated with STATA.

Turning to the main variables of interest, a first observation is that the outcome of the linear specification of the regression model (specification 1) is very disappointing. Without any differentiation among EU Member States, the degree of international production integration does not seem to be related to changes in the value added share of manufacturing. In the entire regression just the change in the real foreign exchange rate, the labour costs and the dummy variable for the group of CE manufacturing core countries are found to be statistically significant. However, the result changes considerably when the interaction term between the $GVC\ participiation$ and the $CEMC$ dummy is included (specification 2). The estimated coefficient of $GVC\ participiation$ is negative and now statistically significant (at least at the 10% level), indicating that, on average a higher $GVC\ participiation$ rate is associated with a stronger decline in the share of manufacturing in the economy. Next, the positive coefficient of the $CEMC$ dummy (0.009) in the regression confirms that the relative decline of the manufacturing sector was milder in the CE manufacturing core countries than in the rest of the EU. Most importantly, the interaction between the $GVC\ participiation$ and the $CEMC$ dummy is positive and statistically significant. With a magnitude of 0.0542 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 manufacturing structural change is in fact positive for the members of the CE manufacturing core.[17] This signals that integration in GVCs has helped the CE manufacturing core countries to strengthen an already existing comparative advantage in manufacturing. The opposite is true for the other EU Member States.

In quantitative terms this means that a 10 percentage point higher $GVC\ participiation$ rate is expected to accelerate the negative rate of manufacturing structural change of the average EU Member States *not* belonging to the CE manufacturing core by 0.28 percentage points. In contrast, for the CE manufacturing core countries a 10 percentage point higher $GVC\ participiation$ rate slows down the negative rate of manufacturing structural change by 0.26 percentage points ([-0.0284 + 0.0542] x 10).

The discussion so far has focused on the OLS results. Given the panel structure of the data it is, however, possible to include also country effects.[18] In Table 2 and Table 3 results with both country random and country fixed effects are reported. It is reassuring to see that the general pattern of the coefficients of the GVC variables is maintained throughout all specifications though in the random effects model specification (4) the GVC x CEMC interaction terms just fails to be statistically significant at the 10% level.[19] In any case, the Hausman test that we performed suggests that the fixed effects model is the appropriate model.[20] Focusing therefore on the fixed effects model (specification 6) it is interesting to note that the inclusion of country fixed effects suggests a more prominent role of the initial conditions. More precisely, the initial share of manufacturing is now highly statistically significant and economically large. This result assigns a certain convergence power to the manufacturing sector, in the sense that the de-industrialisation process within the EU was on average less pronounced in countries with initially lower manufacturing shares and hence that the structural differences are reduced. Also, the initial GDP per capita turns out to be statistically significant in the fixed effects model. The positive coefficient obtained for the main effect and the negative coefficient for the quadratic term are in line with the findings in Chenery and Syrquin (1975). Taken the two coefficients together we obtain a positive total effect for all income ranges in our sample. The positive correlation between higher incomes and

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17 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.

18 Time fixed effects have already been included in specifications 1 and 2.

19 The level of significance is 10.9 per cent. The random effects models delivers more significant results in the variant of the model using FVAiT as the production integration measure (see Table 2).

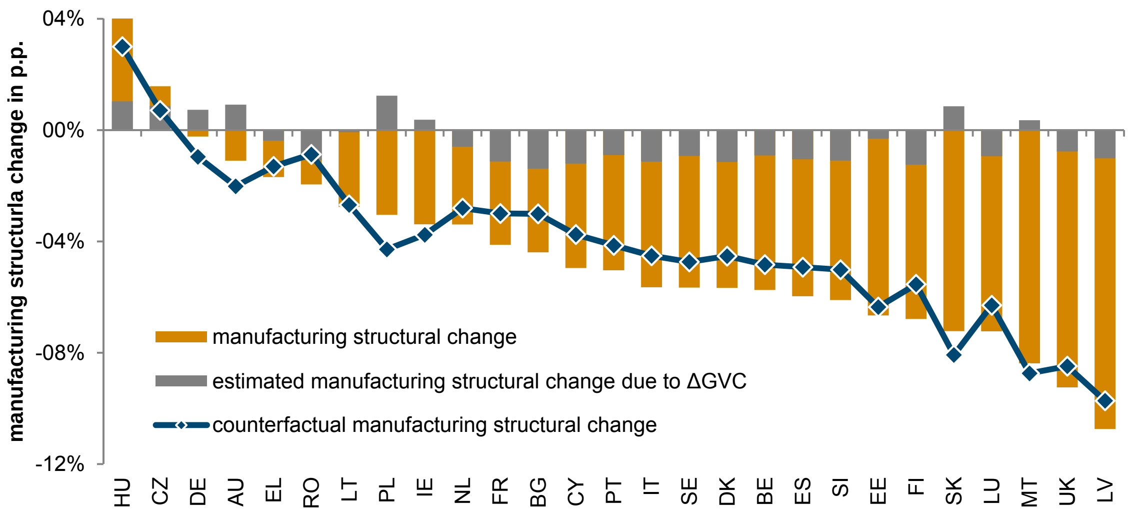
20 Results from both the Hausman test are available upon request. Moreover, in the F-test for the joint significance of the fixed effects the null that all fixed effect are equal to zero is rejected.

structural change in favour of manufacturing could signal a home market effect or simple that the income elasticity of manufactures is not so small compared to services. In any case, it contradicts the predictions that countries generally shift out of manufacturing as they grow richer.

With regards to the effects of GVC integration, both the main effect and the interaction term with GVC become larger in magnitude, amounting to -0.09 and 0.15 respectively. However, the main effect is now estimated with less precision and it is not statistically significant anymore. The effect on manufacturing structural change from a 10% increase in GVC participation for the members of the CE manufacturing core therefore amounts to 0.61 percentage points ([-0.0932 + 0.1543] x 10). This result also holds when using the FVAiT as the measure for production integration and the estimated coefficients are also similar in magnitude (see specification 6 in Table 3).

Having established the statistical significance of GVC participation for manufacturing structural change, it is worth exploring the economic relevance of the results. The key result is that the part of manufacturing structural change that can be attributed to the development of GVC participation differs across Member States. This differential impact of production integration on the rate of manufacturing structural change across Member States is shown in Figure 4. There are two reasons for these differences. Firstly, the extent to which GVC participation intensified differs across Member States. Secondly, according to our regression results, there is the differentiated impact of GVC participation on manufacturing structural change for the members of the CE Manufacturing Core and other EU Member States. The latter explains why the contributions of GVC participation to manufacturing structural change (the dark grey bars in Figure 4) are all positive for the members of the CE manufacturing core.[21]

Figure 4 / Structural change and contribution of GVC participation to structural change, 1995-2011



Note: The counterfactual rate of structural change is the change in the manufacturing share assuming that the GVC participation rate had not changed between 1995 and 2011. The impact of intensified GVC participation is based on the estimated coefficients for GVC and GVC x CEMC in Table 2 (specification 6).
Source: WIOD, own estimations.

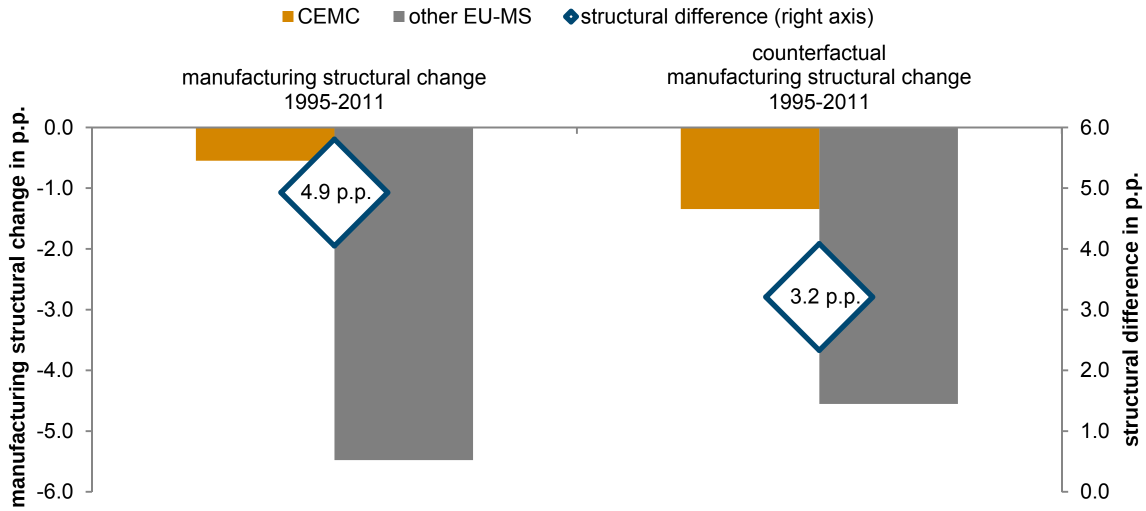
[21] The explanation for why Ireland and Malta have slightly positive contributions to structural change is that their GVC participation actually declined between 1995 and 2011.

Hence, the structural shift towards manufacturing between 1995 and 2011 would have been smaller in the Czech Republic and Hungary if integration into GVC had not intensified. Likewise the comparatively small negative rates of manufacturing structural change experienced by Germany and Austria during that period would have been somewhat more pronounced. The same is true for Poland and the Slovak Republic. In contrast, the shifts out of manufacturing that are observable for all other EU Member States would have been a bit milder in the absence of ongoing production integration. The counterfactual manufacturing structural changes in Member States that would have materialised if GVC participation had not changed are indicated by the grey line in Figure 4.

With the estimated coefficients we can also assess the impact of GVC participation on the degree of structural divergence within the EU. In that, we will focus on the difference in the rates of structural change related to the manufacturing sector between the CE Manufacturing Core countries and other EU Member States. Based on the changes in the GVC participation rate, which amounted on average to 10 percentage points over the sample period, the counterfactual structural divergence can be calculated where the counterfactual is again a situation without intensifying GVC participation. This is shown in Figure 5. The actual structural divergence between the two groups of Member States was 4.9 p.p. for the period 1995-2011. Taking out the impact of GVC participation reduces the manufacturing-related structural divergence to 3.2%, a reduction by 1.7 p.p.

These numbers illustrate that production integration did not account for the lion's share of the manufacturing-related structural divergence that occurred in the EU between 1995 and 2011 but equally that it is not a negligible factor.

Figure 5 / Impact of GVC participation on the manufacturing-related structural divergence, 1995-2011



Note: The counterfactual rate of manufacturing-related structural change is the change in the manufacturing share assuming that the GVC participation rate had remained constant between 1995 and 2011. The manufacturing-related structural difference is the difference in the rate of manufacturing structural change between the CE manufacturing core countries and the remaining EU Member States.
Source: WIOD, own estimations.

In sum, these results are evidence for a differentiated impact of integration into global supply chains on Member States' economic structures. More precisely, the Members of the CE manufacturing core seem to have experienced a strengthening of the manufacturing sector due to this development, while for the other EU Member States, it rather accelerates the 'de-industrialisation' process. An immediate consequence of this differentiated structural impact is that the phenomenon of increasing production integration contributed to the concentration of manufacturing activities in the CE manufacturing core within the EU. On the one hand this result is not entirely surprising because international production integration can be considered to be 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 the competitiveness of Member States' manufacturing sectors which in practice does not seem to be the case.

6. Conclusions

In this paper we linked three empirical observations related to European manufacturing. First, there was a continued EU-wide decline of the value added share of manufacturing between 1995 and 2011. Second, this decline was significantly less pronounced in the countries belonging to the CE manufacturing core than in the other EU countries. Third, international production sharing has increased markedly throughout the period 1995-2011 for both groups of Member States.

These empirical facts are analysed in a panel regression model that explains manufacturing structural change with increasing participation in global value chains. The econometric results suggest that the growing GVC participation had a significant but differentiated impact on manufacturing-related structural change in Member States. More precisely, we find that increasing GVC participation seem to have had a negative effect on manufacturing structural change in the average EU Member State. The opposite is true for the countries belonging to the CE manufacturing core whose manufacturing sectors have benefited from GVC participation in the sense that it accelerated the structural shifts towards manufacturing (in the Czech Republic and Hungary) or softened the structural shifts out of manufacturing (in Austria, Germany, Poland and the Slovak Republic). Hence, the structural impact of international production integration seems to be country-specific, strengthening manufacturing structural change in some cases, 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 Europe's manufacturing competitiveness[22]. Our results show that this strategy is to be questioned because integration in global value chains does not have a uniform effect in 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) these developments may 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.

This contribution is a first attempt to investigate the structural implications of growing integration in global value chains in the EU where we focused on the manufacturing sector. There are several routes along which this investigation could be extended. One aspect is that so far we did not explore the particular roles countries play in the GVCs. For example, the more technologically-advanced EU Member States

[22] 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.

are mainly offshoring countries, whereas the Central and Eastern European countries are mainly offshoring destinations. Hence, firms from different countries are likely to fulfil different functions in international production networks which could be relevant for the resulting manufacturing structural change. Related to this is the issue of innovation itself, as differences in the innovativeness of firms (and as a result also of countries) may be a key factor for the success of GVC participation. Another factor is that we grouped EU Member States simply according to their manufacturing sectors' performance and their geographic position in Central Europe. This ad hoc grouping we believe is highly relevant and also legitimate but it would also be interesting to explain how countries cluster into groups that benefit from GVC participation in terms of manufacturing structural change and those that do not. However, this is a very complex question and the sorting depends on a plethora of factors including the prevalence of a lead-country in close geographic proximity (e.g. the role of Germany within the CE manufacturing core), skill complementarities between offshoring countries and offshoring destinations, differences in factor prices and also agglomeration effects. We leave these issues for future research.

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