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Reassessing the Decline of EU Manufacturing: A Global Value Chain Analysis

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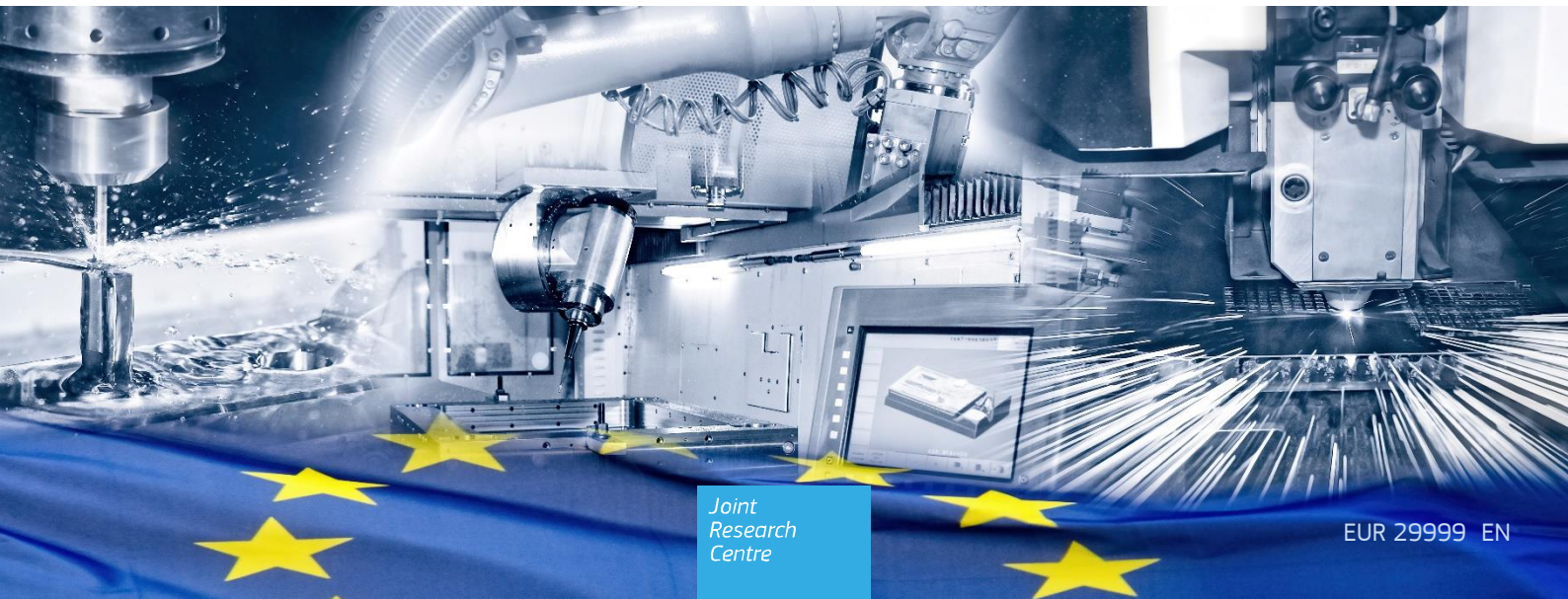

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Contents

Abstract

The declining contribution of EU manufacturing to total GDP and the simultaneous fall of its share in global manufacturing have led to concerns about an overall loss of EU competitiveness, in particular vis-à-vis China. We analyse the empirical evidence underpinning these concerns by applying a newly developed decomposition technique to global input-output data spanning the years 2000 to 2014. In this, we consider both the sectoral and final demand (or value chain) definition of manufacturing. We find, first, that manufacturing's lower share in EU total value added has generally been exaggerated due to the use of nominal measures, noting that higher-tech manufacturing actually grew in real terms. Second, the decomposition analysis reveals that lower economic growth in the EU relative to the world had the strongest negative impact on the contribution of its manufacturing sector, while shifts in demand patterns exerted a negative (positive) impact for activities with lower (higher) technological content. And third, the observed loss of market shares confirms a downturn of EU manufacturing competitiveness, especially in textiles and electronics, with pharmaceuticals as the only industry showing resilience under external competition.

JEL classification: F14, L16, L60

Keywords: Deindustrialization, manufacturing, global value chains, competitiveness, industrial policy, value-added trade.

1 Introduction

Maintaining a competitive manufacturing sector is one of the priorities of the European Union's economic policy. Viewed as "key driver of productivity and innovation", the European Commission set a strategic target of rising the share of industry([1]) in total GDP to 20% by 2020 – compared to around 15% in 2009 (European Commission 2012, 2014, 2017). Corroborating this objective was the call of EU heads of state – 2019 spring summit – for an "assertive industrial policy allowing the EU to remain an industrial power".([2])

The concern of policymakers can be explained by a series of unsettling observations. In the EU, the nominal share of manufacturing in total GDP (its 'weight') declined at an average rate of 0.25 percentage points per year between 2000 and 2014. Whereas the EU represented 26% of the world's total manufacturing in 2000, this figure fell to 21% in 2014. At the same time, the share of China jumped from 7% to 25%.([3]) Here, beyond the mere concern about losing weight against a catching-up giant economy, the EU worries about a loss of capacity and leadership in key technologies of the future (JRC 2019, p.9-11). Following this trend, manufacturing jobs – valued as well-paid blue collar jobs (Veugelers 2013, p.20) – dropped in the EU from 38 to 32 million people between 2000 and 2014.([4])

To some extent, these developments reflect the increased fragmentation of global value chains. Information technology, global logistics, and low trade barriers have enabled the unbundling of different production stages (e.g. development, production, distribution). As a consequence, a range of economic activities – in particular those characterized by higher labour intensity – relocated to low wage countries ('offshoring'). Empirical evidence confirms the increasing use of foreign sourced inputs in the EU and the presence of foreign value added in its exports (e.g. De Backer et al. 2013).

However, at such aggregate level these observations constitute more than else anecdotal evidence, and hardly justify conclusions on the real 'state of health' of EU manufacturing, e.g. whether it has experienced a loss of competitiveness that would warrant public policy intervention. Therefore, the purpose of this paper is to provide an in-depth study of the evolution of EU manufacturing and its specific sectors, both relative to the non-manufacturing part of the EU economy and also vis-a-vis the manufacturing sectors of its main competitors.

By doing so we expand the study of Timmer et al. (2013) to more recent years (they mostly stop at 2008) and address the question they were discussing but not analysing formally: is the declining share of the EU's manufacturing a 'natural consequence' of structural change in final demand, i.e. its sectoral and geographical composition? Timmer et al. (2013) claim that the decline is mainly the consequence of a lower presence of EU value-added in each category of manufacturing final demand (see their footnote 7), but do not provide further evidence on this point.

Our contribution does exactly this, by developing an analytical decomposition technique and applying it to nominal and real-terms global input-output data (WIOD) spanning the years 2000 to 2014. We first quantify how the EU manufacturing's weight has changed over the considered period and then attribute these changes to different types of underlying trends in global value chains. In doing so we reveal a number of economy-wide patterns, but also the considerable idiosyncrasy found at the sector level, which prompts the need to re-assess our view on manufacturing and to interpret the afore-mentioned stylized facts more cautiously.

In technical terms, the main innovation of our decomposition approach (derived in Section 3) is its ability to disentangle four different drivers of changes in value-added shares: two types of demand effects – namely volume and composition of demand – and two types of value chain participation effects – namely sectoral participation and market shares. Whereas the demand components represent standard categories, the two participation components were conceived for this study and capture changes in the distribution of value added across sectors and countries generated by one unit of final demand of a given product. They can, thus, be associated with competitiveness. Lastly, another advantage of our decomposition is its generality, allowing us to apply the same formal framework both to the question of the weight of manufacturing within the EU's total economy and to the share of EU manufacturing in worldwide manufacturing.

([1]) Here, "industry" is a broader term referring to manufacturing, extractive industries, and utilities. However, in value-added terms manufacturing dominates this group, accounting for more than 80%. Our analysis focuses on manufacturing as it is clearly defined and relatively more homogenous than the wider category of industry.

([2]) https://data.consilium.europa.eu/doc/document/ST-1-2019-INIT/en/pdf

([3]) More stylized facts on the recent evolution of EU manufacturing are presented in the second chapter of both Veugelers (2013) and (2017).

([4]) Also, the financial crisis 2008-12 was viewed as a demonstration of why excessive reliance on the financial sector should be avoided (Veugelers 2013, p.1), epitomized by the quick recovery of Germany, which maintains a larger manufacturing share than the other large EU members.

When defining the value-added contribution of manufacturing, let us note that two equally defensible approaches exist: (i) sector-based, which consists of summing up all value-added generated in the EU manufacturing sectors (i.e. motor vehicle sector, chemical sector, etc.), and (ii) demand-based, which means summing up all value-added embodied in manufacturing final products (cars, household appliances, medicine etc.), i.e. all value-added that is generated in the production of manufactured final goods.([5]) The second definition typically includes a substantial amount of value-added from service sectors, given that service inputs (e.g. legal services, design, distribution services, etc.) are widely used in the production of manufactured goods.

In our contribution, we will consider and compare both sides: the more conventional sector-based measure of manufacturing value-added, as well as the final demand perspective.([6]) Based on this, we provide a detailed analysis of the decline of the EU's manufacturing share from four different angles: (i) sector-based against the EU's total value-added, (ii) sector-based against worldwide manufacturing value-added, (iii) final-demand-based against the EU's total value-added and (iv) final-demand-based against worldwide manufacturing value-added. In this, we focus on the real economy, using chain-linked data expressing volumes relative to year 2010. However, an initial investigation based on nominal data is carried out to highlight the for some sectors important role of price dynamics, especially when analysing the decline of the manufacturing within the EU's total economy.

Regarding our main empirical findings, the analysis of the EU's domestic manufacturing share first of all shows that the seemingly dramatic decline (from 18.7% to 15.3%) has to be put into perspective, given that price dynamics – the decline of prices for manufactured goods relative to service goods – account for more than two thirds of the observed overall downturn. In fact, the aggregate value-added share of the seven manufacturing sectors with higher technological content has actually increased in real terms (especially pharma, electronics and motor vehicles). Second, we find that a combination of various factors is responsible for the remaining (real terms) 1.1 percentage points decline: the structural shift in the consumption basket away from manufacturing demand at the EU domestic level, the EU's loss of market shares in textiles and electronics, and, finally, technological change reducing the use of EU manufacturing inputs.

On the other side, the decline of the EU's global share in total manufacturing value-added (from 30% to 21%) is found to be by more than 60% attributable to demand effects, reflecting the fallen weight of the EU economy in the world and the shrinking share of manufacturing in total domestic demand. However, an important finding is that nearly 40% of the EU's decline is associated with the competitiveness dimension: the EU's loss of market shares in final and intermediate product markets and technological change that moved away from products with higher presence of EU manufacturing value-added are shown to have contributed about equally to the reduced participation of EU manufacturing value-added in global value chains.

Turning to the final-demand perspective (or GVC income), we first show that the share of the EU economy contributing to manufacturing value chains is about 4 percentage points higher than the share of value-added represented by manufacturing sectors themselves. However, it still follows the same weakly declining trend observed under the sectoral perspective (-1.4 percentage points decline vs. -1.1). Also the factors explaining this trend do not notably differ from those identified in the sectoral view analysis; with the only exception that the negative effect from technological change becomes negligible, which is a consequence of the final demand perspective's more neutral view with regard to sectoral changes in the input structure, at least as long as new inputs have the same amount of EU added-value as those used before.

With respect to the EU's global manufacturing share, its decline is slightly less pronounced from the perspective of final demand, pointing to the stabilizing role of service contributions to global manufacturing. Still, both perspectives robustly confirm the key finding that the EU's downturn is significantly larger than that of either US or Japan, whereas China experienced a spectacular increase of its global share. The larger decline of the EU than that of its competitors is explained by a stronger negative impact of demand effects, which for the EU account for more than 70% of the total effect. Consistently bucking the negative trend is the EU pharmaceutical industry, which slightly increased its global value-added share, under both perspectives.

Finally, in a short extension we analyse two complimentary aspects: The EU's relative specialization within global manufacturing value chains and the associated employment. The former provides evidence on how the EU has moved from being a provider of manufacturing value-added – especially of higher tech manufacturing – towards being a contributor to manufacturing by means of value-added from business and other service

([5]) This was first proposed, as far as we can see, by Timmer et al. (2013) under the name of GVC income.

([6]) While we generally subscribe to the arguments in favour of the final demand perspective made by Timmer et al. (2013) and Miroudot (2019) for the question of cross-country competiveness analysis, for the study of the manufacturing share in a given economy's GDP it is also useful to adopt the sectoral value-added perspective.

activities (e.g. health, public administration). The latter confirms the structural change at the level of employment – in 2014 less than 50% of the total EU employment linked to manufacturing value chains is found in manufacturing sectors – and also the simultaneous strong losses of employment in manufacturing sectors (–5.5 mn over 2000 to 2014) and lighter gains in business services (+1.3 mn). Our decomposition framework is then applied to show that both the EU's diminishing specialization on manufacturing and the loss of employment in manufacturing sectors are driven mainly by demand factors and technological change, and to a lesser extent by a loss of competitiveness.

In terms of the policy implications, we argue that the generally gloomy view on EU manufacturing needs to be more differentiated and partially revised when zooming in on particular sectors. While it is true that some low-tech manufacturing sectors like textiles have recorded substantial losses of competitiveness and, consequently, of value-added shares, others actually improved their competitive position. Our study illustrates how challenging it is to disentangle the simultaneous and sometimes countervailing impacts of demand, technology and competitiveness shifts, but the sectoral idiosyncrasies that we identify also demonstrate that a 'one size fits all' policy intervention lacking such detailed information would miss its target.

The remaining part of this paper is organized as follows. Section 2 reviews the literature on global trends for manufacturing activities and on measurement approaches to account for the relevance of this sector. It underlines similarities and differences with respect to our methodology, which is introduced in Section 3 together with our data sources. Section 4 analyses the manufacturing share in the EU's total value-added, comparing the nominal and the price-adjusted measure. Section 5 delves deeper and quantifies the role of demand and participation effects for the observed changes in the EU manufacturing sector and individual activities, also in comparison with global competitors. This analysis is complemented in Section 6, where the final demand perspective is adopted to measure the sector's weight and characterize its evolution. Finally, Section 7 summarizes the main findings and discusses policy implications.

2 Literature review

The renewed attention of policy debates on the manufacturing sector is neither a European nor a very new phenomenon. Policy makers have for some time seen the manufacturing sector as an important driver of productivity growth, innovation, and export capacity (European Commission 2014). Indeed, manufacturing provides the largest part of private R&D investments, and manufactured goods dominate international trade (Veugelers, 2017, p.26).([7])

In the US, amidst a surge of manufacturing offshoring during the 2000s, the potentially negative impacts from a shrinking manufacturing sector on national innovation capacities were discussed widely, see, e.g., Pisano and Shih (2012). Baily and Bosworth (2014) reviewed the evolution of US manufacturing over the last decades, to assess whether or not the US is undergoing a manufacturing crisis. They argue that the concurrent trends of a steadily falling employment share and a roughly constant output share (in terms of real value-added) actually represent a long-term stable behaviour and should not cause alarmism.

However, their study also points to the fact that in recent years the stability of the US manufacturing share was only maintained due to the exceptional real output growth of nearly 20% annually in the computer and electronics sector, while the combined GDP share of the rest of manufacturing actually fell. They emphasize the strong dependency of the reported real manufacturing output on the deflator of these quickly evolving goods, calling for caution in view of the statistical uncertainties involved in adjusting nominal prices for quality improvements (e.g. when computer become faster and have larger memory).([8])

Extending the geographical scope, Felipe and Mehta (2016) construct 64 country time series spanning from 1970 to 2010, and show that the constancy – in real value-added terms – of the manufacturing share in total GDP also holds at the global aggregate level. Nevertheless, their data also puts into evidence how the weight of different world regions in total global manufacturing value-added has changed. The 'Europe and Central Asia' region, in particular, dropped from representing around 37% to around 20% of global manufacturing value-added.

Another strand of research on the state of manufacturing in industrialized countries starts with the conceptual question of *what should be counted as manufacturing*: is it really justified to limit the analysis of manufacturing to the value-added (and employment) of the manufacturing sectors themselves, or – in view of today's fragmented value chains – shouldn't upstream service (and other) inputs also be included?([9]) The seminal work in this area, Timmer et al. (2013), introduces the measure of "GVC (Global Value Chain) income" to account for the entire value chain of all manufactured goods in final demand. The authors advocate this as a better indicator of manufacturing competitiveness than gross exports, giving examples of how the latter can overestimate competitiveness and lead to incorrect conclusions on countries' revealed comparative advantage.

In their contribution, Timmer et al. (2013) derive how the GVC income can be formally computed from global input-output data. Using the WIOD database, the measure is then used to study the manufacturing competitiveness of the EU and its member states during the period of 1995 to 2011. At the aggregate level, the EU's share in global manufacturing GVC income has declined from 32% in 1995 to 24% in 2011, quite similar to the finding of Felipe and Mehta (2016) for the more narrowly defined manufacturing sector share. Timmer et al. (2013) rule out the possibility that this decline simply reflects a 'natural' structural change triggered by relatively lower demand for manufactured goods when income in the EU rises, arguing that the domestic bias for manufactured goods is relatively weak and that therefore the shift of global manufacturing demand towards emerging economies like China should not be an obstacle for the generation of value-added in EU industries. They also exclude an impact from shifts in the sectoral composition of manufacturing demand (e.g. from cars towards electronics), and thus conclude that the decline of the EU's share "is due to losses in its value added share in each product GVC", i.e. an overall reduction of EU value-added embodied in final manufacturing products.

This central finding is interpreted as a loss of EU competitiveness, and as main culprit the analysis points to the EU's insufficient participation in the value chains of growing non-EU manufacturing demand. Further corroborating this is a decomposition analysis that quantifies which part of the *absolute* increase of EU

([7]) A more critical review of the expected benefits from a higher manufacturing share is Coad et al. (2019).

([8]) The singular role of this particular sector for the analysis of aggregate manufacturing, and the relevance of the price deflator is also discussed – with an update to more recent data – by Schmalensee (2018).

([9]) Changes in the official classification system leading to some manufacturing activities becoming recorded as service activities–as happened with wholesale and retail trade in the US–can also have a relevant impact on what is reported as the weight of manufacturing, especially for employment (Fort and Klimek, 2016).

manufacturing GVC income stems from increased global demand and which part from changes in (EU and non-EU) production structures, finding that demand growth was the dominating driver of increased GVC income in the EU.

However, this decomposition does not quantify the contributions of the different drivers to the observed decline of the EU's share in global manufacturing GVC income, which is one of the key results of our study. Moreover, in their definition of the demand driver all types of changes in the final demand vector are pooled together, including a shift from, say, EU produced chemicals to Japanese chemicals in US final demand. This deviates from most approaches, which differentiate changes in the geographical and sectoral composition of demand from changes in the specific demand for a product of a certain country. While the former represent compositional effects, the latter can be interpreted as a country-specific performance factor, as done, e.g., in the below discussed Cezar et al. (2017) and in our own approach. Finally, Timmer et al. (2013) also do not delve into the competitiveness of disaggregated manufacturing sectors, except for an analysis of revealed comparative advantage.([10]) Providing evidence on the significant heterogeneity among sectors in terms of their GDP share and international competitiveness is another of the key contributions of our study.

Cezar et al. (2017) also advocate the final-demand approach for cross-country studies of manufacturing competitiveness, backed-up by evidence of the increasing value-added contribution of services and foreign inputs in manufacturing products.([11]) They compute the GVC income (calling it "value added for manufacturing final demand", or VAMFD) for eight large economies, and study its evolution. As a result, they find that the final-demand perspective leads to a less divergent picture in terms of countries' competitiveness, in particular for the case of France vs. Germany. Based on a shift-share analysis, they then decompose observed manufacturing performance (growth rate of exports and of total sales) in terms of geographical specialization, sectoral specialization, and country specific performance. Although the motivation behind this decomposition is similar to ours, the formal approach they employ seems unsuitable for identifying the full impact of demand factors. In contrast to our results, they only find a marginal impact of sectoral and geographical factors on the manufacturing performance (at least for aggregate manufacturing), and conclude by re-confirming the performance convergence of EU countries' manufacturing sector.

For Miroudot (2019), the GVC nature of production and in particular the increased bundling of manufacturing products and service activities (e.g. 'servitisation', 'factoryless goods production') means that the traditional dichotomy between these two areas needs to be questioned. Even more this is the case in view of how statistical data on sectoral economic activity is currently constructed: following the System of National Accounts (SNA) 2008 and classifying firms according to their *principal* activity, manufacturing–in this context– represents a simplifying aggregation of firms that *mostly* produce goods.([12]) Further complicating the statistical classification are manufacturing firms that outsource their core assembly activity, as, e.g. in the case of Apple and Foxconn.([13]) Emphasizing that these imperfections also affect the WIOD database, he still chooses to use it in order to explore three indicators of competitiveness and productivity that follow the GVC income concept of Timmer et al. (2013), concluding that the final demand perspective of this approach indeed increases consistency.

([10]) On the other side, their study also comprehensively analyses the evolution of EU employment – called "GVC jobs" – which we review only briefly in Section 6.

([11]) Another of the paper's key arguments is that the GVC income approach also takes into account domestic performance in the assessment of a country's competitiveness, which is not (or less) the case when just using export market shares.

([12]) See also the data on service-related jobs in the manufacturing sector presented in Fig.17 of Veugelers (2013).

([13]) Related to the changing nature of manufacturing, Bernard et al. (2017) study manufacturing employment in Denmark, and find that half of the decline observed between 1994 and 2007 is explained by manufacturing firms switching their industry to services. Hence, studies focussing on the 'official' manufacturing sector alone overestimate the loss of manufacturing capabilities, which to some extent is retained by the switching firms.

3 Data and methods

Studying the global macro-economy with its country and cross-sectoral linkages by using global input output data has become a widely used approach since the pioneering work of Hummels et al. (2001). Broadly speaking, the input-output accounting structure comprises all economic transactions between the possible combinations of included producing sectors and countries, differentiating between production used for further processing (intermediate demand) and production used for final consumption or investment (final demand).

In this study we rely on the well-known World Input Output Database (WIOD), in its year 2016 version([14]), complemented by the so-called Socio-Economic Accounts (SEA) and the tables in previous year prices released in 2019.([15]) With annual frequency and encompassing the years between 2000 and 2014, WIOD covers 56 economic activities in 43 individual countries – including all EU member states – and an aggregate region representing the rest of the world.

Based on this framework, we develop a methodology that allows decomposing any observed change of value added into a complete set of individual contributions, which represent the economic drivers of interest. We group these into two broad categories; one related to changes in final demand and the other one linked to shifts in participation in value chains, where the latter is interpreted as a measure of competitiveness.

3.1 Decomposition of changes in value-added

This sub-section provides details on how the decomposition is computed from the input-output dataset. For a given sector j (j∈J) in country c (c∈C) we can write its total production as the sum of intermediate demand (ID) and final demand (FD) for its output in all countries:

$$\mathrm{Y_{c,j}} = \sum_{\mathrm{d,k}} \mathrm{ID_{(c,j),(d,k)}} + \sum_{\mathrm{d}} \mathrm{FD_{(c,j),d}} \quad (1)$$

where ID_(c,j),(d,k) is the intermediate demand of products from sector j in country c by sector k in country d, and FD_(c,j),(d) is the final demand of products from sector j in country c by country d.

The value added generated in sector j of country c is determined by the difference between the value of its output and the cost of intermediates used in the production process:

$$\mathrm{VA_{c,j}} = \mathrm{Y_{c,j}} - \sum_{\mathrm{d,k}} \mathrm{ID_{(d,k),(c,j)}} \quad (2)$$

Following the Leontief (1986) framework, we can rewrite the value added for a number of sectors J and countries C in matrix format:

$$\mathrm{VA} = \mathrm{vay} \times \mathrm{M} \times \mathrm{FD} = \left\{\mathrm{VA_{c,j}}\right\}_{\mathrm{C\times J,1}} \quad (3)$$

The first component is related to the value added share within one unit of output in sector j of country c that is retained by the producing sector itself:

$$\mathrm{vay_{c,j}} = \frac{\mathrm{VA_{c,j}}}{\mathrm{Y_{c,j}}} \quad (4)$$

which represents an element of vay, a diagonal matrix including the value added-to-output ratio for all the CxJ country-sector pairs. We later label associated effects of changes in this matrix with sec_vay.

The second component in Equation 3 represents the country-sector interlinkages through the structure of intermediate demand for production processes. The corresponding matrix is a square one of CxJ dimension known as the Leontief inverse:

$$\mathrm{M} = (\mathrm{I} - \mathrm{A})^{-1} \quad (5)$$

where I is the identity matrix and A corresponds to the matrix of technical coefficients.

Each element of the matrix of technical coefficients represents the share of inputs from sector k of country d within one unit of output in sector j of country c, and can be further decomposed as follows:

$$\mathrm{a_{(c,j),(d,k)}} = \frac{\mathrm{ID_{(c,j),(d,k)}}}{\mathrm{Y_{d,k}}} = \frac{\mathrm{ID_{(c,j),(d,k)}}}{\sum_c \mathrm{ID_{(c,j),(d,k)}}} \times \frac{\sum_c \mathrm{ID_{(c,j),(d,k)}}}{\mathrm{Y_{d,k}}} = \mathrm{id_{(c,j),(d,k)}} \times \mathrm{a_{(j),(d,k)}} \quad (6)$$

([14]) Timmer et al. (2016). Data and methodology available at http://www.wiod.org/release16.

([15]) Some minor adjustments have been made to the original dataset, mainly to correct methodological breaks stemming from the use of different national account systems over the sample period.

where id_(c,j),(d,k) corresponds to the share of inputs from sector k provided by each country (ms_id effects) and a_(j),(d,k) to an aggregate technical coefficient accounting for the total share of inputs from sector k used for one unit of output (sec_tech).

Finally, the third component in Equation 3 encompasses the demand of products by economic agents for final use and is represented by a diagonal matrix of dimension CxJ. Each element of the diagonal matrix corresponds to the total final demand of products from a country-sector pair and is the result of aggregating across countries (d) and final demand components (v):

$$\mathrm{FD}_{\mathrm{c,j}} = \sum_{d,v} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}} \tag{7}$$

where FD_(c,j),d[v] is the demand of products from sector j in country c for final use v in country d. WIOD differentiates three components of final demand: private consumption, public consumption, and gross capital formation.

As it was the case for the matrix of technical coefficients, each element of the final demand matrix in Equation 7 can be further disaggregated as follows:

$$\mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}} = \sum_{\mathrm{c,j,d,v}} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}} \times \frac{\sum_{\mathrm{c,j,v}} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}}}{\sum_{\mathrm{c,j,d,v}} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}}} \times \frac{\sum_{\mathrm{c,j}} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}}}{\sum_{\mathrm{c,j,v}} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}}} \times \frac{\sum_{\mathrm{c}} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}}}{\sum_{\mathrm{c,j}} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}}} \times \frac{\mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}}}{\sum_{\mathrm{c}} \mathrm{FD}_{(\mathrm{c,j}),\mathrm{d[v]}}} = \mathrm{FDW} \times \mathrm{fd}_{\mathrm{d}} \times \mathrm{fd}_{\mathrm{d[v]}} \times \mathrm{fd}_{\mathrm{j,d[v]}} \times \mathrm{fd}_{(\mathrm{c,j}),\mathrm{d[v]}} \tag{8}$$

where FDW is total world final demand (vol_W effects), fd_d is the share of country d in world final demand (vol_geo), fd_d[v] is the share of component v in total final demand of country d (comp_fd), fd_j,d[v] is the share of products from sector j in component v of final demand of country d (comp_prod), and fd_(c,j),d[v] is the share of country c in the supply of products from sector j to final use v in country d (ms_fd).

Having decomposed each of the elements in the vector of value added shown in Equation 3, we now turn to the different factors contributing to changes in that vector. For a given sector j in country c, the change of value added can be written as:([16])

$$\Delta\mathrm{VA}_{\mathrm{c,j}} = \Delta\mathrm{vay}_{\mathrm{c,j}} \times \mathrm{M} \times \mathrm{FD} + \mathrm{vay}_{\mathrm{c,j}} \times \Delta_{\mathrm{sec\_tech}}\mathrm{M} \times \mathrm{FD} + \mathrm{vay}_{\mathrm{c,j}} \times \Delta_{\mathrm{ms\_id}}\mathrm{M} \times \mathrm{FD} + \mathrm{vay}_{\mathrm{c,j}} \times \mathrm{M} \times \Delta_{\mathrm{ms\_fd}}\mathrm{FD} + \mathrm{vay}_{\mathrm{c,j}} \times \mathrm{M} \times \Delta_{\mathrm{comp\_fd}}\mathrm{FD} + \mathrm{vay}_{\mathrm{c,j}} \times \mathrm{M} \times \Delta_{\mathrm{comp\_prod}}\mathrm{FD} + \mathrm{vay}_{\mathrm{c,j}} \times \mathrm{M} \times \Delta_{\mathrm{vol\_geo}}\mathrm{FD} + \mathrm{vay}_{\mathrm{c,j}} \times \mathrm{M} \times \Delta_{\mathrm{vol\_W}}\mathrm{FD} \tag{9}$$

In view of the different economic nature of these contributions, they can be grouped into two broad categories, participation effects (pe) and demand effects (de):

$$\Delta\mathrm{VA}_{\mathrm{c,j}} = \mathrm{pe}_{\mathrm{sec\_vay}} + \mathrm{pe}_{\mathrm{sec\_tech}} + \mathrm{pe}_{\mathrm{ms\_id}} + \mathrm{pe}_{\mathrm{ms\_fd}} + \mathrm{de}_{\mathrm{comp\_fd}} + \mathrm{de}_{\mathrm{comp\_prod}} + \mathrm{de}_{\mathrm{vol\_geo}} + \mathrm{de}_{\mathrm{vol\_W}} \tag{10}$$

Demand effects would capture changes in value added due to shifts in the volume (vol_geo and vol_W) and composition (comp_fd and comp_prod) of final demand, which are associated with the impact of overall economic performance and income catch-up. In turn, participation effects would reflect changes in the distribution of value added across countries (ms_id and ms_fd) and sectors (vay and tech) generated by a unit of final demand in a given country for a given product, and hence could be associated with the competitiveness dimension.

([16]) All interaction terms are equally distributed among contributing factors.

4 The manufacturing share in EU's economy and the role of relative prices

4.1 Evolution of aggregate manufacturing

According to nominal WIOD-based data, the contribution of the manufacturing sectors to total EU value added has declined from 18.7% in year 2000 to 15.3% in 2014, as seen in Figure 1. However, when adjusting the data for changes in the relative price between manufactured and all other goods and services([17]), it turns out that the manufacturing share has not nearly fallen as much. Thus, almost two thirds of the total decline of the nominal value-added share of manufacturing until 2014 is solely due to the relative decline of the price of manufactured goods.

This striking difference between the nominal and 'real prices' view has already been noticed for the US manufacturing sector, stimulating a lively debate on its meaning and implications (e.g. Baily and Bosworth 2014, Schmalensee 2018). The prices of manufactured goods relative to others – mainly services and commodities – generally tend to fall, because of the larger productivity increases realized in this sector (mechanization, automation, etc.). On top of this, the time period considered here is characterized by the drastic technological advancement of the ICT sector, which continuously improved performance while hardly increasing – and sometimes decreasing– prices, as in the case of computer and electronics.

In sum, analysis at the aggregate level shows that the seemingly dramatic decline of the value-added share of manufacturing has to be put into perspective, given that the relative price effect is responsible for the largest part of the observed effect. What is more, based on the corresponding variables in National Accounts released by Eurostat, data for the most recent years suggest that the manufacturing share might (nearly) be recovering its pre-crisis level. This would be in line with the long-term stability of the manufacturing share observed for the US (Baily and Bosworth 2014).

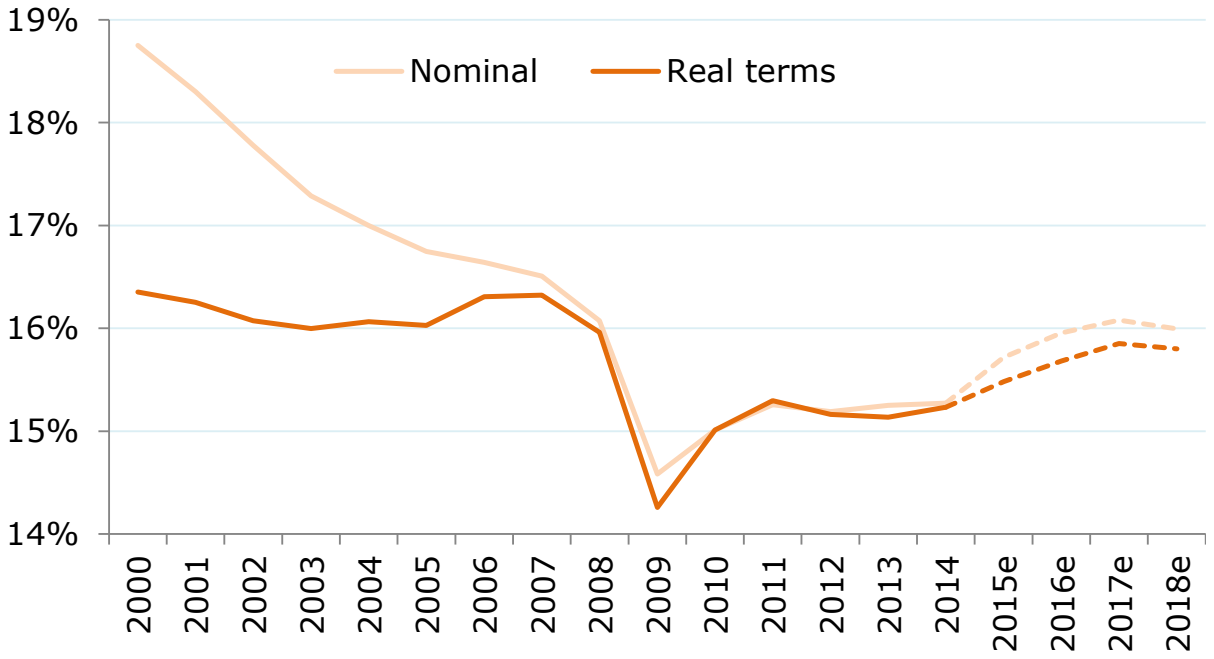

Figure 1: Share of manufacturing sector in total value added generated in the EU economy, both for nominal (current prices) and real terms (chain-linked volumes, reference year 2010). Manufacturing includes all C-lettered activities in the NACE classification (see Appendix for detailed list). Data for 2000-2014 are based on WIOD and 2015-2018 correspond to estimations using National Accounts from Eurostat.

([17]) Real term figures throughout the whole report are presented in chain-linked volumes referred to 2010, which is the base year for price indices provided in WIOD's SEA.

4.2 Heterogeneity across individual manufacturing sectors

Policy discussions on the declining EU manufacturing share typically focus on the evolution of the sector as a whole, but a more detailed analysis reveals strong sectoral heterogeneity and thus questions the meaningfulness of 'aggregate manufacturing'.

Most importantly, there is a notable difference in the evolution of manufacturing sectors with lower and with higher technology content as defined by the OECD criteria (Galindo-Rueda and Verger, 2016). As can be seen in Table 1, if it were not for the relative price effect, which had a stronger impact on higher than on the lower tech activities, those sectors with higher technology content would have overall increased their share in the EU total economy, by 0.5 percentage points (pp). On the contrary, the declining share of lower tech sectors was driven to larger extent by the negative evolution in real terms.

In particular, 'C26 – Electronics' shows a very peculiar pattern. On the one hand, it is among those activities with the strongest decline in nominal terms, being in fact the largest single contributor to the overall nominal decline of the manufacturing share. But on the other hand, its share in the total economy increased in volume terms. This contrasting effect is due to the extraordinary strong decline of the relative price of these goods, which is – as mentioned before – well known (Schmalensee 2018). As can be seen in Table 1, of the total relative price effect, which by itself lowered the EU manufacturing share by 2.4pp, 'C26 – Electronics' accounts for 0.8pp, i.e. one third.

A similar pattern is observed for two other high tech manufacturing activities, 'C21 – Pharma' and 'C29 – Motor Vehicles', which also both increased their share in the total economy in real terms. On the other side, just three activities with lower technological content account for half of the total negative contributions in real terms, namely 'C13_15 – Textiles', 'C10_12 – Food' and 'C31_32 – Furniture (and other manufacturing)'.

Evidently, the overall degree of heterogeneity is significant within the manufacturing sector and it follows that a generic statement on its aggregate performance is of limited relevance and might be misleading for policy analysis. We further study these patterns in the next sections, where we focus only on real term figures.

	Nominal	Price effects	Real terms
C - Total Manufacturing Activities	**-3.5**	**-2.4**	**-1.1**
Lower technological content	**-2.5**	**-0.9**	**-1.6**
C10_12 - Food	-0.3	0.0	-0.3
C13_15 - Textiles	-0.4	0.0	-0.4
C16 - Wood	-0.1	0.0	-0.1
C17 - Paper	-0.2	-0.2	0.0
C18 - Printing	-0.3	-0.2	-0.1
C19 - Petroleum	-0.1	0.0	-0.1
C22 - Plastics	-0.1	-0.2	0.0
C23 - Mineral Products	-0.3	-0.1	-0.2
C24 - Basic Metals	-0.2	-0.1	-0.1
C25 - Fabricated Metals	-0.2	-0.1	-0.1
C31_32 - Furniture	-0.2	0.1	-0.3
C33 - Repair	0.0	0.0	0.0
Higher technological content	**-1.0**	**-1.5**	**0.5**
C20 - Chemicals	-0.3	-0.2	-0.1
C21 - Pharma	0.1	-0.2	0.3
C26 - Electronics	-0.5	-0.8	0.3
C27 - Electrical	-0.2	-0.1	-0.1
C28 - Machinery	-0.1	0.0	-0.1
C29 - Motor Vehicles	-0.1	-0.2	0.2
C30 - Transport	0.0	-0.1	0.0

Table 1: Changes in percentage points in the value-added share of manufacturing in the EU overall economy between 2000 and 2014 based on WIOD, contributions by individual manufacturing sectors and aggregates, and by type of effect. Real terms refer to chain-linked volumes, reference year 2010. Due to rounding the nominal figure can deviate by ±0.1 from the sum of the two contributions.

5 The contribution of demand and participation effects

The last section provided a first step for disentangling the drivers of different nature and policy relevance behind the manufacturing sector's declining weight, with a view on the objective of retaining a strong manufacturing base within the EU. On the one hand, it was shown that the change of relative prices had a strong influence, which is associated with global technological progress rather than with industrial policy. And on the other hand, we found that the analysis of manufacturing as a whole is of limited relevance since the behaviour of individual manufacturing sectors is strongly heterogeneous.

Along these lines, we now present results from the full decomposition of the observed changes in the price-adjusted value added share of individual manufacturing activities, differentiating between demand and participation effects. As explained in Section 3 on data and methods, the former capture changes in value added due to shifts in the volume and composition (geographical and sectoral) of final demand, whereas the latter reflect changes in the distribution of value added generated by one unit of final demand in a given country for a given product. Participation effects include shifts in value added retention and technological coefficients –both associated with redistribution at sectoral level, as well as changes in geographical market shares at the level of both inputs and final products. These effects can be viewed as indicators of sectoral competitiveness gains/losses. The objective of this section is to identify whether and for which specific sectors concerns about the competitiveness of EU manufacturing might be justified. Box 1 in following pages serves as a methodological guidance relying on one individual manufacturing industry, namely 'C26 – Electronics'.

Table 2 shows the decomposition of the change in the real terms value added share of manufacturing activities.([18]) It can be observed that on top of the sectoral heterogeneity found for the overall change, there also is considerable variation in terms of the different drivers' contribution to the sectors' evolution. For instance, for the two broad aggregations based on technological content, we find that both the demand composition and the sectoral participation effect had impacts with opposite signs: for low-tech manufacturing these two effects alone would have lowered its value added share in the economy by 1.5 percentage points, while for high-tech they would imply an increase by 0.3 percentage points.

The effect of demand composition can be explained by the dampening impact of the crises aftermath on EU investment and durable consumption, which has taken its toll on manufacturing inputs –mainly those with lower technological content. In addition, shifting weights in the consumption basket away from basic goods (e.g. food and textiles) have not only benefited services but also high-tech products, such as electronics or pharmaceuticals –the latter also being supported by ageing populations.

And on the other side, the sectoral participation effect – negative for lower, positive for higher tech sectors – reflects the change in the sectoral composition of the value added generated within production chains, mainly due to technological progress that is increasing the use and participation of electronics (as shown in Table 2 by its significant positive 'sectoral participation effect').

A more homogenous picture emerges for the demand volume effect, which shows positive or neutral figures in both technological subsectors and across most individual manufacturing activities. Positive contributions of this driver occur as the result of the stronger economic growth in foreign than in domestic markets observed during the considered time period, as manufactured goods are highly tradable and hence profit more than other sectors from the growth of export markets. In fact, 22% of EU manufacturing output was exported to non-EU countries in 2014 compared to 6% for the rest of the economy.

Finally, changes in global market shares, which we associate with competitiveness, made only a limited negative or neutral contribution for the vast majority of manufacturing industries, i.e. the loss (or gain) of EU market shares for most manufacturing goods was in line with those experienced by the EU economy as whole. Still, the overall figure of a -0.8 percentage points reduction of the EU manufacturing share is quite significant and mostly stems from only two sectors, 'C13_15 – Textiles' on the low-tech side and 'C26 – Electronics' within the high-tech group. As shown in Table 2, these two together explain 0.6pp out of the 0.8pp loss in the value added share of the manufacturing sector. The former is unsurprising and reflects the rise of Asian textile production and the accompanying loss of EU value added in that sector. The latter might be less expected, given the overall gain of weight of electronics. However, as explained with detail in Box 1, the negative contribution captures the fact that within the strongly positive effect of the shift of demand and technology towards electronics, the market share of EU value added actually declined (but the net effect is

([18]) It is important to keep in mind that the decomposition is applied to the manufacturing share. As a consequence, a positive contribution from, say, the demand effect means that EU manufacturing value added increased relatively more (or shrank relatively less) than the EU's total value added.

still positive, i.e. growth of overall size dominated the EU's shrinking share, leading to an increase of value added). Finally, it's worth highlighting that for this driver the only noticeable positive impact is found for 'C21 – Pharma'.

In sum, we find that the interplay of various trends has determined the overall change of the EU's manufacturing share. First, higher economic growth in non-EU markets had a positive effect, particularly for export-oriented high-tech manufacturing activities. Second, crises legacies within the EU and worldwide shifts in the consumption basket are translating into lower relative demand for manufacturing products, with the only exceptions of electronics and pharmaceuticals. Third, technological progress is increasing the use and value added participation of electronics in production chains. And fourth, EU competitiveness losses, as a result of changing global market shares, were not significantly different from non-manufacturing sectors except for textiles and electronics. These trends will be further analysed and EU compared to its global competitors in the following sub-section

	Real terms	Demand effects		Participation effects	
		Volume	Composition	Sectoral	Mkt. shares
C - Total Manufacturing Activities	**-1.1**	**1.0**	**-1.0**	**-0.2**	**-0.8**
Lower technological content	**-1.6**	**0.3**	**-1.0**	**-0.5**	**-0.4**
C10_12 - Food	-0.3	0.0	-0.3	-0.1	0.0
C13_15 - Textiles	-0.4	0.0	-0.1	0.0	-0.3
C16 - Wood	-0.1	0.0	-0.1	-0.1	0.0
C17 - Paper	0.0	0.0	0.0	0.0	0.0
C18 - Printing	-0.1	0.0	0.0	-0.1	0.0
C19 - Petroleum	-0.1	0.0	0.0	-0.1	0.0
C22 - Plastics	0.0	0.0	0.0	0.1	0.0
C23 - Mineral Products	-0.2	0.0	-0.1	-0.1	0.0
C24 - Basic Metals	-0.1	0.1	0.0	-0.1	0.0
C25 - Fabricated Metals	-0.1	0.1	-0.1	0.0	-0.1
C31_32 - Furniture	-0.3	0.0	-0.2	-0.1	0.0
C33 - Repair	0.0	0.0	0.0	0.1	0.0
Higher technological content	**0.5**	**0.7**	**0.0**	**0.3**	**-0.5**
C20 - Chemicals	-0.1	0.1	-0.1	-0.1	0.0
C21 - Pharma	0.3	0.0	0.1	0.0	0.1
C26 - Electronics	0.3	0.1	0.1	0.4	-0.3
C27 - Electrical	-0.1	0.1	0.0	0.0	-0.1
C28 - Machinery	-0.1	0.2	-0.2	-0.1	-0.1
C29 - Motor Vehicles	0.2	0.1	0.0	0.0	0.0
C30 - Transport	0.0	0.1	0.0	0.0	0.0

Table 2: Changes in percentage points in the real terms (chain-linked volumes, reference year 2010) value-added share of manufacturing in the EU overall economy between 2000 and 2014 based on WIOD, contributions by individual manufacturing sectors and aggregates, and by type of effect. Due to rounding the first columns' figure can deviate by ±0.1 from the sum of the four contributions.

Box 1. Methodological guidance: the case of 'C26 – Electronics'

Results presented throughout this paper correspond to the aggregate net effect of changes in individual transactions between different sectors and countries. The purpose of this box is to provide a specific example to have a better understanding on what's behind the decomposition explained in Section 3. We have chosen 'C26 – Electronics' based on its relevance for the analysis presented here.

Value added in this sector increased in the EU at an average annual rate of 4.3% between 2000 and 2014 in real terms, which favourably contrasts with the 1.2% recorded for the total economy, and resulting in an increase this sector's weight of 0.3 pp over the whole period (as shown in Table 2). As explained in the main text, this differential is the net result of positive demand and sectoral participation effects against the loss of global market shares.

Namely, around 35% of the output from EU electronics' manufacturers is exported to non-EU regions, which has allowed the sector to benefit from higher growth in those areas compared with other activities that are more oriented towards EU markets. In addition, as shown in Figure A, both the share of electronics in world final demand and the share of electronics used as inputs for global output (i.e. the corresponding technical coefficients explained in Section 3) have increased over time as a result of income and technological developments shifting consumer and producer preferences, respectively. These factors have been strongly amplified by the increase of the value added share within one unit of output that is retained on average by EU electronics' manufacturers, reflecting efficiency gains against other sectors (Figure B).

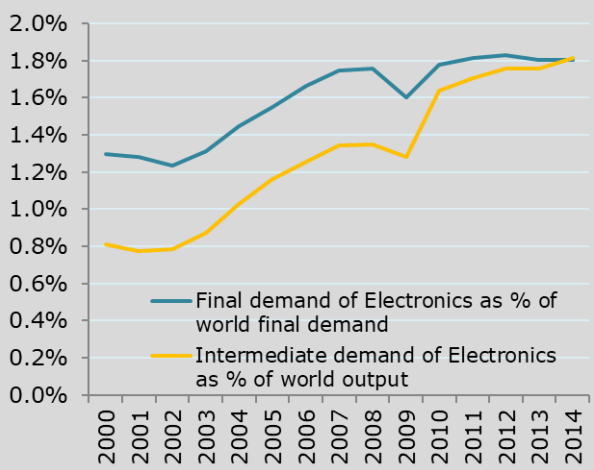

Figure A: Share of products from 'C26 – Electronics' in total global final demand and output. In real terms (chain-linked volumes, reference year 2010), based on WIOD.

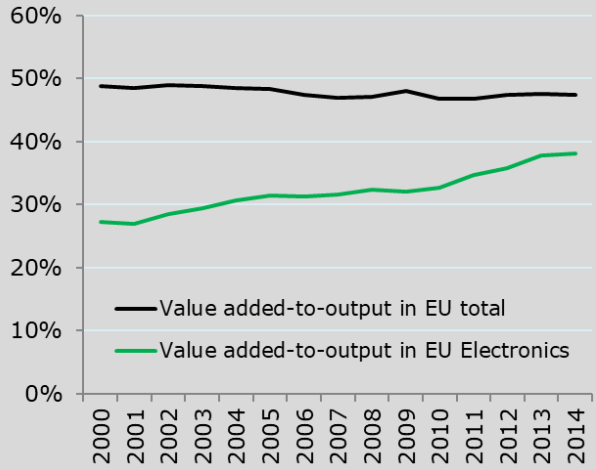

Figure B: Value added share within one unit of EU output, total and 'C26 – Electronics'. In real terms (chain-linked volumes, reference year 2010), based on WIOD.

On the contrary, EU electronics' manufacturers have been subject to stronger competition from non-EU producers, limiting the positive impact of the aforementioned tailwinds. As shown in Figures C and D, this is reflected in a growing share of imports of electronics for both final and intermediate demand, as well as in a declining participation of EU exports in the use of electronics in the rest of the world. Overall, we estimate that EU losses in global market shares for the electronics' sector dragged 0.3 pp from its share in total economy between 2000 and 2014 (as shown in the last column of Table 2).

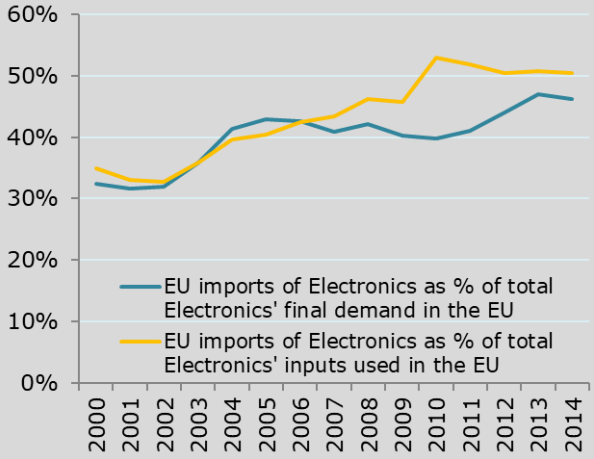

Figure C: Share of EU imports from non-EU countries as percentage of total final demand and use of inputs from 'C26 – Electronics' in the EU. In real terms (chain-linked volumes, reference year 2010), based on WIOD.

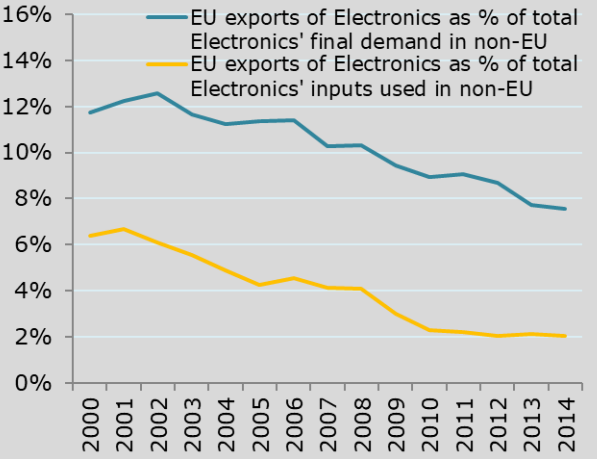

Figure D: Share of EU exports to non-EU countries as percentage of total final demand and use of inputs from 'C26 – Electronics' in non-EU countries. In real terms (chain-linked volumes, reference year 2010), based on WIOD.

Moreover, when considering the global context, a couple of other features undermine further the initial favourable assessment for EU electronics' manufacturers. First, the increase of both the use of these products as inputs in production processes and their value added-to-output ratio – shown respectively in Figures A and B – has been more intense in the rest of the world and hence contributed more positively to value added generation in Electronics than in the EU. And second, the overall negative growth differential between the EU and non-EU economies, which was shown to have a positive contribution in Electronics when compared to total EU economy (as shown in Table 2), exerts in this case a sizeable drag on value added growth for EU electronics' manufacturers relative to non-EU producers

5.1 EU's manufacturing in the global context

Motivated by the concern about the EU's manufacturing share, we so far analysed the manufacturing sector only relative to the EU overall economy. This implicitly puts activities on the same footing that are not really

comparable due to their very different degree of tradability. Therefore, this section compares the EU manufacturing sector to the manufacturing sectors of a set of relevant competitor countries – namely the United States and Japan within developed economies, and China and India among the emerging world. The objective is to identify whether and in which specific sectors concern about the competitiveness of EU manufacturing might be justified from a global perspective. From a methodological point of view, the focus on manufacturing bears the advantage of comparing 'likes with likes', and thus limiting the influence of relative price effects to the one between countries and exchange rates, which – due to the high tradability of manufactured goods –should be minor.

In aggregate terms, and using chain-linked volumes referred to 2010, EU manufacturing activities accounted for close to 30% of worldwide sectoral value added at the beginning of the period – two thirds together with the US and Japan – and well above China's 6%. The picture in 2014 was rather different, with China showing the largest individual country share (27%) and the contribution of the EU being reduced by a third to 21%. As shown in Figure 2, this positive trend for China (and other emerging economies like India) and the corresponding negative evolution for developed countries was already in place before the Great Recession and does not seem to level afterwards. As a result, the EU-US-Japan bloc represented less than a half of worldwide manufacturing value added in 2014.

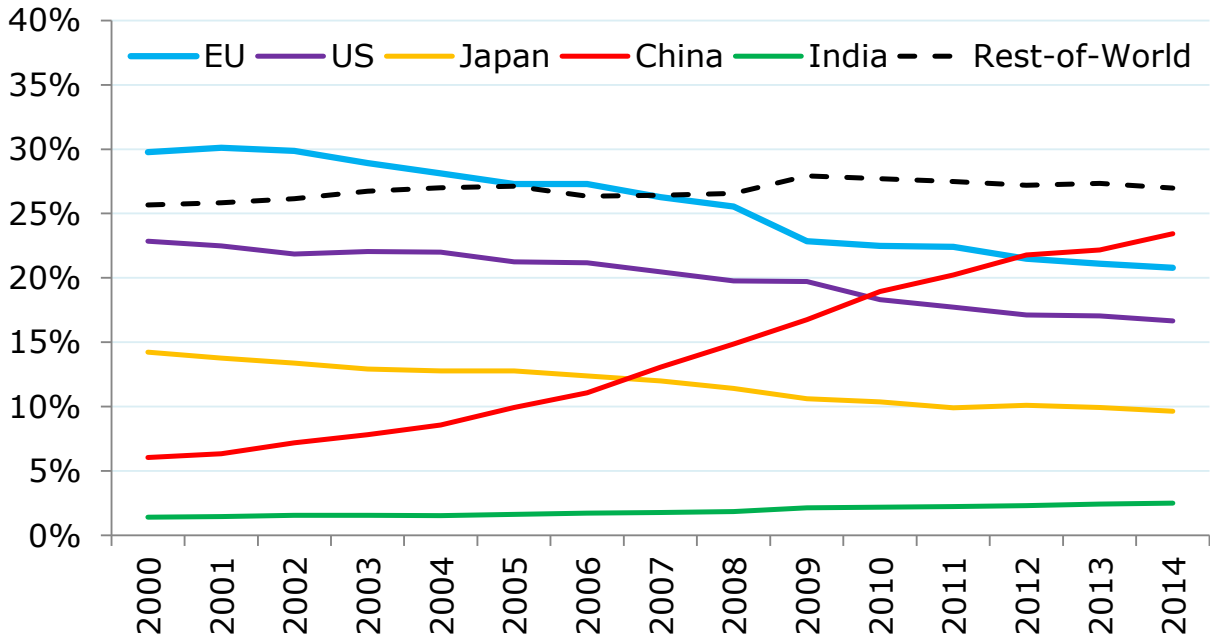

Figure 2: Share in value added generated worldwide in the manufacturing sector, in real terms (chain-linked volumes, reference year 2010). Manufacturing includes all C-lettered activities in the NACE classification (see Appendix for detailed list). Data based on WIOD.

A priori, there are a number of factors that might explain the changing geographical shares of the total manufacturing value added. For a better understanding we again apply the decomposition presented in Section 3. Table 3 shows changes of country shares in real terms between 2000 and 2014 and the contribution of each driver for the manufacturing aggregate, the two low/high tech subsectors and the three individual activities previously highlighted, i.e. 'C13_15 – Textiles', 'C21 – Pharma' and 'C26 – Electronics'.

First, we observe that the largest part of the redistribution in global manufacturing value added – more than 60% in the case of the EU – can be attributed to demand effects, in particular to volume ones – i.e. changes in the geographical weight distribution. The latter is a consequence of the fact that economic growth has been higher in China (and other emerging economies) than in the developed world, which has stimulated the stronger growth of manufacturing value added in these regions. In addition, the developed countries' global share also diminished due to an overall shift in the composition of final demand away from manufacturing goods (mainly on their home market), due to the lasting effects of the crises that restrained expenditure in durable consumption and investment. As the Table's second block (low vs. high tech sectors) shows, this negative composition effect affects low-tech but does not extend to the aggregate of high-tech manufacturing activities, with electronics and pharma in particular recording a positive demand composition effect. Positive contributions across the board are observed for China, driven by income effects and fast-

growing investment, which is intensive in the use of manufacturing. Electronics and pharma show up again as the most noticeable exceptions, recording positive demand composition effects within developed economies.

	TOTAL (real terms)	Demand effects		Participation effects	
		Volume	Composition	Sectoral	Mkt. shares
C - Total Manufacturing Activities					
European Union	**-9.0**	-4.4	-1.2	-1.7	-1.6
United States	**-6.2**	-2.8	-0.4	0.7	-3.7
Japan	**-4.6**	-2.6	-0.2	0.4	-2.2
China	**17.4**	7.8	1.4	1.4	6.7
India	**1.1**	0.8	0.2	-0.3	0.4
Rest-of-World	**1.3**	1.3	0.3	-0.7	0.4
Subsectors by technological content					
Lower technological content					
European Union	-6.5	-2.8	-1.4	-1.6	-0.7
United States	-4.9	-1.6	-0.9	-1.4	-1.1
Japan	-4.7	-1.9	-0.7	-1.2	-1.0
China	8.6	5.0	0.5	-0.5	3.6
India	0.6	0.6	0.1	-0.3	0.2
Rest-of-World	-2.0	0.8	-0.4	-2.2	-0.1
Higher technological content					
European Union	-2.5	-1.6	0.2	-0.1	-0.9
United States	-1.2	-1.2	0.4	2.1	-2.6
Japan	0.1	-0.8	0.4	1.6	-1.1
China	8.7	2.8	0.9	1.9	3.1
India	0.5	0.2	0.1	0.0	0.1
Rest-of-World	3.2	0.5	0.7	1.6	0.5
Selected manufacturing activities					
C13_15 - Textiles					
European Union	-1.0	-0.2	-0.2	-0.1	-0.5
United States	-0.4	-0.1	-0.1	-0.1	-0.3
Japan	-0.3	-0.1	0.0	0.0	-0.2
China	1.4	0.4	0.0	0.5	0.6
India	0.1	0.1	0.0	0.0	0.0
Rest-of-World	-0.1	0.0	-0.2	0.0	0.1
C21 - Pharma					
European Union	0.1	-0.3	0.3	0.0	0.1
United States	-0.3	-0.1	0.1	0.0	-0.3
Japan	0.2	-0.1	0.1	0.3	0.0
China	0.5	0.2	0.0	0.2	0.1
India	0.0	0.0	0.0	0.0	0.0
Rest-of-World	0.0	0.0	0.0	0.0	0.0
C26 - Electronics					
European Union	0.1	-0.2	0.2	0.6	-0.5
United States	1.2	-0.3	0.3	2.0	-0.8
Japan	0.7	-0.1	0.2	1.0	-0.4
China	2.0	0.2	0.1	0.8	0.8
India	0.0	0.0	0.0	0.0	0.0
Rest-of-World	1.9	0.2	0.4	1.1	0.2

Table 3: Changes in the real terms (chain-linked volumes, reference year 2010) value-added share in worldwide manufacturing between 2000 and 2014 based on WIOD, change for the aggregate sector, and contributions by subsectors and selected individual activities by type of effect.

Second, sectoral participation effects go in the same direction for most countries, with positive contributions in high-tech activities and negative for low-tech, mainly as a result of an increasing relative use of electronics in production processes. The net effect – implying an increase in their global share – is positive for the US, Japan and China, while the EU stands out as noticeable exception, even showing a negative – albeit small – effect for high-tech activities. The latter could be the result of either detrimental specialization patterns or a softer shift in the nature of production processes. In any case, the EU clearly contrasts with respect to the US and Japan, which both show large positive sectoral participation effects in high tech, mainly attributable to the electronics' sector. Overall, the EU's relatively lower sectoral participation explains almost 20% of its loss in the global manufacturing share

And third, we find that geographical participation effects, that is, changes in market shares for intermediate and final products provision, has substantially contributed to the expansion of China's global share, similarly for low-tech and high-tech manufacturing subsectors, and to a lower extent to that of India. On the contrary, losses for developed countries are recorded across the board, although the adverse effect seems to be more

limited in the EU when compared with the US and Japan, except for the case of textiles. The EU's pharma sector even slightly increased its market share, but this remains an exception in view of the overall negative contribution of this driver, which accounts for close to 20% of the total reduction of its global manufacturing share.

As mentioned in the methodology, participation effects can be associated with the competitiveness dimension and hence its analysis has the most direct relevance for industrial policy. Accordingly, from the evidence shown in this sub-section, we conclude that concerns in the EU should focus on the electronics' sector, also in view of its pivotal role for global technological change. On the one hand, the increasing use of these high-tech products in value chains seems to have brought less benefit for EU than other regions' companies, including developed countries. And on the other hand, electronics has been the most affected manufacturing activity by EU losses in global market shares. As opposed to the similarly affected textile sector, for which competitiveness losses would be a more natural trend in face of competition by low-wage emerging economies, a persistent negative trend for electronics could eventually harm innovation capacities and erode productivity growth. The latter would strongly depend on whether the competiveness losses in electronics' manufacturing has been compensated elsewhere in the production chain by services with high technological content, such as scientific R&D, software development or IT services.([19])

([19]) Galindo-Rueda and Verger (2016) update the OECD taxonomy of economic activities based on technological intensity to include services.

6 A comparison with the manufacturing value chain perspective

In the previous sections we analysed the EU's manufacturing share with respect to the value added generated in the whole EU economy and worldwide in that same sector. This 'value added perspective' illustrates how manufacturing activities contribute to the generation of value added at different stages of all existing value chains. Some examples would be mineral products used as building materials for housing, chemical inputs for plastics' production, or household expenditure in textiles.

Now, in turn, we focus on how value added is generated in value chains that have at their final stage manufacturing products for consumption or investment, i.e. manufacturing value chains. This 'value chain perspective' coincides with the GVC income measure of Timmer et al. (2013) and compares with the value added view as follows:

- Both include manufacturing inputs for manufacturing final products (e.g. chemical inputs for plastic houseware or food packaging purchased by households), as well as all the value added in the final stage of manufacturing before reaching consumers (e.g. wages and profits distributed by a car manufacturer).
- Manufacturing inputs that participate in value chains of non-manufacturing final products are excluded (e.g. mineral products used as building materials for housing, or chemical inputs for food packaging purchased by restaurants). On average, these inputs account for 40% of worldwide manufacturing value added.
- In turn, manufacturing value chains include value added generated in non-manufacturing activities, whenever their output serves as inputs in any of the stages of the full value chain of a final manufacturing product (e.g. legal services provided to tobacco or pharmaceutical companies). In aggregate terms, non-manufacturing activities represents around half of the total value added in manufacturing value chains, thus becoming a critical element of their competitiveness.

Having clarified the differences between both analytical perspectives, in this section we compare the participation of the EU in global manufacturing value chains to previous results on the value added generated in the EU's manufacturing sector.

First, in Figure 3 we show that the economic weight of manufacturing in the EU's total economy becomes higher when adopting the value chain perspective, around 4pp more than the share of manufacturing value added that we already showed in Figure 1 of Section 4. Nevertheless, this difference has remained quite stable throughout the sample period, with both approaches yielding a very similar trend and decline in recent years vis-à-vis the pre-crisis period (a reduction of 1.1pp using the value added perspective and 1.4pp for the value chain perspective).

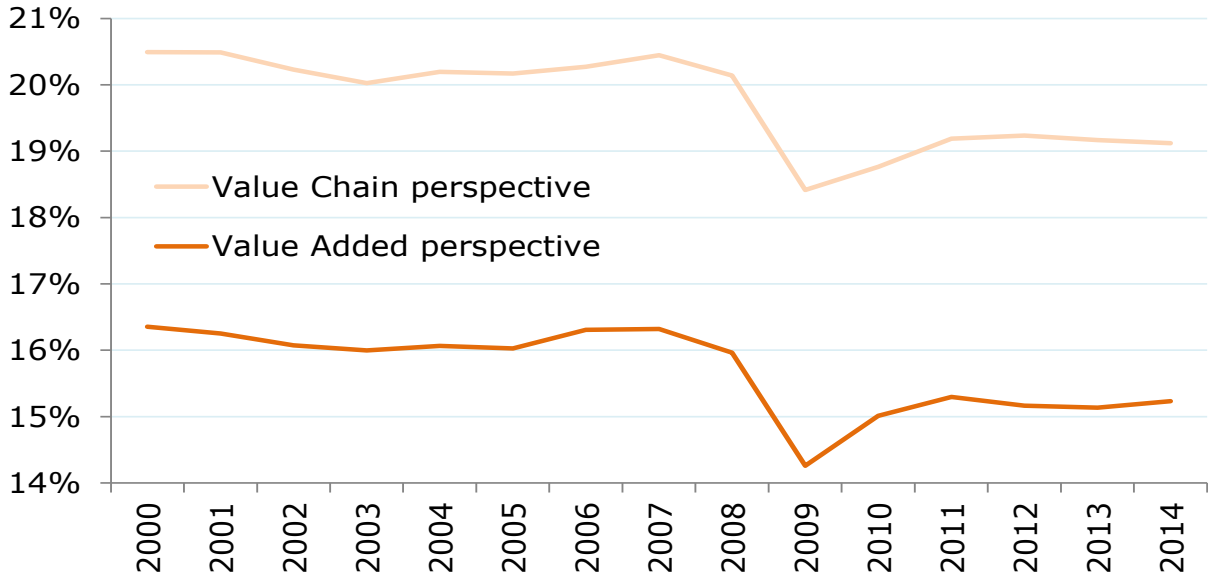

Figure 3: Share of manufacturing sector ('value added perspective') and manufacturing value chains ('value chain perspective') in total value added generated in the EU economy, in real terms (chain-linked volumes, reference year 2010). Based on WIOD.

Second, Table 4 shows that the decomposition of the net change of the EU's global share for manufacturing value chains does not differ significantly at the aggregate level from the one obtained under the value added perspective (Table 2 in Section 5), with demand effects almost neutral and participation effects explaining the overall decline of manufacturing's weight within the EU economy.

	Real terms	Demand effects		Participation effects	
		Volume	Composition	Sectoral	Mkt. shares
C - Total Manufacturing Activities	**-1.4**	**1.3**	**-1.4**	**0.0**	**-1.3**
Lower technological content	**-1.8**	**0.1**	**-1.6**	**0.1**	**-0.5**
C10_12 - Food	-0.4	0.1	-0.7	0.0	0.1
C13_15 - Textiles	-0.7	0.1	-0.3	0.0	-0.4
C16 - Wood	-0.1	0.0	-0.1	0.0	0.0
C17 - Paper	0.0	0.0	-0.1	0.0	0.0
C18 - Printing	0.0	0.0	0.0	0.0	0.0
C19 - Petroleum	0.1	0.0	0.1	0.0	0.0
C22 - Plastics	0.0	0.0	0.0	0.0	0.0
C23 - Mineral Products	0.0	0.0	0.0	0.0	0.0
C24 - Basic Metals	0.0	0.0	0.0	0.0	0.0
C25 - Fabricated Metals	-0.1	0.0	-0.1	0.0	0.0
C31_32 - Furniture	-0.4	0.0	-0.4	0.0	-0.1
C33 - Repair	-0.1	0.0	0.0	0.0	0.0
Higher technological content	**0.4**	**1.1**	**0.2**	**-0.1**	**-0.8**
C20 - Chemicals	-0.1	0.0	-0.1	0.0	0.0
C21 - Pharma	0.3	0.1	0.2	0.0	0.1
C26 - Electronics	0.0	0.2	0.3	-0.1	-0.5
C27 - Electrical	-0.1	0.1	-0.1	0.0	-0.2
C28 - Machinery	-0.1	0.4	-0.3	0.0	-0.1
C29 - Motor Vehicles	0.2	0.3	0.0	0.0	-0.1
C30 - Transport	0.2	0.1	0.1	0.0	0.0

Table 4: Changes in the real terms (chain-linked volumes, reference year 2010) value-added share of manufacturing value chains in the EU overall economy between 2000 and 2014 based on WIOD, contributions by individual manufacturing sectors and aggregates, and by type of effect.

However, on a more disaggregated basis, a number of interesting findings arise. First, sectoral participation effects are almost negligible when using the value chain perspective because the substitution of input products does not generate in this case a redistribution of value added if they are sourced from the EU in a similar proportion. Second, the generation of value added is more concentrated on certain manufacturing value chains, translating in particular into a higher share for final demand-oriented manufacturing activities ([20]), for which demand and participation effects are hence exacerbated; for instance, the effect of a lower share of food products in the consumption basket (negative composition demand effect) was previously spread throughout all contributing manufacturing activities when using the value added perspective, while now it's concentrated within the 'C10_12 – Food' value chain. Third, final manufacturing products with higher technological content rely to a larger extent on foreign markets than value added generated in those sectors, so volume demand effects are more positive when using the value chain perspective. And fourth, the effects of shifting market shares show a very similar pattern under both approaches, suggesting that competitiveness readings do not differ substantially whether looking at value added generated in manufacturing activities or the manufacturing value chain; we find only two exceptions, 'C19 – Petroleum' (where the EU lost global participation in its sizable value chain but gained in sectoral value added), and 'C24 – Basic Metals' (the opposite case, to the detriment of the EU providing these extensively used inputs to other value chains).

Now we turn attention to the global comparison. Figure 4 shows the global share of value added generated by manufacturing value chains for different economic areas. First, we observe that trends do not differ significantly from the ones observed for manufacturing value added (Figure 2 in Sub-section 5.1), confirming the persistently declining share for the EU, US and Japan to the benefit mainly of China (and other emerging economies). However, the decrease of the EU's share is somewhat less pronounced when considering manufacturing value chains, suggesting that the EU's contribution in the form of service inputs has positively contributed to its role in global manufacturing.

([20]) Food products, motor vehicles and machinery concentrate around 50% of global value added in manufacturing value chains in contrast with a third for manufacturing value added. On the contrary, typical manufacturing inputs, such as metals, minerals or plastics have their weight halved to 10% when using the first approach.

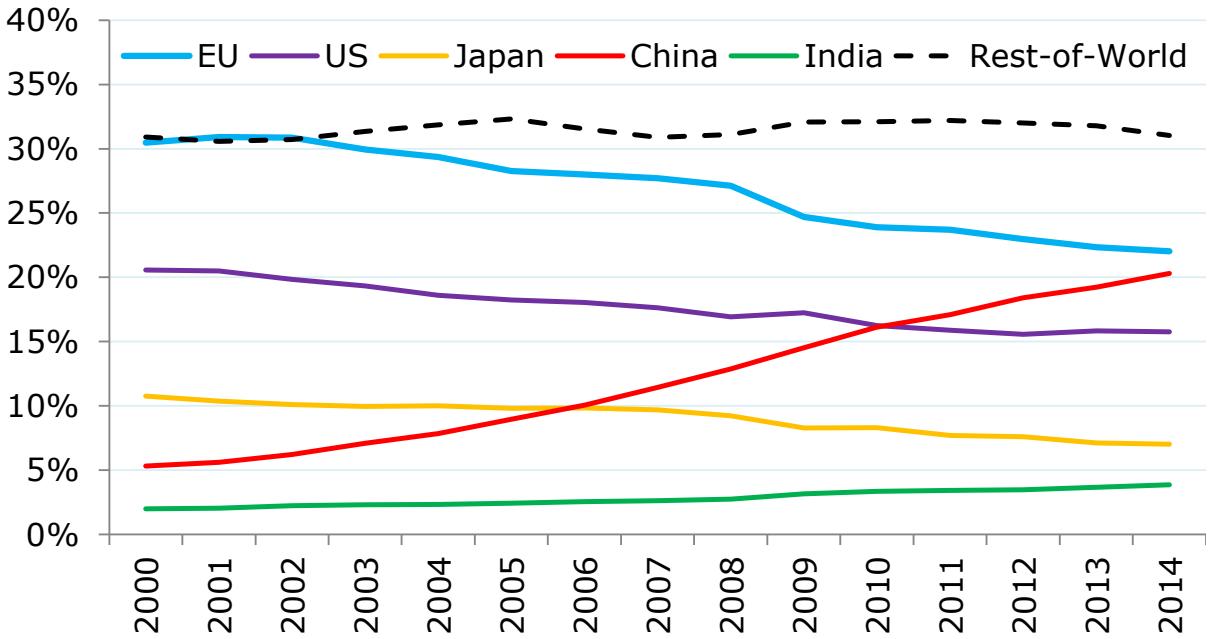

Figure 4: Share in value added generated worldwide in manufacturing value chains, in real terms (chain-linked volumes, reference year 2010). Data based on WIOD.

And second, the observable differences in the absolute level of the shares between the two perspectives give a hint on specialization patterns across economic areas. Table 5 shows a detailed decomposition of global shares for each of the economic activities contributing to manufacturing value chains. In rough outlines, India and Rest-of-World record a higher contribution to value added in manufacturing value chains due to their supply of certain services and raw materials, respectively, whereas shares for Japan, US and China were larger in manufacturing value added for their prevalent participation in downstream activities (particularly high-tech manufacturing in the two developed economies); finally, the aggregate picture does not change much for the EU, showing a slightly higher contribution under the manufacturing value chain perspective. In the following sub-section we complement this analysis with focus on trade specialization patterns between the EU and the rest of the world.

		EU	US	Japan	China	India	RoW	TOTAL
Total Economic Activities		**22.1**	**15.7**	**7.0**	**20.3**	**3.9**	**31.0**	**100.0**
Manufacturing		**22.6**	**17.1**	**9.4**	**21.8**	**3.0**	**26.1**	**100.0**
C-L	Manufacturing - Low Tech	21.9	14.6	8.3	22.3	3.8	29.0	100.0
C-H	Manufacturing - High Tech	23.2	19.5	10.6	21.4	2.1	23.3	100.0
Non-Manufacturing								
Primary Activities		**6.9**	**10.8**	**1.6**	**23.6**	**4.8**	**52.3**	**100.0**
A	Agriculture	9.9	9.0	2.9	29.2	7.9	41.1	100.0
B	Mining	4.0	12.5	0.4	18.1	1.8	63.2	100.0
Utilities		**23.0**	**8.7**	**4.5**	**19.5**	**3.5**	**40.8**	**100.0**
D	Electrictiy, Gas	18.3	7.5	4.5	21.7	4.1	43.9	100.0
E	Water, Waste	44.8	14.6	4.5	9.3	0.3	26.6	100.0
Logistic services		**24.3**	**12.2**	**5.9**	**18.3**	**6.5**	**32.8**	**100.0**
G	Trade	23.5	12.4	5.9	18.0	7.3	32.9	100.0
H	Transport	26.1	11.8	5.8	19.1	4.7	32.5	100.0
Business services		**31.6**	**20.6**	**5.9**	**14.4**	**3.4**	**24.0**	**100.0**
I	Accommodation, Food	16.7	13.1	12.3	27.5	2.8	27.7	100.0
J	Information, Communication	33.3	22.4	9.0	7.1	7.0	21.2	100.0
K	Finance	21.6	10.7	6.3	25.9	8.1	27.5	100.0
L	Real Estate	42.9	16.1	2.7	16.7	0.1	21.5	100.0
M	Professional, Technical	32.6	28.3	5.8	12.8	1.1	19.4	100.0
N	Administrative, Support	40.7	24.2	3.2	0.7	0.1	31.1	100.0
Other Activities		**32.9**	**17.1**	**5.2**	**14.5**	**4.9**	**25.3**	**100.0**
F	Construction	40.5	8.9	6.2	7.9	5.9	30.5	100.0
O	Public Administration	31.1	36.0	5.1	6.0	0.0	21.9	100.0
P	Education	49.6	8.3	3.9	11.8	1.2	25.2	100.0
Q	Health	35.9	9.7	12.9	11.2	1.4	29.0	100.0
R&S	Personal Services	21.7	12.2	3.8	29.4	9.8	23.1	100.0

Table 5: Share in value added generated worldwide in manufacturing value chains, by economic area across group and individual NACE sector. Data based on WIOD (chain-linked volumes, reference year 2010).

With respect to the contribution of the different factors to changes in global manufacturing shares, figures in Table 6 using the value chain perspective look in principle similar to those in Table 3 (based on the value added perspective), although some differences are worth highlighting. First, the dispersion in demand volume effects is less pronounced using the value chain perspective, showing developed economies with a less negative contribution due to their relative specialization in non-manufacturing upstream activities serving manufacturing value chains, whereas the opposite is observed for China. Second, demand composition effects are more intense for the EU and China; by definition the value chain perspective is a final demand approach and those components that are more manufacturing-intense are durable consumption and investment, which show a very contrasting picture between these economic areas during the sample period. Third, this same effect is found across the board for 'C13_15 – Textiles' and 'C26 – Electronics', which manufacture products that have changed substantially their weight in the consumption basket over the last years. Fourth, as explained before for the analysis on the share in total EU economy, sectoral participation effects are more moderate from a value chain perspective than when considering individual manufacturing activities or aggregates by technological content; the most remarkable example would be 'C26 – Electronics', for which its increase use as inputs in different production processes was highly beneficial in value added terms and allowed compensating other negative factors in developed economies to gain global shares.

	TOTAL (real terms)	Demand effects		Participation effects	
		Volume	Composition	Sectoral	Mkt. shares
C - Total Manufacturing Activities					
European Union	**-8.4**	-4.3	-1.8	0.0	-2.3
United States	**-4.8**	-2.1	-0.3	0.8	-3.1
Japan	**-3.7**	-1.7	0.0	0.2	-2.1
China	**15.0**	5.7	1.9	0.2	7.2
India	**1.9**	1.2	0.3	0.0	0.4
Rest-of-World	**0.1**	1.2	0.1	-1.1	0.0
Subsectors by technological content					
Lower technological content					
European Union	-5.7	-2.7	-2.2	0.2	-1.0
United States	-2.9	-1.2	-1.1	0.3	-0.9
Japan	-2.6	-1.1	-0.8	0.0	-0.8
China	5.4	2.7	0.1	0.1	2.6
India	1.2	0.9	0.2	-0.1	0.3
Rest-of-World	-1.7	0.5	-1.4	-0.6	-0.2
Higher technological content					
European Union	-2.7	-1.6	0.3	-0.2	-1.3
United States	-1.9	-0.9	0.7	0.5	-2.2
Japan	-1.1	-0.7	0.8	0.1	-1.4
China	9.6	3.0	1.8	0.1	4.6
India	0.6	0.3	0.1	0.0	0.2
Rest-of-World	1.8	0.7	1.5	-0.5	0.2
Selected manufacturing activities					
C13_15 - Textiles					
European Union	-1.3	-0.3	-0.4	0.0	-0.6
United States	-0.6	0.0	-0.1	0.0	-0.5
Japan	-0.4	0.0	-0.1	0.0	-0.3
China	1.6	0.5	-0.2	0.1	1.3
India	0.3	0.2	0.0	0.0	0.1
Rest-of-World	-0.4	0.0	-0.4	-0.1	0.1
C21 - Pharma					
European Union	0.1	-0.2	0.3	0.0	0.1
United States	-0.1	-0.1	0.1	0.0	-0.2
Japan	0.0	0.0	0.0	0.0	0.0
China	0.2	0.1	0.0	0.0	0.1
India	0.1	0.0	0.0	0.0	0.0
Rest-of-World	0.0	0.0	0.0	0.0	0.0
C26 - Electronics					
European Union	-0.4	-0.2	0.5	-0.1	-0.7
United States	-0.1	-0.1	0.4	0.2	-0.5
Japan	-0.2	-0.1	0.3	0.0	-0.5
China	2.0	0.1	0.3	0.1	1.5
India	0.0	0.0	0.0	0.0	0.0
Rest-of-World	0.7	0.1	0.7	-0.2	0.1

Table 6: Changes in the real terms (chain-linked volumes, reference year 2010) value-added share in worldwide manufacturing value chains between 2000 and 2014 based on WIOD, change for the aggregate sector, and contributions by subsectors and selected individual activities by type of effect.

And fifth, what should be considered the most relevant feature for competitiveness considerations, participation effects in the form of shifts in market shares show a worse picture using the value chain approach for the EU, and even higher gains for China, particularly in high tech manufacturing but also in the case of 'C13_15 – Textiles'. These results suggest that value added redistribution within value chains has taken place beyond manufacturing activities themselves and their associated domestic supply chains, reaching genuine competitiveness losses (gains) within non-manufacturing upstream sectors in the EU (China). On the contrary, a less negative outlook is observed for the US, which could be explained by a larger capacity to split value chain processes, retaining a larger share of the domestic supply chain and hence limiting the loss of global participation (as observed for 'C26 – Electronics').

6.1 EU trade specialization within manufacturing value chains

The analysis based on the value chain perspective presented so far corresponds to total value added generated across all participating activities serving global final demand of manufacturing products. In this sub-section we turn attention to the contribution of the different economic sectors to the value added that is traded between the EU and the Rest-of-World (ROW). In particular, we analyse the degree and evolution of EU specialization following the approach in Balassa (1965), but using the concept of Trade in Value Added (TiVA) – as described in Stehrer (2012) – instead of the standard gross exports.

The Revealed Comparative Advantage (RCA) of the EU in sector j is computed using a hyperbolic tangent transformation that allows for a symmetric index:

$$RCA_j^{EU} = tanh\left(ln \frac{\frac{VA_j^{EU \to ROW}}{\sum_j VA_j^{EU \to ROW}}}{\frac{VA_j^{EU \leftrightarrow ROW}}{\sum_j VA_j^{EU \leftrightarrow ROW}}} \right) \in [-1,1] \quad (11)$$

where VA_j_EU→ROW (VA_j_ROW→EU) accounts for EU (ROW) value added of sector j in final demand of ROW (EU).

We are particularly interested in identifying changes in specialization associated with gains or losses of competitiveness, i.e. due to shifts in country market shares for the provision of intermediate and final products. For that purpose we build TiVA time series taking only into account the impact of this factor.

The first two columns in Table 7 give an order of magnitude for the weight of NACE sections and sectoral groups participating in TiVA between the EU and ROW in 2014. Then we show for these activities the corresponding EU RCA in 2000 and 2014, as well as the change over the whole period, for which we consider both all driving factors and the restricted computation of TiVA as described above.

Besides confirming the intuition that ROW is strongly specialized in primary activities serving manufacturing value chains, the RCA analysis provides a couple of interesting highlights. First, the EU increased its degree of specialization in business services, such as ICT, professional and technical activities, or administrative and support services (NACE sections J, M and N, respectively), to a larger extent when considering only the effect of shifts in market shares. In particular, we observe that the impact on these upstream activities was lower when relocating from EU to ROW stages of manufacturing value chains that serve EU final demand instead of ROW. And second, within the manufacturing value added, the most striking result is that the degree of EU specialization in high-tech industries declined when considering all driving factors, but this does not hold for the restricted measure. EU de-specialization in this sector was then not driven by competitiveness but other factors, namely a higher value added share of high-tech products – electronics in particular – manufactured in ROW within one unit of output.

		% TiVA (2014)		EU RCA			
		EU → ROW	ROW → EU	2000	2014	2000-2014 Total change	2000-2014 Mkt. Shares effect
Total Economic Activities		**100.0**	**100.0**				
Manufacturing		**50.8**	**43.8**	**0.18**	**0.06**	**-0.12**	**-0.02**
C-L	Manufacturing - Low Tech	19.0	20.3	0.05	-0.03	-0.07	-0.07
C-H	Manufacturing - High Tech	31.8	23.5	0.28	0.12	-0.16	0.01
Non-Manufacturing							
Primary Activities		**3.1**	**21.0**	**-0.88**	**-0.86**	**0.03**	**-0.04**
A	Agriculture	1.9	5.9	-0.78	-0.59	0.19	0.04
B	Mining	1.2	15.2	-0.92	-0.95	-0.03	-0.08
Utilities		**2.7**	**3.5**	**0.02**	**-0.11**	**-0.13**	**-0.01**
D	Electrictiy, Gas	1.7	3.0	-0.09	-0.28	-0.19	-0.07
E	Water, Waste	1.0	0.5	0.26	0.26	0.00	0.14
Logistic services		**17.4**	**15.3**	**0.05**	**0.06**	**0.01**	**0.05**
G	Trade	11.7	10.3	0.03	0.05	0.03	0.06
H	Transport	5.8	5.0	0.08	0.06	-0.02	0.02
Business services		**22.7**	**14.3**	**0.14**	**0.18**	**0.04**	**0.07**
I	Accommodation, Food	0.5	0.7	-0.31	-0.13	0.18	0.05
J	Information, Communication	3.3	1.9	0.14	0.20	0.07	0.09
K	Finance	3.9	3.7	0.06	0.02	-0.04	-0.03
L	Real Estate	2.9	1.2	0.28	0.30	0.02	0.08
M	Professional, Technical	7.6	4.4	0.15	0.21	0.05	0.07
N	Administrative, Support	4.5	2.5	0.18	0.22	0.04	0.15
Other Activities		**3.3**	**2.1**	**0.07**	**0.18**	**0.11**	**0.09**
F	Construction	1.1	0.5	0.27	0.26	-0.01	0.10
O	Public Administration	0.8	0.6	-0.17	0.15	0.31	0.22
P	Education	0.5	0.2	0.35	0.35	0.00	0.08
Q	Health	0.2	0.1	-0.08	0.21	0.29	0.11
R&S	Personal Services	0.7	0.7	-0.11	-0.02	0.09	-0.07

Table 7: Trade in Value Added (TiVA) for manufacturing value chains between the EU and Rest-of-World (ROW), weight in 2014 and EU Revealed Comparative Advantage (RCA) in 2000 and 2014, by group and individual NACE sector of value added. Based on WIOD and value added in real terms (chain-linked volumes due to all factors and only to 'participation effects - market shares', reference year 2010).

6.2 EU employment in manufacturing value chains

We complement the analysis on the EU role in manufacturing value chains with the employment dimension, which has also raised concerns in the de-manufacturing debate. In particular, we follow the concept of GVC-jobs as in Timmer et al. (2013), i.e. the employment across all economic activities and geographical areas that participate throughout all stages of a manufacturing value chain.

In the first two columns of Table 8 we show for 2000 and 2014 the sectoral disaggregation of EU employment([21]) serving all manufacturing value chains. As mentioned before, we confirm the importance of non-manufacturing activities, which represent around 50% of total employment and mainly correspond to agriculture, logistic services (trade and transport), professional and technical activities, and administrative and support services.

Table 8 also provides the EU employment change between 2000 and 2014, differentiating by geographical area of final demand (EU or ROW). The middle columns consider all driving factors of EU employment, while the last two take only into account the impact of shifts in market shares, as we did for EU-ROW TiVA in the previous section.

According to our estimations, 6.3 million (or 13%) jobs serving manufacturing value chains were lost in the EU during that period. There is however a great deal of heterogeneity at a more disaggregated level. First, the net change was the result of strong job destruction within those activities participating in value chains serving EU final demand (10.4 millions), compared with a considerable gain in the case of ROW final demand (4.1 millions). And second, the reduction of EU employment was concentrated in manufacturing activities – low-tech industries in particular – and agriculture (a total of 7.3 millions), while there was in fact job creation in other economic activities, such as business services (up to 1.2 million within those serving manufacturing value chains ending in ROW).

([21]) We indistinctively refer to employment in terms of people or jobs, although the variable used from WIOD SEA corresponds to the number of persons engaged.

With respect to the role of competitiveness, we estimate that shifts in market shares explained around 15% (or 1 million jobs) of the aggregate employment loss in the EU. Similar shares are accounted for the decline in manufacturing value chains serving EU and gains for those ending in ROW. On a sectoral basis, the main exceptions are agriculture, for which positive contributions from competitiveness are compensated by other factors, and the opposite is observed for professional and technical activities, and administrative and support services.

Other factors than competitiveness played then overall a much more relevant role in shaping EU employment dynamics. First, apparent labour productivity increased significantly within agriculture, manufacturing and logistic services, being in EU markets insufficiently offset by demand growth and hence having a negative impact on sectoral employment. Second, strong economic growth in non-EU markets was the main driver of EU employment across all activities serving manufacturing value chains ending in ROW. And third, EU employment in business services benefited, on the one hand, from a general increase of sectoral participation in manufacturing value chains – ICT services in particular –, and, on the other hand, from a stagnant labour productivity in professional and technical activities, and administrative and support services.

Thousands of people	EU employment		2000-2014 employment change			
			Total effects		Mkt. Shares effect	
	2000	2014	EU final demand	ROW final demand	EU final demand	ROW final demand
Total Economic Activities	**50,084**	**43,700**	**-10,443**	**4,058**	**-1,804**	**850**
Manufacturing	26,555	21,012	-6,885	1,342	-951	226
C-L Manufacturing - Low Tech	17,438	13,285	-4,795	642	-860	252
C-H Manufacturing - High Tech	9,117	7,726	-2,090	700	-91	-26
Non-Manufacturing						
Primary Activities	6,757	4,903	-2,147	293	38	389
A Agriculture	6,393	4,651	-2,030	288	113	396
B Mining	363	252	-117	6	-75	-7
Utilities	533	570	-39	76	-6	18
D Electrictiy, Gas	288	249	-58	18	-10	4
E Water, Waste	244	321	19	58	3	15
Logistic Services	8,537	8,075	-1,386	925	-327	263
G Trade	6,214	5,846	-1,094	725	-290	254
H Transport	2,323	2,230	-293	200	-37	9
Business services	6,061	7,388	101	1,226	-511	-54
I Accommodation, Food	273	361	21	67	-10	5
J Information, Communication	634	679	-54	99	-55	-7
K Finance	750	743	-75	68	-50	-24
L Real Estate	108	116	-8	16	-4	2
M Professional, Technical	2,342	2,832	4	486	-249	-33
N Administrative, Support	1,954	2,657	214	489	-143	3
Other Activities	1,642	1,752	-87	197	-47	7
F Construction	563	640	-13	90	-16	7
O Public Administration	278	329	5	46	-4	1
P Education	275	251	-46	22	-11	1
Q Health	81	103	9	13	0	5
R&S Personal Services	444	429	-41	25	-17	-6

Table 8: EU employment in 2000 and 2014 serving manufacturing value chains, thousands of people, by group and individual NACE sector of employment. Total change and shift due to 'participation effects - market shares', by destination of final demand. Based on WIOD.

7 Conclusions

The declining contribution of manufacturing to total GDP has led to concerns among policy makers in industrialized countries due to the widely assumed importance of this sector for productivity improvements, as well as for technological and exporting capacities. There are also concerns that the declining weight of manufacturing in the EU might reflect its declining competitiveness vis-à-vis China and other emerging economies. This article has presented a comprehensive study of the trends and drivers behind the decline of the EU manufacturing sector, both with a view on its weight within the EU's total economy, and in terms of its share within global manufacturing.

In our first finding we highlight that the declining weight of manufacturing in Europe is likely exaggerated due to the use of nominal statistics. Using deflated data, we show that between 2000 and 2014 the manufacturing share of the EU economy has been almost flat, except for a slump during the crisis. In addition, dynamics have been quite heterogeneous across EU manufacturing activities. For instance, the relative cheapening of electronics accounts for half of the difference between nominal and deflated manufacturing weights, whereas its price-adjusted share shows the largest growth (in opposition to the sharp decline in the textile industry).

Second, we developed a formal decomposition analysis applied to global input-output data, by which it was possible to formalize and quantify competitiveness as 'participation in value chains', and to decompose any change of value-added as a sum of contributions from various relevant drivers. Based on this, we find that whereas lower economic growth in the EU relative to the world has been detrimental for all manufacturing sectors, shifts in demand patterns – both for intermediate and final products – have exerted a negative (positive) impact for manufacturing activities with lower (higher) technological content. Moreover, the observed loss of global market shares (mainly to the benefit of China) is interpreted as declining competitiveness of EU manufacturing. This was most acute for textiles, electronics and electrical equipment, while pharmaceuticals came out as the only industry to show resilience under external competition.

Third, in line with these overall trends, and similar to what can be observed for the US and Japan, also the share of the EU in global manufacturing value added has significantly decreased since 2000. Following the critique of the sector-based approach forwarded by Timmer et al. (2013) and Miroudot (2019), we have applied the decomposition both to the sector-based and final-demand definition of manufacturing, finding that demand effects are the main driver behind the EU's reduced global share, accounting or 62% and 73% of the total decline, respectively. It is worthwhile to note that sectoral and market share impacts are attenuated under the final-demand perspective, which is plausible under the EU's relative specialization on service inputs for manufacturing, which we uncovered in a short extension.

In Table 9 we summarize the main quantitative results obtained for the aggregate manufacturing sector of the EU, showing the decomposition into informative drivers of the 2000-2014 change under both approaches: the value added and the value chain perspectives.

2000-2014 change (percentage points)	**Value Added perspective**					**Value Chain perspective**				
	Total change	Demand effects		Participation effects		**Total change**	Demand effects		Participation effects	
		Volume	Comp.	Sectoral	Market shares		Volume	Comp.	Sectoral	Market shares
Weight in EU total economy	**-1.1**	1.0	-1.0	-0.2	-0.8	**-1.4**	1.3	-1.4	0.0	-1.3
Weight in global manufacturing	**-9.0**	-4.4	-1.2	-1.7	-1.6	**-8.4**	-4.3	-1.8	0.0	-2.3

Table 9: Summary of main quantitative results.

However, at the level of individual manufacturing sectors the picture is rather idiosyncratic. For example, one technological trend with strong repercussions in our empirical analysis is the increased importance of electronics in manufacturing value chains. Due to this pull effect ('sectoral participation' in our terminology), the EU electronics sector increased its share in the EU's total economy and it also helped to sustain the EU's global manufacturing value-added share. However, the EU did not reap the same benefits from the rise of this sector as its competitors US and Japan, because of a concomitant loss of market shares, which essentially neutralized the positive impulse. The loss of market shares becomes even more pronounced when

looking at final demand for electronics, which inflicted a loss of global value-added share for this product class upon the EU, again larger than that of US or Japan.

In view of this evidence and the sector's pivotal technological role, our results suggest that policy concerns in the EU should focus on the electronics sector. Electronics has been the most affected manufacturing activity by EU losses in global market shares. As opposed to the similarly affected textile sector, for which competitiveness losses would be a more natural trend in face of competition by low-wage emerging economies, a persistent negative trend for electronics could eventually harm innovation capacities and erode productivity growth. The latter will strongly depend on whether the competiveness losses in electronics manufacturing can been compensated elsewhere in the production chain by services with high technological content, such as scientific R&D, software development or IT services.([22])

Finally, as a caveat to our objective of presenting a rigorous analysis of the global drivers of the EU's manufacturing performance, let us recall the limitations of the current statistical approach in national accounts mentioned by Miroudot (2019), who rightfully pointed out that these imperfections also affect the WIOD input output data used in this (and in his) study. We fully subscribe to his suggestion that in view of the simplifications applied in sector classifications, the presence of bundled manufacturing with service products, the use of in-house services by manufacturing companies, and the difficulty of deriving consistent sectoral price deflators, analyses of the manufacturing share in GDP or employment should always be taken with great caution.

([22]) Galindo-Rueda and Verger (2016) update the OECD taxonomy of economic activities based on technological intensity to include services.

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Annex

Annex 1. Economic activities in WIOD, 2016 Release

NACE code	Name of economic activity
A01	Crop and animal production, hunting and related service activities
A02	Forestry and logging
A03	Fishing and aquaculture
B	Mining and quarrying
C10-C12	Manufacture of food products, beverages and tobacco products
C13-C15	Manufacture of textiles, wearing apparel and leather products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31_C32	Manufacture of furniture; other manufacturing
C33	Repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply
E36	Water collection, treatment and supply
E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
F	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Wholesale trade, except of motor vehicles and motorcycles
G47	Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I	Accommodation and food service activities
J58	Publishing activities
J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
J61	Telecommunications
J62_J63	Computer programming, consultancy and related activities; information service activities
K64	Financial service activities, except insurance and pension funding
K65	Insurance, reinsurance and pension funding, except compulsory social security
K66	Activities auxiliary to financial services and insurance activities
L68	Real estate activities
M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities
M71	Architectural and engineering activities; technical testing and analysis
M72	Scientific research and development
M73	Advertising and market research
M74_M75	Other professional, scientific and technical activities; veterinary activities
N	Administrative and support service activities
O84	Public administration and defence; compulsory social security
P85	Education
Q	Human health and social work activities
R_S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organizations and bodies

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