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# *De-* vs. *re-*industrialisation: is structural change reversible?

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**Abstract**

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**JEL Codes:** F1, L5, L6, O2, C67

**Key Words:** Industrial policy, de-industrialisation, global value chains, Input-Output analysis, WIOD

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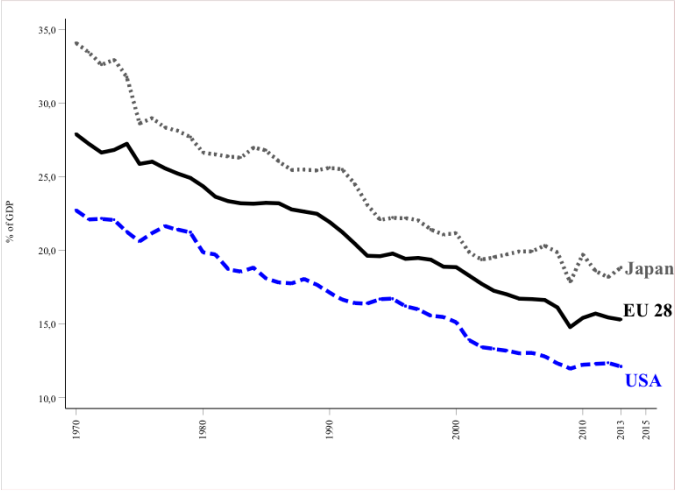
# 1 Introduction

After decades of steady decline, in the year 2013 the share of manufacturing in value added amounted to only 12% in the US and about 15% in the EU. People generally feel alarmed. Such numbers stand in sharp contrast to the higher shares in fast growing Asian economies (ca. 30% in China or South Korea) and to the higher share of manufactured goods in their own final demand (et al. 44% in the EU in 2011). Among developed economies, there is a widespread fear that *de*-industrialisation has gone too far, taking globalization and the drift of comparative advantage towards emerging countries as the main culprit.

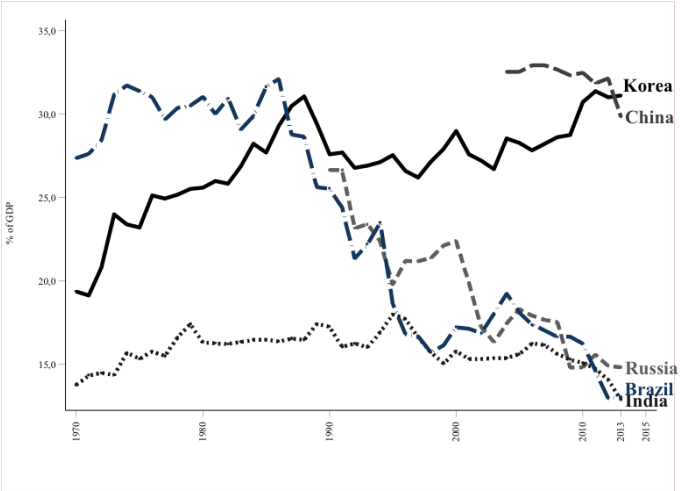
De-industrialisation in terms of relative income shares is anything but new. However, before the economic crisis the attitude was largely affirmative towards its counterpart, i.e. the vision of an increasingly intangible, service-based, and knowledge-driven economy (Peneder et al, 2003; De Backer et al 2015). Now people not only accept that manufacturing matters (Cohen and Zysman, 1987) but increasingly embrace a 'manufacturing imperative' (Rodrik, 2011; Stöllinger et al, 2013) and acknowledge the sector's particular importance, e.g. in terms of R&D expenditures, productivity growth, trade, or as carrier of embedded intermediate services. Szirmai and Verspagen (2015) empirically confirmed that the manufacturing sector is still a significant *engine of growth*, but more so for developing countries and generally less since the 1990s. At the same time, industrial policy, commonly held in disregard for long, re-emerged in academic as well as policy debates[1] and nourished the hope for an industrial renaissance (Marsh, 2012; Rifkin, 2012). On both sides of the Atlantic, policy increasingly turned to the vision of *re*-industrialisation, culminating in the European Commission's (2012) ambitious target of achieving a 20% share of manufacturing in GDP by 2020.

The ambitious policy objectives are based on an implicit assumption that structural change can be reversed by means of public intervention. But is that really the case? In search for empirical indications, Section 2 illustrates how the Input-Output system can go a long way in explaining the differences between the manufacturing share in final demand and value added. In Section 3 we take benefit of the trade linkages provided by the World Input Output Database (WIOD) and introduce new measures of so called "induced value added chains." These directly relate global demand and production to the manufacturing share in GDP, and allow us to separate the impact of domestic expenditures from those of international trade. Section 4 discusses the empirical findings. Section 5 draws our attention towards a peculiar paradoxon: Meaningful industrial policies will raise productivity growth in manufacturing relative to other sectors leading to a faster decline of relative prices. Against their stated purpose, and given at best an average elasticity of demand, they won't reverse but rather accelerate global *de*-industrialisation of income shares.

[1] Aiginger (2007), Aghion et al. (2012), Berger (2013), Cimoli et al (2015), Farla (2016), Mayerhofer (2013), O'Sullivan et al. (2013), Pianta (2014), Stiglitz et al (2013), Van Reenen (2013), or Warwick (2013).




(a) Triade




(b) BRICS

Figure 1: Long run trends of the manufacturing share

## 2 From final demand to income shares: "peeling the onion"

In a first step, we address the systematic differences between the share of manufacturing in value added, and hence the incomes people earn, as compared to its share in final demand, which more directly affects people's everyday experience in terms of what they spend. In short, the Input-Output systems records the interdependencies between production and the consumption of goods and services. Starting from the final demand for commodities, we will move all the way to value added, i.e. the income earned by a sector, in a step-by-step fashion. Not unlike the "peeling of an onion", at each step removing another layer of its "skin" explains part of the discrepancy between the commodity view and the value added view of a sector's share in the total economy. Because of the more detailed separation of supply-use tables in purchaser and producer prices, we take the total of the EU as an illustrative example.

### 2.1 The demand side

Starting from total demand, one routinely distinguishes intermediate from final uses, the difference being that intermediate goods and services are used up in the production of other goods and services. *Final demand* for goods and services, which are not used up in production, encompasses private ($CP$) and public consumption ($CG$), consumption by non-profit organizations($NPISH$), investment ($I$), inventories ($Inv$) and exports ($X$).[2] To avoid double counting of goods both produced and used in a sector, we disregard intermediate demand for the current purpose (it will return for the calculation of "induced value chains" introduced in the following section). After having peeled off intermediate demand, the WIOD data[3] show that on average manufactured products account for 44% of final demand in the EU – which is a sizable share, far above that of manufacturing in GDP, and showing a relatively modest decline of less than 1 percentage point since 1995 (Table 1).

While the consumption by private and public households as well as non-profit organisations (i.e. $CP$, $CG$ and $NPISH$) is easily identified as final demand, exports play an ambiguous role, since they can be used either for intermediate or final demand (et al. car parts *vs* finished vehicles). In addition, they reflect differences in a country's comparative advantage, which we aim to separate from the development of the demand for manufactured goods. For our purpose, it is therefore consistent also to remove exports from the analysis.[4] Looking at the new aggregate of *domestic final demand* in the EU, the manufacturing share reduces to 32%. The substantial difference to the previous aggregate reflects the higher tradability of manufactured goods, which leads to a more than proportional share of manufacturing in total exports. Moreover, after we have eliminated exports (and

[2]Investment and inventories are also linked to production but do not vanish into the new goods and services. Investment is used up, but only over time, which the depreciation rate accounts for.

[3]See Dietzenbacher et al. (2013); Timmer et al. (2015).

[4]If $X$ ends up in final demand, it will be recorded in the importing country's $CP$, $CG$, $NPISH$ or $I$.

hence the impact of comparative advantage as well as growth differentials between the domestic and foreign economies), the below average growth of domestic final demand for manufactured goods caused a marked decline of its share by three percentage points since 1995.[5]

Subtracting investment and inventories from the above domestic final demand leads us to *consumption* proper (*CP*, *CG* and *NPISH*), which arguably is the ultimate raison d'etre of the economic system. In the EU the manufacturing share now amounts to 31% of all goods and services consumed. It also exhibits a diminishing trend.

So far, the analysis has focused on the consumption of goods and services as seen from the consumers' point of view – accordingly, it has valued consumption at *purchaser prices*, i.e. the prices which are paid by the consumers. These, however, are not at all the prices that the producers of the goods and services in question receive: part of the purchaser price consists of commodity taxes (value added tax being only the most important one). With respect to commodity taxes, not all products are treated the same: public administration, for example, is typically tax-free; often, so are health and education and public transport (which, additionally to being only lightly taxed, are often subsidized as well). On the other hand, some manufactured products are taxed way beyond normal VAT rates: in many countries, petroleum products or tobacco face high tax rates, justified either on health or environmental grounds. So, whereas most manufactured products bear sizable commodity taxes, commodity subsidies are to be found largely outside manufacturing: agricultural products, mining, public transport are the products (and sectors) which are highly subsidized in many countries. More than in other sectors, this introduces a large wedge between the share of manufactured goods in total expenditures and the share of the manufacturing sector in total income (GDP).

But this has not been the final "skin" to remove. *Trade* and *transport margins* are not earned as manufacturing income but raise purchaser prices and thus the share of manufactured goods in total expenditures. While in principle applying to all sectors, the higher tradability in combination with economies of scale in production leaves a larger scope for trade and transport margins in manufacturing than the typical service sectors. Manufactured goods, when bought by a consumer, are really composite products – they consist of the good itself plus the trade and transport services used in its distribution (and with commodity taxes on top). Conversely, services are typically free of transport costs (and low in trade costs). All in all, the wedge between the price that a consumer pays, the (familiar) purchaser price, and the price that the producer receives, the producer price, is much smaller in the case of services than for manufactured products.

To get a more accurate share of manufacturing in total consumption, we need to turn to *producer prices*, which are net of commodity taxes (and subsidies) as well as trade and transport margins and thereby better recognizes the composite nature of the purchased

[5] Assuming constant relative prices and growing income during that period, this implies that the income elasticity of demand for manufacturing is less than one.

Table 1: "Peeling the onion" – EU manufacturing share in %

| | 1995 | 2000 | 2005 | 2009 | 2011 |
|---|---|---|---|---|---|
| **Demand** | | | | | |
| Share of manufactured **goods** in ... | | | | | |
| Final demand (pp) | 44.9 | 46.8 | 43.8 | 41.8 | 44.1 |
| Domestic final demand (pp) | 35.1 | 36.2 | 32.6 | 31.1 | 32.1 |
| Consumption (pp) | 34.2 | 34.6 | 31.8 | 30.9 | 31.2 |
| Consumption (bp) | 22.8 | 23.1 | 20.5 | 19.3 | 20.1 |
| Consumption w/o food (bp) | 15.6 | 16.5 | 14.6 | 13.6 | 14.5 |
| **Production** | | | | | |
| Share of manufactured **goods** in ... | | | | | |
| Gross output (bp) | 29.6 | 29.2 | 26.8 | 24.6 | 26.7 |
| Share of manufacturing **sector** in ... | | | | | |
| Gross output (bp) | 31.0 | 30.7 | 28.1 | 25.8 | 28.1 |
| Value added (bp) | 20.1 | 19.5 | 17.2 | 14.7 | 15.8 |

Note: pp = purchaser prices; bp = basic prices.
*Source:* WIOD, own calculations.

good.[6] Valued at producer prices, the share of manufactured goods in total consumption further declines to 20%.

A final observation reveals that the decline in consumption over time is to a large part due to one sector, i.e. *food and beverages* (NACE15). As a consequence, further excluding NACE15 leads to only a modest decline from a share of 15.6% in 1995 to 14.5% in 2011. In contrast, the rapidly decreasing share of the food sector in total consumption points at two likely causes. First, the income elasticity of the demand for food and beverages is generally less than one, which implies that rising incomes lead to a falling share in total expenditures. Second, there are price effects. In particular, the late 1990s witnessed falling price levels for agricultural and (to a lesser extent) food products. Despite a higher volatility, its prices have on average remained flat since the mid-2000s.

[6]The value of trade and transport margins is transferred from manufacturing to the trade and transport sectors, so that the total value itself remains unchanged.

## 2.2 The production side

*Gross ouput* is the most comprehensive measure on the production side, with the share of manufactured goods amounting to about 27% in the EU in 2011. This share is almost the same, no matter if we shift from the commodity side to the *sector perspective* of production. Discrepancies arise because any good can be produced by more than one sector – and, vice versa, any sector can (and typically does) produce more than one good. This "non-characteristic production", however, is rather low, especially when looking at the aggregates of manufacturing and services: only 5% of manufacturing's output consists of services, while the share of manufactured products in the service sectors' output is less than 2%.

But for our purpose gross output is misleading, since it again includes the value of intermediate inputs that are purchased from other firms and used up in one's own production. To avoid double-counting, only *value added* is of interest when determining the gross domestic product (GDP). Since the share of intermediate inputs contained in gross output tends to be (much) higher in manufacturing than in services, the share of the manufacturing sector in total value added further drops to about 16%.

In manufacturing, the share of value added in gross output is only around 25%, i.e. much lower than in other sectors. What is more, this share has a falling tendency, due to ongoing specialization and division of labour, both between sectors (outsourcing) and regions (offshoring). Since 1995, the value added share in manufacturing has decreased by some 3.4 percentage points (equivalent to around 10% of the share), which is about double the trend in the rest of the economy. On the one hand, this increase in input intensity implies a reduction of the direct value added effects – for every Euro of output in Europe's manufacturing sector, value added is currently only 26 cents. On the other hand, this means that increasingly other sectors profit from indirect effects, via goods and services that manufacturing buys from them. Accounting for these indirect effects, the share of those sectors that, directly or indirectly, work for the production of manufactured goods, rises to more than 20% of total value added. This is not only markedly higher than the official share of 16% of manufacturing in GDP, but it also has held up better over time.

But other sectors are not the only beneficiaries of the continuing decline of the manufacturing share in value added. Driven by above average productivity growth and intense competition, the producer (value added) prices of manufacturing tend to decline relative to the rest of the economy. From 1995 to 2009 (the latest year with reliable sectoral price data), the relative prices for manufacturing decreased by 18.7% (Table 2), which explained about half of its decline in the nominal value added share in the EU. Thus, by means of declining relative prices, most of the productivity growth in manufacturing rapidly dissipates into the consumers' rent instead of raising the nominal value added earned by the industry. The reason is, that on aggregate the larger economic impact of productivity growth in manufacturing is not the rise of nominal incomes of the producers, but the increasing purchasing power and hence the real income growth of consumers.

Table 2: Development of relative (basic) prices

| **Sector** | **Country** | **1995** | **2000** | **2005** | **2009** |
|---|---|---|---|---|---|
| *Manufacturing* | | | | | |
| | USA | 100 | 88.7 | 77.7 | 73.5 |
| | EU27 | 100 | 94.7 | 85.7 | 81.3 |
| | Japan | 100 | 94.0 | 85.6 | 78.2 |
| | South Korea | 100 | 86.9 | 76.2 | 71.0 |
| | China | 100 | 91.0 | 89.4 | 85.0 |
| | Other (mean) | 100 | 91.0 | 88.4 | 87.1 |
| *Non-manufacturing* | | | | | |
| | USA | 100 | 102.2 | 104.3 | 104.8 |
| | EU27 | 100 | 101.4 | 103.6 | 104.2 |
| | Japan | 100 | 101.7 | 104.6 | 106.5 |
| | South Korea | 100 | 106.4 | 113.7 | 119.0 |
| | China | 100 | 105.3 | 106.2 | 109.3 |
| | Other (mean) | 100 | 103.1 | 104.1 | 104.4 |

*Source:* WIOD, own calculations.

# 3 Induced value added ($IVA$)

## 3.1 Decomposition

Turning to the second step, we use the trade-linked Input-Output data from WIOD, specifically the time series of World Input-Output Tables (WIOTs), in order to separate the impact of cross-sectoral and international demand flows on an industry's share in GDP. The following basic relationship characterises the overall system:

$$\mathbf{x} = \mathbf{Lf}$$

With $s$ the number of sectors and $r$ the number of regions, $\mathbf{x}$ is the $s \times r$ vector of outputs by industry and region, $\mathbf{L} = (I - A)^{-1}$ is the $[s \times r, s \times r]$ matrix of Leontief coefficients derived from the global input-output matrix $\mathbf{A}$, and $\mathbf{f}$ is the $s \times r$ vector of final demands for the outputs of $s$ industries in $r$ regions. Premultiplying by $\hat{\mathbf{v}}$, the $s \times r$ vector of value added shares (i.e. the share of output spent on the incomes of factors labor and capital; here expressed as a diagonal matrix), we derive the $[s \times r, s \times r]$ matrix of *induced value added*:

$$\mathbf{IVA} = \hat{\mathbf{v}}\mathbf{Lf} \tag{1}$$

Tracking value added by the source and destination of countries and sectors, global value chains ($GVCs$) require a four dimensional notation (Johnson and Noguera, 2012). The individual *items* of induced value added are then given by the value added of sector $i$ produced in region $p$, which originates in the final demand of region $o$ for the output of sector $j$:

$$iva_{ij}^{po} = v_i^p l_{ij}^{po} f_j^o \tag{2}$$

Under the assumption of market clearing prices, for any sector and region the sum of value added produced must equal the sum of value added induced by final demand, i.e.

$$va_i^p = \sum_o \sum_j iva_{ij}^{po} \tag{3}$$

For the global economy this naturally aggregates to

$$va^{tot} \equiv \sum_p \sum_i va_i^p \equiv \sum_p \sum_i \sum_o \sum_j iva_{ij}^{po} \equiv iva^{tot}$$

If we assume the most simple case possible, that is a system with only two countries, domestic $d$ *vs* foreign $f$, and two sectors, manufacturing $m$ *vs* non-manufacturing $n$, Table 3 provides a complete decomposition of the global value added into its respective items of induced value added. Note that the subscripts and superscripts denote first the sector and country, where the value added is produced, followed by the sector and country of the final demand that induced it. Table 3 illustrates the difference by depicting the scalars

Table 3: Global Induced Value Added (2 countries, 2 sectors)

| | Domestic | | Foreign | | Row |
|---|---|---|---|---|---|
| | Manufacturing | Non-Manuf. | Manufacturing | Non-Manuf. | sum |
| Domestic | | | | | |
| Manufacturing | $iva^{dd}_{mm}$ | $iva^{dd}_{mn}$ | $iva^{df}_{mm}$ | $iva^{df}_{mn}$ | $va^{dg}_{mt}$ |
| Non-Manuf. | $iva^{dd}_{nm}$ | $iva^{dd}_{nn}$ | $iva^{df}_{nm}$ | $iva^{df}_{nn}$ | $va^{dg}_{nt}$ |
| Foreign | | | | | |
| Manufacturing | $iva^{fd}_{mm}$ | $iva^{fd}_{mn}$ | $iva^{ff}_{mm}$ | $iva^{ff}_{mn}$ | $va^{fg}_{mt}$ |
| Non-Manuf. | $iva^{fd}_{nm}$ | $iva^{fd}_{nn}$ | $iva^{ff}_{nm}$ | $iva^{ff}_{nn}$ | $va^{fg}_{nt}$ |
| Column sum | $iva^{gd}_{tm}$ | $iva^{gd}_{tn}$ | $iva^{gf}_{tm}$ | $iva^{gf}_{tn}$ | $iva^{tot} = va^{tot}$ |

$va$ of the value added produced in a certain sector and region as the respective row sums. Together they represent the total value added produced in either sector $t = m + n$ of the global economy $g = d + f$:

$$va^{tot} = va^{dg}_{mt} + va^{dg}_{nt} + va^{fg}_{mt} + va^{fg}_{nt} \tag{4}$$

In contrast, the scalars $iva$ are the column sums of the value added induced by the final demand for the output of a certain sector in a particular region produced in either sector $t$ of the global economy $g$. Together these represent the final demand for value added originating in either sector of the global economy:

$$iva^{tot} = iva^{gd}_{tm} + iva^{gd}_{tn} + iva^{gf}_{tm} + iva^{gf}_{tn} \tag{5}$$

The above decomposition of global value added into separate items of induced value added by country and sectors provides all the components necessary to construct the new measures. In principle, one can express each $iva$-chain by a straightforward enumeration of the individual items in Table 3. To simplify the representation, however, we will summarise specific partitions of the table over $g$ and $t$.

### 3.2 Recombination

In the developed economies, industrial policy revolves much around the fear of *de*-industrialisation and hopes for *re*-industrialisation. Empirically, both focus on the share of manufacturing in total value added, which also represents its share in nominal income. In terms of our

items of induced value added, the familiar *value added share* ($VAS$) of manufacturing corresponds to the ratio of the first line to the sum of the first and second line in Table 3:

$$\text{VAS} = \frac{\mathbf{va}^{\mathbf{dg}}_{\mathbf{mt}}}{\mathbf{va}^{\mathbf{dg}}_{\mathbf{tt}}} \tag{6}$$

Manufacturing is a disproportionately important source of demand for intermediate goods, which end up as value added in the services sectors. $VAS$ therefore underestimates the contribution of manufacturing to a country's total value added. The indirect effects are often presented as gross numbers, which do not account for the reverse effects from intermediate demand of services. Such numbers obviously overestimate the wider impact of manufacturing. Trade-linked Input-Output data allow to calculate a comprehensive net impact of indirect effects, accounting for all cross-sector and transborder flows. We call it the *manufacturing induced value added share* ($MIVAS$) of domestic final demand. It corresponds to the ratio of the first column to the sum of the first and second column in Table 3:[7]

$$\text{MIVAS} = \frac{\mathbf{iva}^{\mathbf{gd}}_{\mathbf{tm}}}{\mathbf{iva}^{\mathbf{gd}}_{\mathbf{tt}}} \tag{7}$$

MIVAS is a consistent global value chain measure to address the popular questions about indirect effects of the manufacturing sector on total value added. In this analysis, however, we are more interested in the share of manufacturing in the value added that originates in the domestic final demand for either manufactured or non-manufactured goods. The intention is to characterise the value added content of final demand by sectors, which we interpret as a final demand for value added. Summing up the first two items in the first and third line of Table 3 and then dividing it by the total of the first two columns, we define the *domestically induced value added share* ($DIVAS$) as follows:[8]

$$\text{DIVAS} = \frac{\mathbf{iva}^{\mathbf{gd}}_{\mathbf{mt}}}{\mathbf{iva}^{\mathbf{gd}}_{\mathbf{tt}}} \tag{8}$$

Fears of *de*-industrialisation hinge on the presumption that the decline of VAS reflects the erosion of comparative advantages in global competition. We therefore aim to separate

[7] In order to calculate a global measure of MIVAS, one can alternatively use the ratio of the first and third column in Table 3 to the total value added.

[8] In order to calculate a global measure of DIVAS, one can alternatively use the ratio of the first and third lines in Table 3 to the total value added.

the impact of international trade from domestic influences on the manufacturing share. Measures of *revealed comparative advantage* ($RCA$) are a natural point to start with and rely on the same pairing of one industry and country *vs* all others, as we do in our framework of two sectors and two regions. Traditional $RCA$ refers to gross trade flows, whereas we need a measure that is integrated in the global value chain ($GVC$) framework [9] and must consequently substitute gross trade by trade in value added net of re-imported value added.

The decomposition of $IVA$-items in Table 3 allows for a straightforward transformation of the familiar *Balassa index* from gross trade into the GVC approach. Balassa (1965) defined $RCA$ as an industry's share in total exports ($xs$) of a particular country relative to its share in total exports of the world (or any other reference area). Again the superscript *df* denotes the domestic country's net value added exports, which were produced at home, but absorbed by the foreign final demand. Conversely, the superscript $fd$ marks domestic net value added imports, which is equal to foreign's net value added exports. The Balassa index in terms of global value chains is then given by the following expression:

$$\mathrm{RCA}_{xs}^{gvc} = \frac{\dfrac{\mathbf{iva_{mt}^{df}}}{\mathbf{iva_{tt}^{df}}}}{\dfrac{\mathbf{iva_{mt}^{df}} + \mathbf{iva_{mt}^{fd}}}{\mathbf{iva_{tt}^{df}} + \mathbf{iva_{tt}^{fd}}}}$$

An alternative $RCA$-measure is given by the compound fraction of a country's export to import ratio ($x/m$) in one sector and the same ratio for all sectors:

$$\mathrm{RCA}_{x/m}^{gvc} = \frac{\dfrac{\mathbf{iva_{mt}^{df}}}{\mathbf{iva_{mt}^{fd}}}}{\dfrac{\mathbf{iva_{tt}^{df}}}{\mathbf{iva_{tt}^{fd}}}}$$

The two measures generally produce very similar results, with the correlation coefficient in our data amounting to 96%. But they nevertheless serve somewhat different purposes. The initial Balassa index is bound to be neutral with regard to any developments that

[9] To mention only a few pioneering contributions, Hummels et al. (2001) introduced an Input-Output based indicator of *vertical specialisation* ($VS$), calculating the value-share of imported intermediate goods that is embodied in exports. In contrast, Johnson and Noguera (2012) introduced the concept of *value-added exports* ($VAX$) by linking Input-Output to bilateral trade data. Koopman et al. (2014) presented an integrated formal framework for both approaches. In recent years, the construction of trade-linked Input-Output databases such as WIOD has prompted amajor surge of new studies. Among its first applications, Timmer et al. (2013) applied the data to construct new measures of $GVC$-income and jobs, Foster-McGregor and Stehrer (2013) provided generalized measures of vertical specialization, and Los et al. (2015) focused on the *foreign value added share* ($FVAS$) as a measure of fragmentation in production chains. For further applications, discussions and surveys of the empirical evidence, see e.g. Amador and di Mauro (2015), Baldwin and Lopez-Gonzales (2015), De Backer and Miroudot (2014), Johnson and Noguera (2014), Streicher and Stehrer (2015) or Timmer et al. (2014).

equally affect the country's overall share of total exports in world exports. Conversely, the alternative $RCA$-measure uses imports as the benchmark and is thus by definition not affected by any change in the economy's overall export to import ratio.

Originating in the analysis of gross trade flows, however, one cannot expect them to fully exploit the benefits of trade-linked Input-Output tables and their opportunity to integrate global value chains in terms of both production and final use by country and industry. In contrast, by further exploration of the above $IVA$-chains, the simple ratio of $VAS$ and $DIVAS$ provides us with an alternative measure of the direct *trade effect on value added shares* ($TEVAS$):

$$\text{TEVAS} = \frac{\text{VAS}}{\text{DIVAS}} = \frac{\frac{\mathbf{va^{dg}_{mt}}}{\mathbf{va^{dg}_{tt}}}}{\frac{\mathbf{iva^{gd}_{mt}}}{\mathbf{iva^{gd}_{tt}}}} \tag{9}$$

One can interpret the values analogously to the aforementioned $RCA$ indexes: If $TEVAS$ is equal to, above, or below one, trade has a neutral, positive, or negative impact on the domestic value added share of the sector. It also produces very similar outcomes, with the coefficient of correlation amounting to 80% for $RCA^{gvc}_{xs}$ and 81% for $RCA^{gvc}_{x/m}$. But different from them, the distinctive purpose of $TEVAS$ is to directly relate the net value added flows in trade to domestic production as induced by domestic and foreign final demand, both within and between sectors. This is arguably a more accurate measure for the purpose of our analysis, but should also render $TEVAS$ a helpful indicator for other studies of demand and supply-side drivers of structural change. Enriching the available set of indicators, it offers an additional yield on the benefits of trade-linked Input-Output data, more generally.

One particular advantage is that $TEVAS$ allows for a straightforward decomposition of changes in the value added share over time. With $\Delta$ indicating the difference between two years $t$ and $t-1$, changes of $VAS$ can be split into the following components:

$$\begin{aligned} \Delta\text{VAS}^t_{t-1} = &\Delta\text{DIVAS}^t_{t-1} \times \text{TEVAS}_{t-1} \\ &+ \Delta\text{TEVAS}^t_{t-1} \times \text{DIVAS}_{t-1} \\ &+ \Delta\text{DIVAS}^t_{t-1} \times \Delta\text{TEVAS}^t_{t-1} \end{aligned} \tag{10}$$

The first term denotes the impact of shifts in the shares of expenditures of domestic final demand for value added of a particular industry and the second term the impact of changes in the trade effect. The third term is a residual interaction effect, which is positive when $DIVAS$ and $TEVAS$ move in the same direction, and negative otherwise.

# 4 Empirical findings

Calculating the above $IVA$-chains for the available data from WIOD, Table 4 summarizes the results for selected years and countries. For a brief illustration, we stick with the example of the EU27. In 2011 manufacturing accounted for 28.1% of gross output by products and 26.7% of gross output by sectors. Subtracting the use of intermediate goods, the value added share of manufacturing $VAS$ amounted to 15.8%. Reallocating the value added of intermediate goods to the sector, where the final demand originates, $MIVAS$, i.e. the share of value added induced by final demand for manufacturing, amounted to 22.1%. Consistent with the above-average demand of manufacturing for intermediate goods from other sectors, $MIVAS$ is larger than $VAS$. The decline of $MIVAS$ tends to be lower than that of $VAS$, confirming that part of *de*-industrialisation as observed in official statistics reflects the increased outsourcing of activities to specialized suppliers.

In 2011 $DIVAS$, i.e. the share of manufacturing in the global value added that was induced by the domestic final demand, amounted to a mere 15.3% after 19.5% in 1995. In both years, $DIVAS$ was slightly smaller than $VAS$. The difference is due to a small but positive trade effect identified by $TEVAS$, which contributed an additional 3.2% in 1995 and 3.3% in 2011 to the share of manufacturing in the value added induced by domestic final demand. In other words, if the impact of global trade had been neutral, the value added share of manufacturing in the EU would have been lower by about half a percentage point.

Within the EU, the trade effects had been very diverse. $TEVAS$ was lowest in countries like Greece, Cyprus, or Bulgaria, and strongest in Germany, Ireland, or Finland. In the US $TEVAS$ was below one. But the negative trade effect slowly improved from -1.6% in 1995 to -0.5% in 2011. In Japan and South Korea, the high and increasing positive trade effects reveal growing comparative advantages of manufacturing in value added terms. Though China turned from a negative to a positive trade effect, it appears still moderate in value added terms, reflecting the country's strong demand for imported intermediate goods. For many other emerging economies and the residual 'rest of the world' the trade effect is consistently negative.

As a final step, we decompose the changes in the value added shares of manufacturing into the respective impacts of changes in the domestic demand for manufacturing value added and the changes in comparative advantage as measured by the trade effect. Table 5 summarizes the findings for the WIOD data for the period 1995 to 2011. The first column shows the change of value added shares in percentage points, the other columns its decomposition into the three components of equation 12. The findings are largely at odds with the popular perception of globalization and relocation to be the main cause of *de*-industrialisation. With one exception, all countries experienced a decline in the value added share of manufacturing. On average the decline was -3.25 percentage points.[10] By far the

[10] This is if we take the EU27 as a total.

Table 4: IVA-chain indicators for manufacturing in %

| **Country** | **VAS** | | **MIVAS** | | **DIVAS** | | **TEVAS** | |
|---|---|---|---|---|---|---|---|---|
| | 1995 | 2011 | 1995 | 2011 | 1995 | 2011 | 1995 | 2011 |
| *Triade* | | | | | | | | |
| USA | 15.5 | 12.3 | 17.2 | 13.9 | 15.8 | 12.3 | 98.4 | 99.5 |
| Japan | 22.6 | 18.6 | 21.2 | 17.7 | 21.3 | 16.3 | 106.3 | 114.1 |
| EU27 | 20.1 | 15.8 | 25.3 | 22.1 | 19.5 | 15.3 | 103.2 | 103.3 |
| Germany | 22.6 | 22.4 | 27.1 | 29.4 | 20.9 | 19.7 | 108.5 | 113.8 |
| France | 14.2 | 10.1 | 20.5 | 18.9 | 14.5 | 11.2 | 98.3 | 90.0 |
| United Kingdom | 20.9 | 11.7 | 24.0 | 14.3 | 20.9 | 12.5 | 100.1 | 93.7 |
| Italy | 22.2 | 16.6 | 29.5 | 24.0 | 21.6 | 15.6 | 102.9 | 106.4 |
| Spain | 19.2 | 13.2 | 24.3 | 17.7 | 19.5 | 13.1 | 98.5 | 101.3 |
| Poland | 21.1 | 18.1 | 26.8 | 27.3 | 21.0 | 18.9 | 100.7 | 95.5 |
| Romania | 25.6 | 23.6 | 33.4 | 25.9 | 26.0 | 24.7 | 98.3 | 95.7 |
| *BRICS* | | | | | | | | |
| Bresil | 18.6 | 15.2 | 24.3 | 22.8 | 18.3 | 15.5 | 101.9 | 98.1 |
| Russia | 17.4 | 16.3 | 21.0 | 19.5 | 18.6 | 18.0 | 93.7 | 90.2 |
| India | 18.5 | 14.6 | 33.7 | 27.5 | 19.2 | 17.0 | 96.6 | 85.8 |
| China | 34.8 | 32.8 | 38.7 | 33.1 | 35.3 | 31.3 | 98.5 | 105.0 |
| South Korea | 27.2 | 31.1 | 29.9 | 29.2 | 26.0 | 24.5 | 104.5 | 126.9 |
| *Other* | | | | | | | | |
| Australia | 14.6 | 8.5 | 16.2 | 11.2 | 16.5 | 10.7 | 88.6 | 79.7 |
| Canada | 18.4 | 16.7 | 22.9 | 20.8 | 18.2 | 17.7 | 100.6 | 94.6 |
| Indonesia | 29.5 | 22.7 | 35.7 | 27.5 | 30.4 | 23.4 | 96.9 | 97.0 |
| Mexico | 19.9 | 17.6 | 34.5 | 29.4 | 23.3 | 20.8 | 85.2 | 84.8 |
| Taiwan | 26.5 | 23.0 | 33.8 | 24.4 | 26.1 | 16.2 | 101.6 | 141.6 |
| Turkey | 29.3 | 18.4 | 36.0 | 28.2 | 29.4 | 19.0 | 99.7 | 97.0 |
| RoW* | 17.4 | 14.5 | 25.1 | 19.3 | 19.8 | 16.4 | 88.1 | 88.2 |

* RoW = Rest of the World

*Source:* WIOD, own calculations.

strongest force is the decline of $DIVAS$. In every country of our sample, manufacturing captured a lower share in the final demand for value added in 2011 than it did in 1995. This measure is not affected by the foreign trade position. The net impact of exports, imports or foreign direct investments on the actual value added produced in a country is comprehensively measured in TEVAS, since it is simply captures the difference between a country's demand for and production of manufacturing value added.

Investigating the patterns for individual countries, South Korea was the only large economy able to resist the global trends and increase its value added share by almost 4 percentage points. But this number still underestimates its rise in comparative advantage. Consistent with its growing per capita income and general patterns of productivity growth, the decline in DIVAS has depressed the manufacturing value added share by -1.6 percentage points. If it depended only on the trade effect, South Korea's manufacturing value added share had grown by almost 6 percentage points.

China is the second major economy, which we generally associate with a rapidly growing production base in manufacturing. The trade effect is indeed positive. On its own, it would have raised the manufacturing value added share by 2.3 percentage points. However, the fast growing per capita income has also lead to a marked decline in the contribution from DIVAS, amounting to -4.01 percentage points, and causing the value added share to shrink by about 2 percentage points. A similar pattern applies to Taiwan.

Among the *Triade*, Japan enjoyed a pronounced positive contribution from the trade effect, whereas in both the USA and the EU27 comparative advantages as measured by TEVAS appear to have been very stable with almost negligible but positive impacts on the manufacturing value added share. All three areas, however, show a pronounced negative impact of changes in DIVAS.

Among larger economies within the European Union, Germany is the only country which prevented a marked decline in the manufacturing value added share. The trade effect contributed positively, but the scope of its increase in comparative advantage remains modest in comparison to the aforementioned Asian economies. The more distinctive feature is its low decline in the share of domestic expenditures on final demand for manufacturing value added. This is mainly due to the lower decrease of relative prices in German manufacturing, which from 1995 to 2009 amounted to a modest -3.4% (as compared e.g. to -27.6% in France or -25.1% in the UK). Assuming that the methods of price deflation must be well harmonized within the European Union, this indicates a huge pay-off to Germany's specialization in less price-sensitive, quality-driven segments of manufacturing production, probably together with a comparatively high intensity of competition in its services sectors.

Table 5: Decomposition of changes (1995 to 2011)

| **Country** | **VAS** | **DIVAS** | **TEVAS** | **Interaction** |
|---|---|---|---|---|
| | *Change/contribution (in %age points)* | | | |
| *Triade* | | | | |
| USA | -3.25 | -3.39 | 0.18 | -0.04 |
| Japan | -3.99 | -5.27 | 1.66 | -0.39 |
| EU27 | -4.24 | -4.26 | 0.03 | -0.01 |
| Germany | -0.23 | -1.27 | 1.11 | -0.06 |
| France | -4.12 | -3.19 | -1.20 | 0.27 |
| United Kingdom | -9.24 | -8.44 | -1.34 | 0.54 |
| Italy | -5.65 | -6.19 | 0.75 | -0.21 |
| Spain | -5.97 | -6.33 | 0.55 | -0.18 |
| Poland | -3.04 | -2.04 | -1.11 | 0.11 |
| Romania | -1.95 | -1.31 | -0.68 | 0.03 |
| *BRICS* | | | | |
| Bresil | -3.41 | -2.82 | -0.70 | 0.11 |
| Russia | -1.15 | -0.54 | -0.63 | 0.02 |
| India | -3.97 | -2.15 | -2.06 | 0.24 |
| China | -1.96 | -4.01 | 2.32 | -0.27 |
| South Korea | 3.88 | -1.61 | 5.38 | -0.34 |
| *Other* | | | | |
| Australia | -6.07 | -5.12 | -1.47 | 0.52 |
| Canada | -1.61 | -0.55 | -1.10 | 0.03 |
| Indonesia | -6.83 | -6.85 | 0.03 | -0.01 |
| Mexico | -2.26 | -2.18 | -0.09 | 0.01 |
| Taiwan | -3.52 | -10.02 | 10.46 | -3.95 |
| Turkey | -10.85 | -10.34 | -0.80 | 0.28 |
| RoW* | -2.91 | -2.93 | 0.03 | 0.00 |

* RoW = Rest of the World
*Source:* WIOD, own calculations.

# 5 Summary and conclusions

Developed economies are increasingly concerned about the declining share of manufacturing in national income. Most people indict globalization and the assumed drift of comparative advantage from high-income countries towards emerging economies to be its major cause. But comparative advantage is not a natural given. For complex, modern production, it is constantly shaped by institutions and policies which affect e.g. the relative abundance of labour skills, the strength of innovation systems, or the quality of supportive infrastructures (Peneder, 2016). To the extent that *de*-industrialisation is driven by a loss of comparative advantage, it can in principle be reversed by appropriate action. This rationale lies at the heart of the current renaissance of industrial policy and its ambitious objectives of *re*-industrialisation.

We aimed to scrutinize the underlying assumption and determine the extent to which trade effects and hence comparative (dis)advantages are responsible for differences in the value added share of manufacturing. To begin with, a sector's value added share is embedded in a wider assortment of aggregates from demand and production. Using the trade-linked international Input-Output data from WIOD, we first investigated the various quantities involved, starting from final demand for commodities and going all the way down to the value added earned within the sector. Huge differences become apparent. For example, in the EU27 the manufacturing share in final demand at purchaser prices amounted to 44.1% in 2011. After setting aside investment and exports, where manufacturing is particularly important, its share in consumption at purchaser prices reduced to 31.2%. This number reflects the expenditures of domestic consumption on manufactured goods by private and public households (incl. non-profit institutions serving households). For what goes to producers, we turn to basic prices, i.e peel off commodity taxes and margins for retail or transport. Now the manufacturing share further reduced to 20.1%, after 22.8% in 1995. More than half of that decline occurred in the food sector alone.

In a second step, we have introduced new measures of 'induced value added' (*IVA*) chains, which take account of intersectoral and cross-border demand flows in order to disentangle the impact of domestic expenditures from trade effects. The decomposition of the newly formed *IVA*-chain measures reveals that from 1995 to 2011 in all the countries covered by the WIOD database a uniform decline in the share of the domestic demand for manufacturing value added had a strong negative impact on the manufacturing value added share. In contrast, shifts in comparative advantage account for heterogenous trade effects on the changes in the manufacturing value added share. Consistent with popular perception, only the Asian countries Taiwan, South Korea, China and Japan show a pronounced rise in comparative advantage as revealed by increasingly positive trade effects. But South Korea is the only country, where the trade effect outweighed the negative demand effect and caused the value added share of manufacturing to grow. Different from popular perception, both the US and EU27 have successfully maintained their comparative advantage at least up to the year 2011. Their marked decline of the manufacturing value

added share is fully explained by their decrease of domestic expenditures on manufacturing value added. It is the remaining developing and emerging economies which mostly suffered a decline in comparative advantage of their manufacturing production.

To conclude, our findings cast serious doubt on the possibility to reverse *de*-industrialisation. The overwhelming part of the decline in value added shares is mirrored by an according decline in the domestic expenditures on manufacturing value added, which leaves a comparatively minor fraction to be regained by trade effects. One reason is the below average income elasticity of demand for manufactured goods. Neither would we desire policy to interfere, nor expect it to have much leverage. Another reason is the higher growth of productivity in manufacturing. Given intense competition, it leads to lower prices relative to other sectors and the gains dissipate rapidly from nominal producer incomes to consumer rents. Again, we would not want policy to hamper that process, since it is ultimately to the benefit of consumers' real incomes. The major causes for *de*-industrialisation are thus outside the reach of meaningful policy interventions.

However, our findings also confirm substantial heterogeneity of trade effects between countries, which suggests that policies matter. Besides the continuous strive for higher efficiency in the manufacturing operations, the obvious consequence for individual countries and regions is to aim for product differentiation and high-quality segments of the markets, thereby raising the capacity to earn temporary 'Schumpeterian' rents from innovation. Thinking in specific tasks rather than broad sectors, these objectives typically associate with a rising service content in manufacturing production, which is due to the particular importance of R&D, design, legal protection of IPRs, tailor-made customer services, etc.. Depending on the nature and size of markets, these can either increase their share among activities within the manufacturing firm, or increasingly be outsourced to specialised suppliers. In the global value chain perspective, however, the important point is that these activities raise productivity and hence the incomes earned either in the manufacturing or related sectors, whereas competition will maintain the increase of purchasing power, and hence real income, to the benefit of consumers.

But there is a string attached: Exactly if national industrial policies are successful and raise productivity growth of manufacturing, their combined effort will further foster its global decline of relative prices. Paradoxically, and contrary to the stated objective of *re*-industrialisation, successful industrial policies will accelerate de-industrialisation. If the overall priority was to raise the income share of manufacturing, policies must target e.g. the productivity growth of services.

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