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

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Abstract

We introduce new measures of 'induced value added chains' to investigate the causes of *de*-industrialization and potential for *re*-industrialization. Using WIOD data, the relative decline of prices and domestic expenditures on manufacturing value added turns out to be the main driver of *de*-industrialization. International trade has a limited impact, though differences in comparative advantage between countries matter. Paradoxically, if national policies raise productivity growth of manufacturing, they also foster its global decline of relative prices. Contrary to the objective of *re*-industrialisation, they accelerate *de*-industrialisation. To raise the income share of manufacturing, policies must target e.g. productivity growth of services.

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

Key Words: Industrial policy, de-industrialization, global value chains, input-output analysis, WIOD

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1 Introduction

After decades of steady decline, in 2011 the share of manufacturing in value added was only 15.8% in the EU and 12.3% in the US. These numbers contrast with the much higher shares of manufactured goods in final demand of about 44% in the EU and ??% in the US), as well as the value added shares in fast growing Asian economies such as 33% in China or 31% in South Korea. People generally feel alarmed about the numbers and perceive globalization and the gradual drift of comparative advantages towards emerging countries to be the main culprit. Among developed economies, there is a widespread fear that *de*-industrialisation has gone too far.

De-industrialisation 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.[1] Now, people not only accept that manufacturing matters,[2] but increasingly embrace a 'manufacturing imperative'[3] acknowledging the sector's particular importance e.g. in terms of R&D expenditures, productivity growth, trade, or as carrier of embedded intermediate services. Industrial policy, commonly held in disregard for long, re-emerged in academic as well as policy debates[4] and nourished the hope for an industrial renaissance.[5] 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 aim to take full benefit of the international linkages provided by the World Input Output Database (WIOD)[6] 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. The concluding Section 5 draws our attention towards a peculiar paradoxon: Meaningful industrial policies will raise productivity growth in manufacturing relative to other sectors. Against their stated purpose, they will therefore not reverse but further accelerate de-industrialisation in terms of a declining income share of manufacturing.

[1] Peneder et al (2003).

[2] Cohen and Zysman (1987)

[3] Rodrik (2011); Stoellinger et al (2013)

[4] Aiginger (2007); Aghion et al. (2012); Berger (2013); Mayerhofer (2013); O'Sullivan et al. (2013); Stiglitz et al (2013); Van Reenen (2013); Veugelers (2013) or Warwick (2013)

[5] Marsh (2012); Reiner (2012); Rifkin (2012); European Commission (2013)

[6] See Timmer et al (2014a,b) for a detailed documentation and application of WIOD.

2 Manufacturing shares: "peeling the onion"

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).[7] To avoid double counting of goods both produced and used in a sector, we disregard intermediate demand for the current purpose (but it will prominently return for the calculation of "induced value chains" introduced in the following section). After having peeled off intermediate demand, the WIOD data show that on average manufactured products account for 44% of final demand in the EU and 40% among Non-EU-countries – which is a sizable share, and far above that of manufacturing in GDP (Table 1, Figure 1 in the Annex).

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 (e.g., car parts *vs* finished vehicles). For our purpose, it is therefore consistent also to remove exports from the analysis.[8] Looking at the new aggregate of *domestic final demand* in the EU, the manufacturing share reduces to 32%. The substantial decrease reflects the higher tradability of manufactured goods, which leads to a more than proportional share of manufacturing in total exports.

In the next step, 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 any 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*,

[7] 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.

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

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 good.[9] 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

[9]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.

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

Variable	**Years**				
	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.

have, however, on average remained flat since the mid-2000s.

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 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 "atypical production", however, is rather low, especially when looking at the aggregates of manufacturing and services: only 5% of manufacturing's output consists of services, and the share of manufactured products in the service sectors' output is even lower, at less than 2%.

But 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%.[10]

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 and regions (outsourcing). 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, through the rise of real incomes, most of the productivity growth in manufacturing rapidly dissipates into the consumers' rent.

3 Induced value added chains (*IVAs*)

We use WIOD to separate the impact of cross-sectoral and international demand flows on an industry's share in GDP. If VA_i^k is the *value added* of sector i in country k, it is comprised of items of *induced value added* IVA_{ij}^{kl} which originate in the final demand for sector j in country l:

$$VA_i^k \equiv \sum_l \sum_j IVA_{ij}^{kl}. \tag{1}$$

For the global economy, the sum of value added produced must equal the sum of value added induced by final demand, i.e.

[10] The share is almost identical if we use the unweighted mean of EU member states instead of the EU total aggregate.

Table 2: Development of relative prices (bp)

Sector	Countries	Years			
		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.

$$\sum_k \sum_i VA_i^k \equiv \sum_k \sum_i \sum_l \sum_j IVA_{ij}^{kl}. \tag{2}$$

If we further assume the most simple case possible, i.e. a system with only two countries (domestic d *vs* foreign f) and two sectors (manufacturing m *vs* non-manufacturing n), the following vector equation provides a complete decomposition of the global value added into its respective items of induced value added, which we will later recombine into different *IVA-chains*:

$$\begin{pmatrix} VA_m^d \\ VA_n^d \\ VA_m^f \\ VA_n^f \end{pmatrix} = \begin{pmatrix} IVA_{mm}^{dd} & +IVA_{mn}^{dd} & +IVA_{mm}^{df} & +IVA_{mn}^{df} \\ IVA_{nm}^{dd} & +IVA_{nn}^{dd} & +IVA_{nm}^{df} & +IVA_{nn}^{df} \\ IVA_{mm}^{fd} & +IVA_{mn}^{fd} & +IVA_{mm}^{ff} & +IVA_{mn}^{ff} \\ IVA_{nm}^{fd} & +IVA_{nn}^{fd} & +IVA_{nm}^{ff} & +IVA_{nn}^{ff} \end{pmatrix} \tag{3}$$

In the developed countries, industrial policy revolves much around the fear of de-industrialization and hopes for *re*-industrialisation. Empirically, both focus on the share of manufacturing in total value added. Value added can be induced by global final demand ($G = d + f$) for any of the sectors in the total economy ($T = m + n$). For a convenient benchmark and directly addressing the income share of a sector, equation (3) defines the familiar *value added share* (VAS) of manufacturing in any particular country as a composite of the following items of induced value added ($IVAs$):

$$VAS_{mT}^{dG} = \frac{IVA_{mm}^{dd}+IVA_{mn}^{dd}+IVA_{mm}^{df}+IVA_{mn}^{df}}{IVA_{mm}^{dd}+IVA_{mn}^{dd}+IVA_{mm}^{df}+IVA_{mn}^{df}+IVA_{nm}^{dd}+IVA_{nn}^{dd}+IVA_{nm}^{df}+IVA_{nn}^{df}} \tag{4}$$

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 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. WIOD allows to calculate a comprehensive net impact of indirect effects, accounting for all cross-sector and transborder flows, which we call the *manufacturing induced value added share* ($MIVAS$) of domestic final demand:

$$MIVAS_{Tm}^{Gd} = \frac{IVA_{mm}^{dd}+IVA_{nm}^{dd}+IVA_{mm}^{fd}+IVA_{nm}^{fd}}{IVA_{mm}^{dd}+IVA_{mn}^{dd}+IVA_{nm}^{dd}+IVA_{nn}^{dd}+IVA_{mm}^{fd}+IVA_{mn}^{fd}+IVA_{nm}^{fd}+IVA_{nn}^{fd}} \tag{5}$$

Next, we are interested in the share of manufacturing in the value added which originates in the domestic final demand but can be produced either domestically or abroad, and which we depict the *domestically induced value added share* ($DIVAS$):

$$DIVAS_{mT}^{Gd} = \frac{IVA_{mm}^{dd}+IVA_{mn}^{dd}+IVA_{mm}^{fd}+IVA_{mn}^{fd}}{IVA_{mm}^{dd}+IVA_{mn}^{dd}+IVA_{nm}^{dd}+IVA_{nn}^{dd}+IVA_{mm}^{fd}+IVA_{mn}^{fd}+IVA_{nm}^{fd}+IVA_{nn}^{fd}} \quad (6)$$

Fears of *de*-industrialisation hinge on the presumption that the decline of VAS reflects the erosion of comparative advantages in global competition. In a final step, the ratio of equations (4) and (6) provides us with the direct *trade effect on value added shares* ($TEVAS$):

$$TEVAS = \frac{VAS}{DIVAS} \quad (7)$$

We like to interpret $TEVAS$ as an alternative indicator of *revealed comparative advantage* (RCA): If it is equal to (above/below) one, trade has a neutral (positive/negative) impact on the domestic value added share of a sector. Different from traditional trade based measures of RCA, $TEVAS$ focuses on the value added content instead of gross flows in trade. It shares this property with other modern global value chain based measures as recently applied to the new trade-linked international input-output tables.[11] But different from them, $TEVAS$ aims to more directly relate the net value added flows in trade to domestic production as induced by domestic and foreign demand, both within and between sectors. We thus believe that it is not only indispensible for our current purpose, but a helpful tool for the study of structural change, more generally.

Calculating of the above IVA-chains for the available data from WIOD, Table 3 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.

[11] See, e.g. Foster-McGregor and Stehrer, 2013)

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 negative, but 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 and investment goods. For many other emerging economies and the residual 'rest of the world' $TEVAS$ is consistently negative.

4 Summary and conclusions

The developed economies face a growing concern about the declining shares of manufacturing in national income. Globalization and the assumed drift of comparative advantage from high-income countries towards emerging economies are indicted to be the major cause of *de*-industrialization. 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. To the extent that *de*-industrialization 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*-industrialization.

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 investigate 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

Table 3: IVA-chain indicators for manufacturing in selected countries in %

Indicator	**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.

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. Reflecting a low income elasticity of demand, more than half of that decline occurred in the food sector alone.

In the second step, we have developed and 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. In short, our findings cast serious doubt on the possibility to reverse *de*-industrialization. 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*-industrialization 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. 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. productivity growth of services.

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