Trade, global outsourcing and (de)industrialisation, 1995-2019 Volume I: Stylised facts and employment dynamics

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Abstract: This volume is the first part of a two-volumes background paper prepared from the perspective of a wider research project on deindustrialisation. It aims at contributing to the empirical analysis of manufacturing industries in the course of economic maturing, searching for the salient features that accompanied the most recent wave of globalisation. In particular, we search for tipping points in industrial output and employment, with a special attention to the role of trade and outsourcing in an international context. In addition, we contribute also to the literature on truncated industrialisation and premature deindustrialisation in developing countries. Our findings highlight three stylised facts: deindustrialisation is structural but uneven across regions; its gendered impacts are significant; and outsourcing alters the composition of industrial output and labour without halting their overall relative decline. Heterogeneity dominates at regional level; the process is global in its drivers yet local in its manifestations. An implication of the "global village" created by hyper-globalisation is that, for many aspects except employment, the industrial economy functions like a world–wide closed economy. With two implications in terms of deindustrialisation: creative destruction may not happen anymore in the same national territory; the old issue of effective demand may return as a limiting factor, squeezed as it is between amazing productivity improvement and a demand for manufactured goods that remains largely constrained. This volume identifies stylised facts and patterns at aggregate and sectoral production and employment levels; it is completed by a second volume that looks inside the production process itself and its sub–systems.

Key words: industrialisation, global manufacturing, employment, input-output analysis, tertiarization and servicification, regional integration

JEL codes: O14, L60, F14, C67, F16, J16, O47

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1. General Introduction to Volumes I & II

This is the first part of a two-volumes background paper prepared from the perspective of a wider research project on deindustrialisation. The aim is to draw a reference map of global deindustrialisation, adopting a general–to–specific approach, starting from the global perspective before drilling down to sectoral aspects at country level.

Our approach is empirical and data-driven, but no statistical research can take place without some theoretical references. Most of those used here define deindustrialisation as a relative decline in manufacturing employment (Kollmeyer, 2009). From a long-term perspective, labour is expected to reallocate from agriculture (primary sector) to manufacturing (secondary sector), then to services (tertiary sector). According to the three-sector hypothesis, the sectoral shift is mainly driven by differences in income elasticity of demand in the course of development and in labour productivity per sector.

The definition focusing simply on employment is not universally accepted. Other analytical characterisations consider additional factors, such as a time frame for structural change, include absolute and relative contractions of industrial production or consider the international context (Przywara, 2019). In this hybrid approach, trade and time frame are closely related. The structural transitions governing the rise and fall of industrialisation were relatively slow in the past. Due to high trade costs and limited international competition, national economies could develop in a relatively independent manner up to the mid-1950s.[1]

International trade and the rise of large multinational enterprises in the 1970s modified many of the hypothesis underlying previous structural models. With the post-1995 hyper-globalisation era, the time frame in which structural changes took place was dramatically compressed. The rise of global production networks modified the conditions under which industrial development could take place. On the one hand, the cross-border diffusion of labour-saving technical progress and process innovations lowers the demand for manufacturing labour; on the other hand, lower trade costs increase the availability of cheaper and/or better inputs while putting pressure on the gross profit margin of producers.

Building on the premises of this hybrid theoretical perspective, the present background paper looks into both the production (supply), consumption (demand) and employment aspects from an open economy perspective. It explicitly takes into consideration the international context in both its macro- and microeconomic dimensions.

We don't pretend to offer a new definition of deindustrialisation in this essay. Actually, we even conclude that it is at best an elusive concept. Our preferred approach, formalised in Vol. II, derives from our interpretation of today's calls for re-industrialisation: "to keep on — or to restart — producing the strategic manufacturing products that are in critical demand". Our preferred deindustrialisation indicator compares actual production to effective demand in order to diagnose if a decline in production is normal or if it sends a worrying signal. Not that the issue of manufacturing employment is a minor one, but its decline is probably better analysed in today's wave of robotisation and labour–saving technological progress.

[1] The invention of modern standardised shipping containers by M. McLean in 1956 is widely recognised as the starting point of modern international trade. Another important date was the conclusion of the Uruguay round of trade negotiations in 1994, leading to the creation of the World Trade Organization in 1995 and China's WTO admission in 2001.

The first volume (this document) is devoted to the macroeconomic perspective; it relies on comparative statistical analysis to identify stylised facts characterising (de)industrialisation during the post-1995 period. It explicitly searches for specific patterns in production and employment related to the "hyper-globalisation" sub-period (1995-2007) and the "new normal" years that followed the global financial crisis of 2008-2009. The institutional security provided by a reinforced multilateral governance at regional or international level up to 2019 meant also that investors were less shy of offshoring: the creative destruction could take place in different countries, a form of "Schumpeterian Unbundling"[2]. It accelerated deindustrialisation in some places while creating new competitive manufacturing capacities in others. Volume I concludes with a closer analysis of (de)industrialisation and employment, differentiating whenever possible between male and female employees.

The second volume (published simultaneously with this one) adopts a more micro-economic and builds on the disaggregated supply-demand information provided at sectoral level by input-output tables. The data provide a more granular idea of the structural changes that occurred during the period. In this second part, we focus primarily on changes occurring in the industrial production functions and their implications for employment. These modifications are reflected in the use of material inputs and labour, under the influence of technological progress, international trade and new business models privileging the domestic and international outsourcing of non-core activities.

A closer look at the evolution of demand completes the macro-perspective and the input-output analysis. We conclude the second volume with a list of countries and sectors at risk of deindustrialisation. The analysis is conducted on a sample of 76 countries, covering both developed and developing countries in several regions of the World. The study stops in 2019, before the COVID-19 pandemic that disrupted the World economy.

This background document moves from general to more specific points, without claiming to cover all relevant aspects. Our starting point, as well as our ambition, was to make use of the rich statistical information provided by international input–output tables. Some missing topics — such as human, natural, and physical capital endowments, or macroeconomic preparedness and business climate — could also have helped shedding light on the evolution of (de)industrialisation patterns.

For reference, Table 1 presents the contents of the two volumes that constitute the working paper.

Table 1 Table of contents of Volume I and II

General Introduction and Volume I	Volume II and General Conclusions
1. General Introduction to Volumes I & II 2. Literature Review 3. Motivation, Premises and Methodological Orientation **Volume I** 1. Structural Changes in Global Manufacturing 2. Manufacturing and Development 3. Employment, Industrialisation and Outsourcing 4. Income-Related Turning Points in Industrial Employment 5. Preliminary Conclusions References Annexes	1. Introduction 2. Conceptual Background: Outsourcing and Deindustrialisation 3. Accounting Framework: Production Function in an Open Economy 4. Empirical Framework and Data 5. Results: Long–Term and Sub–Period Trends 6. Prototyping Performer vs. Non–Performer 7. Identifying Countries at Risk of Deindustrialisation 8. Summary and Conclusions Bibliography (Vol. I & II) Annexes

[2] With a nod to Baldwin (2006).

2. Literature Review

1) Classical and Structuralist Perspectives

The modern (post-classical) literature on industrialisation and development often refers to Lewis (1954) and Kaldor (1966), two authors usually associated with the structuralist school. Their work on structural changes from the role of manufacturing is in-tune with the more general three-sector hypothesis, that predicts a standard pattern of societal development. This model is credited to Fisher (1935) who introduced the three-sector hypothesis: a first stage based on primary sector (agriculture), followed by the rise of secondary activities (industry), culminating in the dominance of tertiary activities (services).

Rostow (1959) reminds us that the industrialisation path followed by mature developed economies need not prove to be universal. In his words (p.14) "there is the [challenging] problem of organizing the planet, as the whole southern half of the globe and China move through the preconditions, into take-off, and regular growth."

In his influential book on "economic progress", Collin Clark (1957) viewed development as involving shifts in the structure of an economy, specifically from agriculture to industry and then to services. Among the driving forces behind industrialisation and post-industrialisation, income elasticity of demand for manufactured goods takes a prominent role. It is high in poor countries, but low in rich countries, and this probably explains why the share of manufacturing in output and employment rises at first and falls later on.

2) Modern Debates: Global Value Chains, Automation, Premature Deindustrialisation

Aleman–Castilla (2020) presents a comprehensive review of the more recent theoretical literature on trade, industrialisation and labour market outcomes. He points that most analytical and empirical frameworks available to date have focused mainly on the effects of trade on wages, employment, skill bias, informality and gender discrimination. His paper presents also a synthesis of selected empirical studies on the effect of trade on labour market outcomes.

Since Melitz (2003), the focus of attention has moved away from the macro-perspective considering nations as "the" trading entities. The attention is now on the diversity and heterogeneity of firms and workers involved in international trade. This incited researchers to invest more in a micro–economic approach to trade, including the development and use of micro–data bases. A series of statistical initiatives have taken place to bridge the gap between macroeconomic accounting and the more granular business perspective. Disaggregating input–output tables by firms' characteristics leads to "extended I-O tables" that incorporate firm heterogeneity (size, ownership, trade orientation, productivity tiers).

In recent years, the debate has focused on three aspects: the role of automation and robotics, the impact of global value chains, and the challenge of reshoring to promote reindustrialisation. Since the first industrial revolution, technological progress has always played a pivotal role in reducing the labour intensity of manufacturing. This trend accelerated in recent years with the advent of Industry 4.0, where manufacturing processes are increasingly automated. Autor, Dorn, and Hanson (2013) point out that automation and digital technologies have displaced many manufacturing jobs, leading to an "employment polarisation," where middle-skill jobs in manufacturing decline, while high- and low-skill jobs in services increase. This aligns with Acemoglu and Restrepo's (2017) findings that robots and AI technologies have replaced routine tasks traditionally performed by industrial workers, contributing to the decline of manufacturing employment. Baldwin and Forslid (2020) go as far as envisaging a scenario where technology has rendered manufacturing jobless and many services can be freely traded.

When trade and communication technology shorten the economic distance between countries, the classic consideration of comparative advantage takes a sharper aspect. In global value chains (GVC), production is divided into several tasks that can be geographically reallocated to maximise efficiency. Wood (1994) and Feenstra and Hanson (1996) emphasise that trade with developing countries, particularly China, has put pressure on manufacturing sectors in advanced economies by shifting production to lower-cost regions. Rodrik (2016) points out that this phenomenon is not confined to advanced economies; developing countries are also experiencing premature deindustrialisation at lower income levels than historically observed.

Grossman and Rossi-Hansberg (2006) defend that the rise of offshoring within GVCs is reformulating the way we understand comparative advantages in international trade. Likewise, Shiozawa (2018) departs from the standard approach to international trade and highlights the central role of firms and business decisions in explaining specialisation patterns. He stresses the importance of labour costs and trade in intermediate inputs in shaping international competition among firms.

After years of "happy globalisation", recent disruptions following the global crisis of 2008-2009 have led to questioning the sustainability of deeply interconnected global production systems. The higher perception of supply-chain disruption risks challenged some of the axioms of geographically-fragmented business models. Using international input-output tables, Gao, Hewings and Yang (2022) show that after 2007, re-shoring is more likely to be adopted in capital- or technology-intensive manufacturing. Developed economies tend to move back home the high-end production from other high-income economies for rebuilding their own industrial basis while, at the same time, retaining the cost advantages of a global outsourcing of the low-end production segments. Following a similar statistical approach, D'angelo, Di Berardino and Pernagallo (2025) show that in Germany, relocation (reshoring and nearshoring to other EU countries) is shaping a new industrial landscape. They concur with Gao et al. (2022) in observing that the reindustrialisation trend has mainly concerned high and medium technology industries.

The trade-and-deindustrialisation debate has notably taken place in developed countries, albeit it is also present in many developing countries, especially in Latin America. The focus of discussion in developed and developing countries share a common concern about the loss of manufacturing capacities, but with different worries. Supply chain vulnerabilities and dependence on strategic inputs and technologies, in the case of developed economies; premature deindustrialisation and middle-income trap in the case of developing countries. In both groups of countries, the social implications of rapid deindustrialisation is a common concern. A dimension less explored in the literature, yet regularly mentioned by investors, is the loss of human capital and expertise as young people turn their backs on industrial careers that no longer promise openings. Some commentators summarised it as: "You go to China for the skills, not the wages."

3) Demand-Side Perspective

Demand is also considered as one of the main drivers of this structural process in middle to upper income economies. Rowthorn and Wells (1987) argue that deindustrialisation is a natural consequence of economic development, as demand shifts toward services once basic material needs are met. However, Alderson (1999) and Palley (2002) defend a more nuanced "hybrid" frameworks, suggesting that deindustrialisation is driven not only by consumer preferences but also by technological change, trade liberalisation, and globalisation.

According to Baumol (1967), shifts in consumers' demand is not necessary to explain deindustrialisation in advanced economies. As productivity in manufacturing rises faster than in services, the share of manufacturing in employment declines even if demand for industrial goods remains steady. Obviously, this shift is exacerbated by income effects, as consumers demand more services (healthcare, education, leisure) as their incomes rise (Engel's Law).

Herrendorf, Rogerson, and Valentinyi (2013) review historical evidences over the 19th and 20th centuries. They confirm the generally accepted stylised facts concerning the structural transformation of agriculture, industry and services. Increases in GDP per capita have been associated with decreases in both the employment share and the nominal value-added share in agriculture, and increases in both the employment share and the nominal value-added share in services. Manufacturing evolution has followed an inverted U curve "à la Kuznets". Employment and nominal value-added shares in GDP are increasing for lower levels of development and decreasing for higher levels of development. They formalise these stylised facts using a two-sector model that allows them to test for various scenarios, extending it to incorporate international trade and labour mobility. In the process, they offer an interesting review of the related literature.

4) Social and Policy Implications

In the standard three-sector story, labour gradually moves from agriculture into manufacturing and eventually into services. This shift is mostly about productivity differences and the way demand evolves as incomes rise. In closed economies, the process unfolds slowly, so countries follow their own path more or less independently. The process accelerates when economies are open to trade, especially when trade costs are greatly reduced, as was the case after 1995.

i. Productivity, technology, and the acceleration of deindustrialisation

Technological change has pushed things further. The so-called "Industry 4.0 package" (Automation, digitalisation, Internet of things, etc.) allows firms in advanced economies to stay competitive despite high wages. As Arbache and Canuto (2025) put it, a modern plant produces far more value with only a fraction of the workers it once needed. Since productivity has grown faster than output in most rich countries, the decline in manufacturing employment appears to have happened regardless of trade, even if openness to trade and foreign direct investment acted as accelerators.

Globalisation made it easier to reorganise production across borders, transferring capital and know-how. In addition, the productivity gap between rich and poor countries was smaller than the wage gap, which encouraged relocation. While the catching-up process was expected to benefit developing countries, these benefits were unevenly distributed. Felipe, Mehta and Rhee (2019) show that many developing countries now hit their manufacturing peak at lower income levels than before — the "premature industrialisation" idea. Their earlier work (2016) also points out that while individual countries may deindustrialise, the world as a whole hasn't: manufacturing jobs have simply moved from high-productivity, high-wage economies to lower-productivity ones. This spreading-out of industrial activity makes it harder for most single countries to maintain a large manufacturing base.

The Felipe et al. (2016) hypothesis suggests also that demand for manufactured goods in emerging countries has not grown enough to sustain higher global levels of manufacturing. These countries experienced rising income levels, but their demand for manufactured goods still fell short. In that sense, the success of export-led development models in some countries may have contributed to deindustrialisation in others. Thus, one driver of deindustrialisation in developing countries can be linked to effective demand constraints. Lawrence Summers, former U.S. Treasury Secretary and Chief Economist of the World Bank, is often mentioned for a quote about China, on "one billion workers entering the global economy, but soon one billion consumers". Perhaps it takes more time than initially forecasted for China to become a global consumer.

Scale effects and agglomeration forces are also reinforced in open economies. They can either accelerate or undermine industrialisation (Aleman-Castilla, 2020). Countries that manage to build large clusters reinforce their comparative advantages and can keep expanding manufacturing even when domestic demand is saturated. Others, lacking these externalities, deindustrialise faster as imports undercut local producers. Przywara (2019) argues that this is creating a two-tier pattern among developing countries. Home-bias in consumption (Escaith, 2025) further strengthens early movers, and recent work links such preferences to broader attitudes toward trade (Imas, Madarász & Sarsons, 2025).

ii. Employment embodied in trade

Because manufacturing is more labour-intensive in developing countries, trade raises questions about job displacement. Wood (1994) famously estimated that imports from developing countries displace several times more manufacturing jobs in industrialised economies than exports create. Rowthorn and Ramaswamy (1999) disagree, arguing that input–output methods exaggerate these effects and that North–South trade explains less than one-fifth of deindustrialisation. The picture is further complicated by the fact that "developing countries" are far from homogeneous in terms of labour productivity. Treating all developing countries as a single "Global South" is probably mistaken (Escaith, 2007).

The debate is particularly complex when it comes to the differentiated impact of globalisation on female and male employees. The idea of a "global feminisation of labour", especially in developing countries, has been influential as many have argued that high-income countries outsourced to low–cost economies the most labour–intensive segments of their industries, often identified with the highest share of female employment. Tejani and Milberg (2016) find that the evidence is mixed and that capital-intensive upgrading can even create an "anti-female bias".

Sorgner (2021) prefers to highlight a "pro-female" bias in labour demand when services activities become prominent. Measurement is tricky because industrial firms often outsource domestically — or , but less frequently, internationally — back-office tasks such as accounting, legal affairs, marketing, R&D or human resources management, many of them female-dominated, to service providers. This shifts jobs across sectors without changing much in practice. Overall, Aleman-Castilla (2020) concludes that globalisation tends to increase wage inequality but reduce gender wage gaps.

A possible explanation lies in the impact of GVC industrialisation on the quality of employment in developing countries. Using OECD input–output data complemented with ILO statistics, Blanas, Phu, Koch and Viegelahn (2026) conduct an in–depth analysis of the impact of GVC industrialisation on job quality. They find that GVC participation is negatively associated with informal work. Forward GVC participation (from industries supplying domestic value added to other countries' exports) in developing countries tends to reduce informality more strongly in industries with higher shares of female workers. Besides better management practices and higher product standards, GVC integration brings also more formal contractual arrangements. These improvements disproportionately benefit women because they are often over-represented in occupations where informality is common.

3. Motivation, Premises and Methodological Orientation

The three-sector hypothesis and the hybrid model of structural change affecting production and demand in a globalised economy guide the present essay. It aims at contributing to the empirical analysis of the deindustrialisation in the course of economic maturing, searching for the salient features that accompanied the most recent wave of globalisation. In particular, we search for tipping points in manufacturing output and employment, with a special attention to the role of outsourcing in an international context. In addition, we contribute also to the literature on truncated industrialisation and premature deindustrialisation by differentiating between developing countries. We will indifferently use "manufacturing sector" and "industry" — implicitly excluding "construction" — in this essay.

1) Outsourcing and Global Value Chains

Outsourcing of tasks and geographical fragmentation of production is extensively treated in the second volume of this background paper. They are often identified as the markers of the 21st century "fourth industrial revolution" (WTO-IDE-Jetro, 2011). Unlike early 20th century business models advocating vertical integration within the same corporate structure, alternative models recommended a more focused managerial approach, keeping only core-business activities and sub-contracting the others. This model was inspired by Michael Porter's concept of value chain, presented in his influential book on competitive advantages (Porter, 1985).

The concept of global value chains or global supply chains is the international extension of these definitions, responding to the growing phenomenon of global production fragmentation (Jones, Demirkaya and Bethmann, 2019). In their review of the literature, these authors mention three hypotheses to explain international outsourcing:

- (*i*) companies in industrialised countries respond strategically to increasing import competition from low-wage countries by relocating labour-intensive tasks to low-wage foreign countries.

- (*ii*) multinational enterprises increased intra-firm trade in intermediate goods, occurring within a complex network linking parent companies with affiliates in foreign and home countries.

- (*iii*) global sourcing was facilitated by international trade integration. Trade liberalization after the culmination of the Uruguay Round in 1994 has significantly reduced costs associated with tariffs and some nontariff trade barriers.

Lower transaction and coordination costs due to computational and technological innovations (Internet) facilitated also the task of managing complex supply chains operating under demanding Just-in-Time constraints. Regulatory and management culture convergence after the end of the Cold War was also an important contributor. The rise of GVCs has fundamentally changed the structure of international trade, improving access to cheaper mass-consumption products in developed and developing economies. It also lifted millions out of poverty in faster–industrialising emerging countries. GVC prevalence changed also our understanding of industrialisation and development.

2) Defining Deindustrialisation

Deindustrialisation is usually conceptualised in the literature as a decline in the share of manufacturing in total employment. In that sense, industries would be the victim of their own technological progress, due to the high labour productivity growth in manufacturing! This definition opens an interesting statistical issue, as the frontier between manufacturing and services is increasingly blurred. Majzlíková (2024) states that these two sectors are becoming more intertwined, as evidenced by the fact that 40% of jobs in

European manufacturing are linked to services. In Vol. II, we will see that many business services are also closely embodied into industrial production.

Tregenna (2009) suggests that deindustrialisation should more appropriately be defined in terms of a sustained decline in both the share of manufacturing in total employment and the share of manufacturing in GDP. In terms of economic growth, what happens to the share of manufacturing in GDP matters, even if the share of manufacturing in employment may have also long-run growth effects, in addition to social implications. This is particularly relevant in the case for developing countries, as modern theories of endogenous economic development put more emphasis on human capital. Indeed, manufacturing jobs generally tend to require and to develop higher levels of skill than jobs in other sectors, even if some authors challenge the view that manufacturing is the prime route for development (Baldwin and Forslid, 2020). But it should not be ignored when discussing viable long-term growth patterns in developed economies: growing trade deficit in manufactured goods cannot be indefinitely sustained by increasing external debt.[3]

Deindustrialisation is not only to be analysed from the production and employment sides. Demand remains the main driving factor of production in market economies. Actually, it may even be "the" limiting factor in developed economies due to the structural contradiction between the low income-elasticity of demand for manufactured products and the hight growth of industrial productivity. We refer to Mayer (2003) and Sutton (2012) for a review of the pessimistic and more optimistic arguments.

In our empirical quest, we control also for the existence of the statistical bias introduced by value-chain optimisation business models, when some non-core support industrial tasks are outsourced to manufacturing services suppliers. Tregenna (2009) professes that deindustrialisation is often a statistical illusion arising from outsourcing activities to specialised service providers. As a result, manufacturing employment would be reduced proportionately more than would manufacturing output.

Industrial labour statistics may be misleading when outsourcing is prevalent. The focus on the firms' core-business in the "make-or-buy" outsourcing decisions converted several administrative or support non-core "manufacturing" jobs to be classified into business services. In that sense, when outsourcing becomes the dominant business model, observing deindustrialisation through the sole "manufacturing sector" perspective and the related production or labour statistics underestimates the economic size of manufacturing (Lábaj and Majzlíková, 2022). [4]

Accordingly, the focus of an analysis of (de)industrialisation should extend beyond direct employment statistic to cover the manufacturing eco-system, including the manufacturing firm and its first-tier providers. Montresor and Vittucci-Marzetti (2011) apply the concept of industrial subsystem to measure deindustrialisation in the G7 from 1980 to the mid-1990. Considering both direct and indirect effects on value-added and employment at subsystem level, they find that the deindustrialisation was even steeper than when considering only the manufacturing sector only. Their measure of value-added at current price may probably bias the results [5]

[3] Unless the country has a comparable surplus in trade in commodities or in services, including factorial ones.

[4] Blanas et al. (2026) find an opposite statistical effect in low and middle income developing countries, where GVC participation tends to reduce informality.

[5] I thank L. Artige for sharing with me some of his preliminary results (Artige, 2025) that show no such decline at constant price.

3) Empirical Orientation

In the present paper, we use input-output table and labour statistics to measure the labour content of production. Jobs embodied in production can be direct, represented by the total number of employees in the industry producing the output, or can be indirect, representing the jobs from other branches of activity embodied in the inputs purchased by the industry. When discussing international outsourcing, we will concentrate on changes affecting developed economies and whether these changes were beneficial to developing economies.

For practical reasons, the essay is divided into two substantial, self-standing volumes that together form a larger whole. Volume I takes a macroeconomic and sectoral lens to focus on the stylised facts, with particular attention to employment, drawing in part on results developed in Volume II. The latter adopts a more disaggregated sub–system, 'growth-accounting' approach to analyse the extent of domestic and international outsourcing, and it also introduces the role of effective demand in driving (de)industrialisation. It concludes with tentative country-by-country deindustrialisation diagnostics.

Volume I: Stylised Facts and Employment Dynamics

1. Structural Changes in Global Manufacturing

The global manufacturing system has undergone deep transformations in the last 25 years in terms of the geographical dispersion of its industrial activities across countries. Such geoeconomic changes reflect, among other things, the combined effects of four forces.

1) A Tale of Four Forces

The first force is what happens "naturally" to the share of manufacturing in the course of development. It has been extensively covered, as detailed in our review of the literature. The manufacturing peak is not the same for all countries and may change with time. Rodrick (2016) found that since 1990, output shares peak at incomes that are around forty percent of the levels previously experienced.

The second one is contemporaneous, even if it induced important structural changes in the world economy. The rise of Global Value Chains (GVC) increased the geographical fragmentation of manufacturing production firms, away from legacy industrial countries. From 2000 to 2010, GVC chains lengthened for virtually all sectors, adding new participants along the way. According to ADB et al. (2021), it was this breaking up of the production process that "made it possible for developing countries to enter manufacturing production, in particular by finding a niche in the production chain. No longer did developing countries have to produce complete products; they could expand their comparative advantage by taking on certain tasks in the production chain", From 2010 to 2019, production length stagnated in virtually every sector: it did not shorten, but neither did it lengthen.

This increased fragmentation was accompanied by ever-closer functional integration of global firms' activities, redefining our previous understanding of comparative advantages and the traditional division of labour between developed and developing countries. Some of the latter started producing for the global market a wider range of mass-consumption electronic goods, of chemical and transport equipment.

This fragmentation was accompanied with a parallel movement of regional integration, particularly in North America (North American Free Trade Agreement) and in Europe, with the consolidation of the European Union, the single currency adoption in 1999 and the Eastern enlargement in 2004.

The third force is a consequence of the second one. The emergence of China as the "World Factory", initiated in 2001 with its accession to the WTO, challenged the previous industrialisation models inherited from the trade and development theories that matured in the 1950s based on the concept of comparative advantages. [6] Even the "export-led" growth strategy behind the growth of the so-called Asian Tigers in the 1970s appears impracticable today considering the formidable competition from Chinese products across the full range of high-technology to labour-intensive products. Indeed, when measured at constant 2015 USD prices, the share of global manufacturing output made in China rose from 9.7% in 1995 to 36.1% in 2019 (during this period, World industrial output increased by 178%, a 4.4% annual

[6] From the Heckscher–Ohlin free-trade model, built on David Ricardo's notion of comparative advantages. This model was extraordinarily influential and most trade models that followed until the late 1980s were either a refinement or a critique challenging the implications, but from within this framework.

average). The share of other developing countries has remained more or less stable, from 18.2% in1995 to 19.5% in 2019, while the weight of "industrial" developed countries in global manufacturing output dropped from 72.1% to 44.4% during the same period.

The fourth force that has shaped international economy in general, and industrial production and trade in particular, was the 2008–2009 global financial crisis (GFC). For its intensity (merchandise trade decreased by 24% in 2009), GFC has been dubbed the "Great Trade Collapse": the dive of world trade was unprecedented, even in comparison with the Great Depression of the 1930s (Eichengreen and O'Rourke, 2009). Various authors attribute the large drop in trade registered in 2008-2009 to the leverage effect induced by the geographical fragmentation of production (Tanaka, 2009; Yi, 2009). The World economy did not suffer de-globalisation after the 2008-2009 Global Crisis, but entered a phase of "New Normal". After the phase of hyper-globalisation of 1995-2007 when World trade increased much more rapidly than World income, trade-income elasticity returned to its pre-1990s long-term values. But it was not a return to the past: the world is remained much more open to trade than it was before the 1990s.

These forces have affected the production and competitive landscape of manufacturing firms, even when they were not very active in international trade. Large multinational firms were able to benefit from the increasing opportunities to offshore domestic production and exploit global value chain efficiency gains. Confronted with increased competition, smaller firms had to find refuge by specialising in market niches. In this hyper-globalisation context, country heterogeneity in industrial development results from and has been amplified by the ability of the domestic manufacturing firms in each economy to exploit the growth potential offered by lower trade barriers, which enables greater foreign market penetration via exports (Romano, 2016).

2) Geographical Concentration and Dispersion

In this process, the geographical distribution of industrial capacities was greatly modified, especially among developing countries. After a phase of rapid global convergence up to 2007, when the rising tide lifted all boats during the phase of hyper-globalisation, the global crisis on 2008-2009 marked the beginning of an increasing divergence among developing nations, with a mounting dominance of larger emerging producers, especially — but not uniquely — China (see Box 1).

In this essay, we voluntarily treated China as a separate "region". During the 1995–2019 period, China has been the main driver of global manufacturing patterns. As a structural outlier, it did not seat comfortably withing the group of developing countries and its inclusion in Developing East Asia would have biased our results and overshadowed other trends.

Lower trade barriers imply also greater competition from imports: a second explanation for divergence in the performance of national manufacturing systems has to be looked at in the evolution of domestic demand in the countries and its composition between home-made and imported goods. Morceiro and Tessarin (2025) mention in the case of Brazil a loss in "industrial density" due to the competition of imported inputs such as parts and components. The higher prevalence of imported inputs reduced the scope for upstream manufacturing and increased the weight of lower value-added downstream assembly activities, requiring less qualified labour.

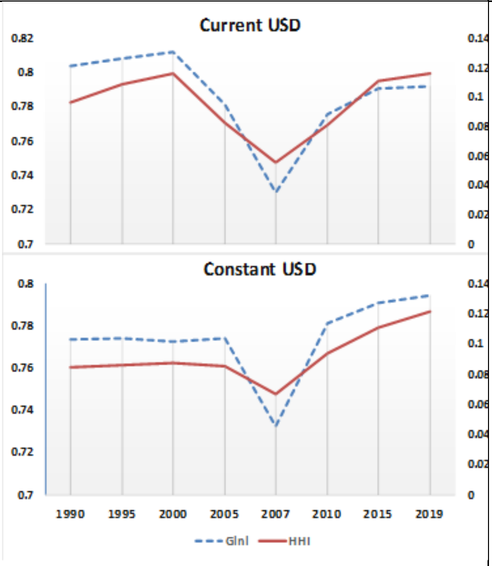
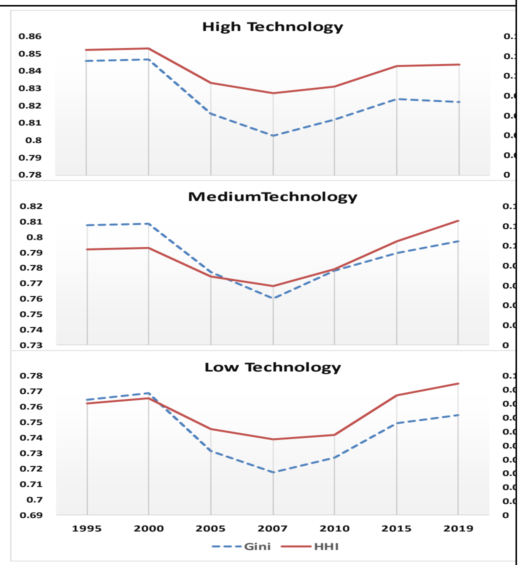
The phase of "happy globalisation" ended in 2008 with the GFC. It was succeeded by an increasing scepticism on the economic and social benefits of globalisation in developed countries and the rise of East-West tensions, especially after 2016. These tensions intensified with the COVID crisis of 2020-21 and the return to nationalistic industrial policies in developed countries.

With their emphasis on 'derisking' the supply chain, these policies aim at reducing the dependency of key domestic producers on foreign suppliers, especially those considered as "risky". For supply chain managers, this meant moving away from a "just-in-time" philosophy to adopt a "just-in-case" one. Calling for more diversification of suppliers, this new business model could eventually reduce the dominance of large emerging countries and benefit producers located in second-tier producing countries.

Box 1: Geographical concentration of industrial production

Figure 1 presents the Gini and Herfindahl-Hirschman Index (HHI) concentration indices, widely used in the literature. They are estimated using countries' manufacturing value-added at country level measured in current and constant USD. The left-hand side panel shows the results for all manufacturing industries, at both current and constant prices. The panel on its right presents the results at current prices disaggregated by technological content; these data are available only after 1995.

Figure 1 Concentration indices on Manufacturing value-added at constant and current price and by technological content

All industries, 1990-2019 [a]	By technological content, 1995-2019 [b]
	
Source: based on UNIDO data	Source: based on OECD data

Notes: Based on data for 76 developed and developing countries. Gini scale (dotted line) on the left axis, HHI scale on the right axis. a/ Constant prices are in 2015 dollars; b/ Value–Added by technological content at current USD.

The two sets of graphs present the same "V-shaped" pattern. This drop in between-countries disparities is associated with a period of high growth in production during the 2000-2007 period (2005–2007 at constant prices). The 2007 dip likely reflects a geographical broadening of manufacturing during the phase of hyper-globalisation, before the global financial crisis. The depth of the decline at current prices may also reflect the USD depreciation vs. euro and emerging markets currencies. This widespread global expansion of manufacturing production is due in part to the rise of global value chains and offshore outsourcing. In addition, the 2002–2008 commodity super-cycle boosted resource-based manufacturing (e.g., basic metals, chemicals) in natural-resources based countries. Mid-sized countries expanded faster than the giants, reducing concentration: the Gini index drops because the middle of the distribution grew; the HHI drops because the largest players' relative dominance declined.

The evolution of High-Tech industries presents some particular characteristics that differ from the other branches of activity, especially after the Global Crisis of 2008-2009. While their concentration indices were higher than Medium-Tech ones in 1995, their distribution in 2019 shows a better between-country distribution, especially for the Gini index. This growth differential reflects a catching-up process of developing countries that contributed to a more equal distribution between the developed and developing countries.

But growth was heterogeneously distributed among these developing regions (Table 2). High-growth developing regions are located in Eastern and South Asia. Latin America does only slightly better than the developed economies. Sub-Sahara Africa is also in a slow-growth pattern, except for the

Medium-Technology industries.

Table 2 Average Regional Annual Growth of Manufacturing Production by technological content, 1995-2019

Period	1995–2019			1995–2007			2010–2019		
Region/Country	High	Medium	Low	High	Medium	Low	High	Medium	Low
China	13.1	12.7	12.5	16.5	15.5	14.4	7.5	7.8	9.1
SAS	7.9	7.9	7.7	8.7	8.5	8.8	6.3	6.6	5.5
EAP_DVG	7.7	7.1	6.6	7.5	6.3	6.6	6.7	7.0	5.3
MNA	6.3	5.9	5.7	7.0	6.7	6.5	4.3	3.7	3.9
SSA	5.6	6.3	5.0	5.3	7.2	6.4	5.4	5.2	2.9
LAC	4.2	4.3	4.1	6.9	6.7	5.8	0.0	0.7	0.5
DVD (all)	4.6	3.8	3.2	8.0	7.8	6.2	1.9	1.3	0.9

Notes: Simple average of countries, output measured in current US dollar.
Regions follow the World Bank categories. EAP_DVG: Developing East Asia and Pacific, excluding China; LAC: Latin America and the Caribbean; MNA: Middle East and North Africa, SAS: South Asia; SSA: Sub-Saharan Africa. DVD: Developed economies.

The contrast between pre and post Global crisis is particularly acute for the group of developed economies and for Latin America. In both groups, the growth of factory output was anaemic at best. In a companion paper (Escaith, 2025) we isolate more formally the dominant role of domestic demand in shaping global manufacturing market shares over the 1995-2019 period. We show that gains in industrial competitiveness by some developing countries may in part reflects better demand-side positioning on burgeoning home markets.

Domestic demand for home-made manufactured products remained strong in developing countries, even during the New Normal. It grew at an annual average of 4.8% and 4.6% for high-tech and medium-tech products, and 3.9% for low-tech. In comparison, the same annual growth rates observed in developed economies were 1.6%, 1.3% and 0.5%.

The between-developing country distribution of manufacturing value-added worsened greatly after the 2008-2009 crisis, especially when measured for the HHI index, an indicator of industrial concentration. The HHI for developing countries, measured at constant price, was equal to 0.057 in 1990, and raised to 0.376 in 2019. This increase highlights the dominance of large emerging producers. This result is robust, even if diluted, after excluding China from the sub-group of developing economies.

2. Manufacturing and Development

The next sections look for stylised facts that may illustrate or contradict the above-mentioned narrative. They build on indicators defined on both the supply and demand sides of industrial production in a large subset of 76 countries, 41 developed and 35 developing, plus a "Rest of World" aggregate. We use two data sources. The first one is based on UNIDO statistics of manufacturing value added at current US dollar (USD) and constant USD at 2015 prices. Our second source is the OECD harmonised input-output tables data base. The data, in current USD, have been aggregated into three sub-groups of manufacturing industries, classified by technological content, for 76 countries plus the Rest of World. [7] We will derive from the input-output data the value of output and the corresponding value-added.

From a development theory perspective, manufacturing as a share of employment or GDP is expected to increase during the initial phase of transition from a traditional agricultural society, then decrease when the economy matures and enter a post-industrial stage where services become a dominant source of both employment and income. This "expected" decline, at least relative to services, is defined as a

[7] We use the 2023 edition of the OECD Inter-Country Input-Output (ICIO). This version has 45 unique industries based on ISIC Revision 4. The tables are provided for 76 countries (and Rest of the World) from 1995 to 2020. It covers inter-industry transactions in current USD for all OECD countries, all large emerging economies and a selection of other developing countries in Africa, (Central, South and Eastern) Asia and in Latin America. The data and metadata are available at https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm.

"positive deindustrialisation" (Morceiro and Tessarin, 2025). The manufacturing sector in mature economies can continue to expand, or at least can limit its loss in relative weight, if export demand sustains its growth (Thirlwall, 2003).

A "negative or pathologic deindustrialisation" in developing countries is associated with structural or conjunctural obstacles to pursue a normal industrialisation path. In this case, the excess labour cannot be absorbed by the services sector, resulting in an increase in unemployment and informality (Escaith, 2006).

Morceiro and Tessarin (2025) indicate that a lesser-known symptom or consequence of "negative deindustrialisation" is its impact on the trade balance. A normal "positive deindustrialisation" in high-income countries is associated to a relative decline in the domestic demand for manufactured products. This relative decline in domestic demand can be compensated by exports if the country is internationally competitive. In developing countries facing premature deindustrialisation, the income-elasticity of demand for these products remains high, leading to larger imports and possibly an increase in balance of payments deficit. Combining high unemployment and external deficit defines archetypes of "pathologic deindustrialisation". Hence the importance of examining also role of demand when analysing deindustrialisation, as we do in Vol. II.

A positive (aka, normal) deindustrialisation occurs when a country initiates its deindustrialisation process after haven reached a certain level of income per capita. Premature or pathological deindustrialisation can be diagnosed when the share of manufacturing value-added starts declining before the country reaches the expected GDP per capita inflection point. Because this inflection point is hypothetical and cannot be observed or even estimated unambiguously,[8] we adopt a more operative definition in this paper, based on hard data. We define in Vol. II deindustrialisation as "pathological" when domestic production declines despite a strong domestic demand.

1) Looking for Manufacturing Peaks

The existence of an inverted "U" shape relating the share of manufacturing industries to the level of per capita income suggests that the relationship is not linear. Accordingly, we employ a Generalised Additive Model (GAM), a data-driven approach that generalises linear regression by adding non-linear interactions between variables. It is possible to fine-tune the flexibility of the model by selecting parameters that penalise "wiggliness" (how quickly a function changes across its range). As a result, the model expectations (the fitted curve) are highly dependent of the parameters used, even if the overall shape of the data does not change. [9]

From a statistical perspective, GAM can handle non-Gaussian cases like manufacturing shares, that are bounded [0,1]. So, it is better suited than the traditional polynomial regressions usually found in the literature. Flexibility comes with a cost: it is an (almost) unsupervised data exploratory technique that "let the data shape the relationship". As no formal model has been specified, unlike traditional regressions, results can be harder to interpret in terms of underlying economic mechanisms. We will use these more traditional regression approaches as robustness checks.

[8] The results obtained with a general additive model suggest that the so–called "Data Generation Process" supposed to determine the inflection point is not unique. Breiman (2001) calls the multiplicity of different models the "Rashomon" effect.

[9] We concurrently used the packages "gam" (Hastie and Narasimhan, 2024) and "mgcv" (Wood, 2025). The method used was from the logit-gaussian family.

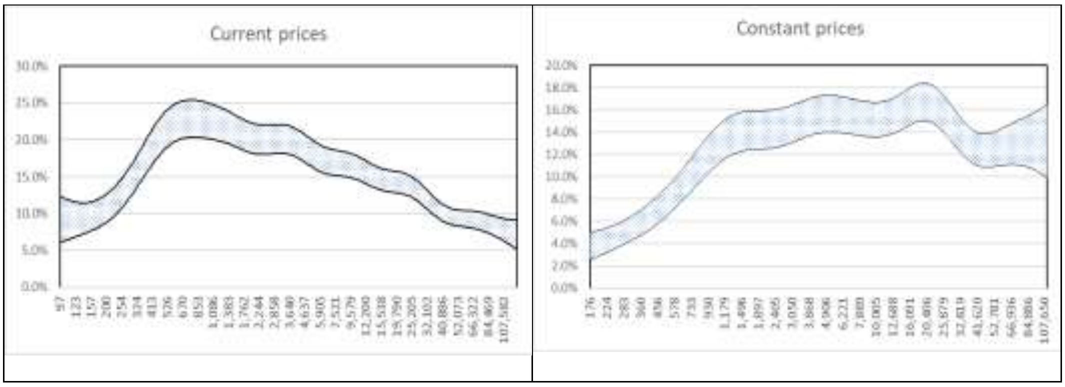
2) Contrasting Current and Constant Prices Patterns

Figure 2 presents the results obtained a current and constant prices when fitting the share of manufacturing value-added to GDP per capita. [10] The data at current prices confirm the inverted "U" shape found by other authors. The peak share of 25% is found at a relatively low-income value (about $1'000).

More puzzling is the large difference between the results at current and constant prices (see Box2). The inverted U shape is less manifest at constant prices, coinciding with Artige (2025) who concludes that manufacturing value–added in OECD is roughly constant over the 1995–2019.

In our results, the peak share of manufacturing value-added in GDP at constant prices is lower (at 18% of GDP) and the tipping point is reached at a higher income of twice the turning-point current price value. The variance increases also at the end of the income distribution, with a coefficient of variation raising to 13%, almost twice the overall average.

Figure 2 Relationship between the share of manufacturing value-added in GDP and per capita income, 1990-2019



Note: The curve shows the 0.95 confidence interval centred on a GAM estimate of the share of VA conditional to GDP per capita, based on data for the full sample of 76 countries.
Source: Based on UNIDO data at current and at constant 2015 dollars.

Box 2. Current or Constant prices?

Two — sometimes contrasted — approaches coexist in the analysis of structural economic changes. In development economics, it is common to adopt a perspective based on constant prices, which allows for meaningful comparison of macroeconomic aggregates over the long run. By contrast, a more sectoral or microeconomic approach, as the one we adopt in the second volume of this research paper, would privilege the evolution of (current) market prices. These are the prices that govern investment choices and input-substitution decisions. In a "make or buy" decisional context, these relative (current) prices are also driving substitution between labour and external inputs (Ruzic, 2025).

Supply–Use tables that serve as the backbone of Input–Output data clear supply and demand at current prices. Recalculating input-output tables at constant price is a complex exercise. The "constant price" employed are rarely the usual Laspeyres indices, since the difference between current and constant prices for each of the disaggregated supply and demand component will tend to widen with the passing of time. Double–deflation can be used to deflate value–added, but is not applicable to other aggregates. Large and widening differences make reconciliation between supply and demand increasingly difficult.

The preferred solution is to use "chain indices", where the base used to calculate real variations is constantly

[10] We explored several options and opted for a flexible number of knots with a k=15 value, with robustness checks done with k=8 and k=30.

updated, using the previous year at current prices. Supply and demand identity at constant price is then obtained by a closing the residual gaps through iterative adjustments. The standard tool used by national statistical agencies is based on the RAS method, also known as bi-proportional scaling or iterative proportional fitting.

While chain indices offer interesting properties for dealing with changing data structure, they can result in significant drift away from fixed-base Laspeyres or Paasche indices over time. Chain drift prevents a simple, direct comparison over a long-time span. In particular, if in a sub-aggregate, the price of some elements is growing constantly faster than others, then the real growth of the series growing more slowly is overstated.

On the other hand, by frequently updating the weights of each component in the aggregate, chain indices better reflect the changing composition of supply or demand over time, measured at the current prices of the previous year.

We will often adopt a hybrid approach. We use constant prices when looking at trends for a single aggregate (e.g., GDP) over the long period, and current prices when analysing the composition of aggregates (e.g., household demand) or how supply or demand within a single market interact. We also use current prices in the second volume of this essay when analysing the substitution between classes of inputs (e.g., labour vs. material inputs; imported vs. domestic inputs) occurring through outsourcing.

3) Towards a Hybrid Current and Constant Price Approach

Actually, comparing income in current USD between 1990 and 2019 is misleading, due to large differences in the local purchasing power of one dollar between these dates. Long-term comparison calls for using income at constant prices, to improve comparability. On the other hand, the ratio of manufacturing value-added on GDP at constant price presents also a series of issues. It is actually more of a "counter-factual" piece of information: what would have occurred to (de)industrialisation if relative prices had remained constant? It is obviously an interesting "nice to have" piece of information, but does not provide any relevant information on the actual status of (de)industrialisation at time "*t*" in a given country.

Actually, the ratio of manufacturing value–added at constant price can be better expressed separating its two constituents: the ratio at current prices and the evolution of relative prices between manufacturing value–added and the GDP (see Boxes 2 and 3).

Box 3 Evolution of the relative price of manufactured products

We infer the relative price of industrial goods in each country through the comparative evolution of the implicit deflator of the manufacturing sector relative to the overall GDP deflator. Figure 3 is based on a comparison of UNIDO data in dollar at current and constant 2015 prices. Data have been rebased at 1995=100 and the time series was adjusted to control for outliers. [11]

The relative prices in the sub–group of ***developed economies*** followed a general downward trend until 2007, albeit at different speed. After this date, EU13 has continued on its decreasing trend while relative prices in the EU15 remained flat until 2015. Industrial prices rapidly touched a bottom in 2007, after a fall of 25 percentage points (ppt). They roughly remained at this level after this date. The situation of manufacturing in East Asia and the Pacific remained more favourable up to 2015, before dipping 5ptt.

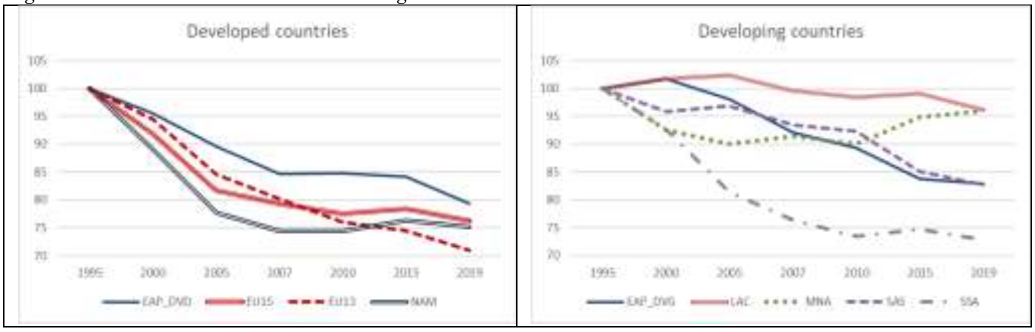
While the deflator of manufacturing industries value–added lost between 20 and 30 percent of their value in average compared to their domestic economy, the fall is generally smaller in the case of ***developing economies***. This slower decline provides some support to the premise that the lower prices of manufactured products in developed economies in the 2000s was partly due to imported deflation.

Only Sub–Saharan Africa followed a pattern similar to developed economies, with an accelerated decrease of more than 25ppt up to year 2010, flattening afterwards. Developing Asia (Eastern and Southern) followed also a less pronounced downward trend. The relative "price" of manufacturing value–added

[11] We shortened the time period to 1995-2019 in order to avoid some outliers, most of them being Eastern European countries that were still in transition in 1990. We only considered cases where the manufacturing sector represented at least 5% of GDP over the period, which led to drop Hong-Kong and Luxembourg.

in Latin America, in the Middle–East and North Africa region lost less than 5ppt over these 25 years, even if the MNA trajectory passed through a 10ppt bottom between 2005 and 2010.

Figure 3 Evolution of the manufacturing industries deflator relative to GDP 1995–2019



Source: Based on UNIDO data in current and constant dollar at 2015 prices.

The long-term changes in relative deflators are expected to have a direct impact on the evolution of the share of manufacturing in GDP at current price. On the other hand, there is no clear correlation between (de)industrialisation and relative prices. Domestic industrial deflators in Latin America appear to have resisted the downward international trend, yet this region is diagnosed with premature deindustrialisation due to the competition of low-cost producers in Asia (Rodrik, 2016). At the contrary, EU13 manufacturing industries blossomed since 1995, despite a very negative trend in relative prices.

iii. Total manufacturing share and real per capita income

We fitted a GAM regression on current industrial value–added share as a function of constant income per capita values, using a regression family aimed at controlling for the fact that the shares are bounded]0,1[. Having many countries with few observations each, we opted for random country effects estimating how much countries vary around the global mean. Finally, we tried several options (k: {8, 15, 30}) for the number of “knots” governing the flexibility of the adjustment (its “*wiggliness*”).

On our data set, the number of knots affects mainly the shape of the curve at the end-points, many high-income countries having relatively low share of manufacturing but some maintaining a much higher one (Figure 5 below). We opted for a moderately flexible k=15 value as our preferred model. It offers a good fit, is full rank and avoids under or over fitting (Table 3).

Table 3 Beta GAM: diagnostic checks

Model: VA/GDP: f (log (GDPpc), country effects)
Method: REML Optimizer: outer newton

Full convergence after 15 iterations.
Hessian positive definite, Model rank = 95 / 95

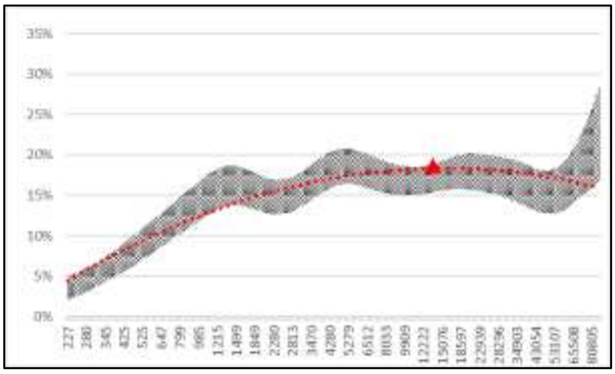
	k'	edf	k-index	p-value
s(log_gdp_pc)	14.0	11.4	1.02	0.62
s(country)	74.0	69.9	...	...

Notes:

- Estimated degrees of freedom (edf) = 11.4; they are below k′ = 14, so the model did not need to use all the flexibility before convergence.
- k-index = 1.02, which is above 1, so k is not too low.
- p-value = 0.62, indicating no underfitting (k is not too low).
- k’ is 14, 15 less one degree of freedom.
- N: 74 countries, after deleting two outliers.

Source: Autor, based on results from package ‘mgcv’ (S. Wood, 2025)

Figure 4 Estimated fit between the share of manufacturing value-added at current price and real per capita income, 1995-2019



Note: Vertical axis: Share of manufacturing value–added in GDP, current prices. Horizontal axis: GDP per capita at constant 2015 USD. The area represents the upper and lower bound of the estimated fit using a GAM model with random country effects and a k=15 parameter. The dotted line represents an OLS quadratic polynomial curve fitted on the GAM predictions.
Source: Based on UNIDO data at current and at constant 2015 dollars.

A quadratic regression on fitted values imposing a single turning point would predict a tipping point when real income reaches about $14,300 at 2015 prices. This turning point corresponds to a manufacturing share slightly above 17%.

Actually, the relationship is more non-linear than a simple quadratic function would suggest, as there are several inflexion points. We observe three local optima in Figure 4. The first local optimum, based on the GAM predictions, is expected at the point [$1,500; 16.2%], the second one at [$5,300; 18.6%], the third at [$20,400; 18.0%]. To control for the GAM model fitting "too much local structure", we compared with the results obtained with a k=8 to reduce the wiggles. But the three humps and the upside end-point pattern remain, indicating this succession of humps is robust to changes in the specification.

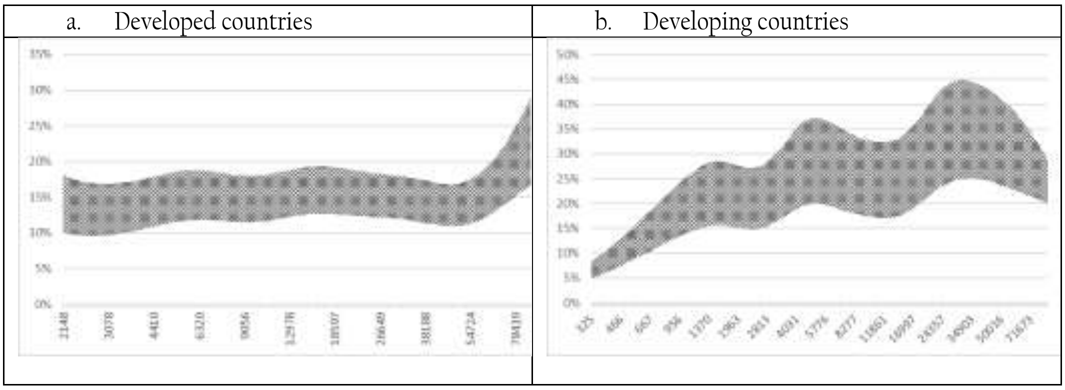
The GAM regression fits poorly the situation of high-income countries, with the standard error around the fitted value increasing at the top range of per capita income (Figure 5). While dispersion is low (3 percentage points) at the OLS peak of [17.1%; $13,400], it increases fourfold to 12 ppt for the highest income range. The higher prediction error is probably due to the influence of a few high-income industrial economies, such as Germany and Ireland. Ireland is almost an outsider, with manufacturing shares rising above 30% in the late 2010s.

Figure 5 shows that the "triple hump" is proper to developing countries (DVG), in a context of large variance in the data. The relationship is weakly non-linear and almost flat in the case of developed economies (DVD). In contrast, the graph shows also that the upward tweak at the end of the income distribution observed in Figure 4 is due to developed countries.

This finding is somewhat unexpected from a global perspective and not easy to rationalise without investigating more in detail the dynamics of (de)industrialisation at country level. Indeed, country effects in Table 4 and Table 5 indicate that several countries maintain a higher-than-average specialisation in manufacturing industries. This particularly the case of East Asian countries such as China, Korea, Malysia, Thailand and Taiwan.

In Europe, only Ireland can rival the Asian cases.[12] When negative country effects are observed in high-income countries, it is usually because of their specialisation in services (the case of small countries) or in natural resources (Australia, Norway).

Figure 5 Estimated fit between the share of manufacturing value-added at current price and real per capita income by Development status, 1995-2019



Note: Vertical axis: Share of manufacturing value–added in GDP, current prices. Horizontal axis: GDP per capita at 2015 USD. The area represents the upper and lower bound of the estimated fit using a GAM model with random country effects and a k=15 parameter.
Source: Based on UNIDO data at current and at constant 2015 dollars.

iv. Regional and national specificities

The multiple peaks in Figure 5 may be explained by the existence of regional clusters, with some regions "peaking" at different income levels. The "triple hump" would reflect a mixture of region-specific paths in a general additive model. As some regional dummies in the present case lacked significance, we used the alternative to split the countries in two groups by development status, adding countries as dummy variables and aggregating them by region.

Table 4 Manufacturing value-added: GAM coefficients with country regional and development status

MVA/GDP: f [0 + region + s (log_gdp_pc, by = development status, k = 15) + s (country, bs = "re") + factor(year))

Parametric coefficients:

	Logit [a]	Equal to:	SE [b]	Signif.
Region DVD	−1.540	17.7%	−20.4	***
Region DVG	−1.296	21.5%	−14.8	***
(year)1995 [f]	0.000	50.0%	…	…
(year)2000	−0.031	49.2%	−1.3	
(year)2005	−0.105	47.4%	−4.0	***
(year)2007	−0.144	46.4%	−5.2	***
(year)2010	−0.226	44.4%	−8.0	***
(year)2015	−0.248	43.8%	−8.1	***
(year)2019	−0.295	42.7%	−8.9	***

Signification codes: '***' 0.001, '**' 0.01, '*' 0.05, '.' 0.1

Regional dummies [c]

Group	Mean [d]	Standard Dev.
EAP_DVD	0.256	0.089
EAP_DVG [e]	0.277	0.067
ECA	0.197	0.083
EU13	0.225	0.071
EU15	0.223	0.062
LAC	0.176	0.025
MNA	0.176	0.068
NAM	0.200	0.005
SAS	0.246	0.061
SSA	0.209	0.049

Notes: MVA/GDP: Share of manufacturing value–added in GDP, current prices. a/ Coefficient estimates are the logit values, they were normalised to % to improve comparability; the adjacent column indicates the expected manufacturing share. b/ Applies to the initial logit coefficients. c/ and d/: Based on an average of country's random effects.; e/ Includes China; f/ Base year for time index.
Source: Autor, based on Package 'mgcv' (S. Wood, 2025)

Table 4 indicates that, in general, at similar income level, developing countries have in average a 4 ppt higher share of manufacturing value-added in their GDP. But this result is mitigated by two other considerations: regional specificities and time trend. The time trend is negative, with a tendential drop of

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[12] We detect in the second volume of this study the existence of a hysteresis effects that may slow-down the industrial erosion in legacy industrial countries.

7.3ppt between 1995 and 2019. The disaggregation by region mitigates the positive dummy observed for developing countries. Considering that they will take time to reach an income level comparable to developed countries, the negative time coefficient will further erode the positive effect of the DVG dummy.

The main systemic differentiation was found at country level. The right-hand side of Table 4 show the mean of country dummies by sub-regions. North America (NAM) is below EU and at the same level than the very heterogeneous other European and Central Asia countries. There is no significant difference between EU13 and EU15 countries, even if there is more heterogeneity in the EU13 group.

From a regional perspective, the highest coefficients are found in East Asia and Pacific, followed by Southern Asia. Sub-Saharan Africa is below the overall developing countries average but remains above Latin America and the Middle East and North African regions. The latter ones appear to have the smallest industrial value–added share, after controlling for other variables such as GDP, time and development status.

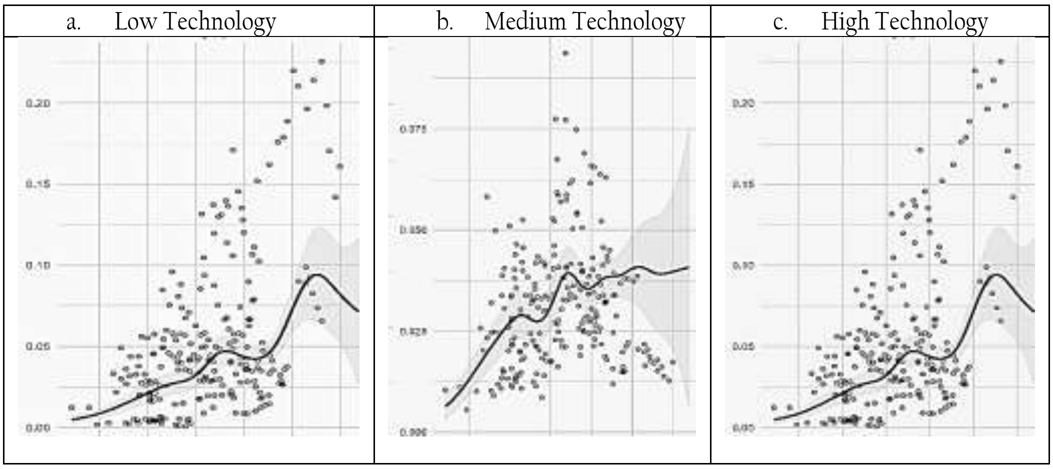
These dummy coefficients affect the intercept of the function, but cannot explain the "triple hump" observed in the graphs. There are many possible interpretations of the "Three Humps" in developing countries industrialisation. Each "hump" may coincide to a development stage: Early Industrialisation (up to \$2,000 GDP/cap); Middle-Income Expansion through labour-intensive or natural resources-based industries up to \$10,000 GDP/cap; Late-Stage Diversification, showing a transition to capital-intensive and high-technology manufacturing. In between, some countries remain caught in a lower-middle income trap and start a process of deindustrialisation.

While the observed pattern invites a range of interpretive hypotheses—including differences in industrial trajectories, technological composition, and policy environments—a thorough investigation of the alternative causes lies beyond the scope of this study and would necessitate more granular, context-specific data. In addition, it would probably require extending the time series to have more historical depth on individual country's trajectory.

4) Does Technological Content Matter?

When differentiating by technological content, the strongly non-linear pattern was observed only in the case of developing countries. For these countries Figure 6 shows a wide dispersion of data around the fitted curves.

Figure 6 Developing countries: Estimated fit between the share of manufacturing value-added at current price and real per capita income by technological level, 1995-2019



Note: Vertical axis: Share of manufacturing value–added in GDP, current prices. Horizontal axis: GDP per capita at 2015 USD. The curve and the shaded area represent the estimated fit and its upper and lower bounds using a GAM model with random country effects and a k=15 parameter.
Source: Based on UNIDO and OECD data

The humps are caused by the local concentration of outliers that are either above or below the fit. But the graph shows also that most of the upper outliers are much farther away from the expected value than the lower ones. It is therefore expected that their influence predominates in shaping the humps.

The distribution of outliers varies across industries and years (see Table 5). It is in 2007 — the culmination of the GVC-based hyper globalisation, before the 2008-2009 global crisis — that we observe for Low and Medium technology industries the greatest concentration of countries staying inside their expected manufacturing pattern (inliers). This new pattern is due to the behaviour of developing countries, while the developed countries were already in their most homogeneous phase since 2005, with a convergence rate close or at 90%.

When comparing developed and developing economies, the High Technology sector differs noticeably from the situation observed for Low and Medium technologies. For the former one, developed countries behave heterogeneously. Year 2007 is one of the four cases where the sub-sample of developed economies shows lower convergence rate than the developing one. This is due to four ex–inlier countries, Great Britain among them, reclassifying as under-performer.[13]

Table 5 Inliers and Outliers frequency by technological level and development status, 1995-2019

Years	Inliers	Outliers	Convergence rate	o/w: DVD	o/w: DVG
			Low Technology		
1995	41	33	55%	68%	41%
2000	53	21	72%	80%	62%
2005	60	14	81%	88%	74%
2007	61	13	82%	88%	76%
2010	55	19	74%	78%	71%
2015	50	24	68%	68%	68%
2019	44	30	59%	78%	38%
			Medium Technology		
1995	52	22	70%	73%	68%
2000	53	21	72%	80%	62%
2005	62	12	84%	90%	76%
2007	65	9	88%	90%	85%
2010	47	27	64%	58%	71%
2015	51	23	69%	63%	76%
2019	46	28	62%	65%	59%
			High Technology		
1995	46	28	62%	60%	65%
2000	50	24	68%	70%	65%
2005	60	14	81%	88%	74%
2007	59	15	80%	78%	82%
2010	62	12	84%	85%	82%
2015	52	22	70%	70%	71%
2019	43	31	58%	55%	62%

Notes: Inliers are within the 0.95 confidence interval of the value predicted by the model in Table 4; the convergence rate is the share of inliers in the total.

If the world industrial economy had entered the 2008-2009 financial turmoil from a relatively homogeneous situation, it was not the same in 2019, just before the COVID-19 crisis. The heterogeneity was especially large in the case of developing economies Low-Tech industries, with only a small minority of them (38%) performing as expected by the model. This was due to a number of countries reclassifying as

[13] Brunei Darussalam, Estonia, United Kingdom, Island and Latvia.

over-performer (see Table 8 below). A similar situation was observed in 2019 for developed countries in the High-Tech sector (see Table 6 below).

Indeed, the heterogeneity observed for developing countries in itself may not be an issue for those that moved upward. Nevertheless, it sends some negative signal for the future of the other countries, left behind, if the transition of the "top performers" is sustained and reflects a lasting improvement in revealed comparative advantages on the international market. If it were the case, the gap between top and bottom performers would increase with time, enclosing the non–performers into a shallow–industrialisation trap.

v. 1995-2019 transitions between higher and lower performers

To track changes in countries' relative industrial performance, we classify each observation according to its position vis-à-vis the expected manufacturing share conditional on income: under-performers and over-performers (below/above the 0.95 confidence interval) and inliers. The following tables report transitions between these categories from year 1995 to year 2019 for low-, medium-, and high-technology manufacturing.

Several countries moved repeatedly across categories over the 1995–2019 period, particularly among smaller or more open economies exposed to external shocks. The "transition matrices" presented here highlight directional changes at selected point of time, rather than structural manufacturing regime shifts. If these results should not be taken as definitive indicators taken in isolation, they contribute nonetheless to the bigger picture as they can reinforce, or at the contrary, weaken, a diagnostic build on several other indicators.

- **High-technology manufacturing**

High-technology manufacturing, which is probably the most relevant indicator of industrial development, presents sometimes unexpected patterns.

Table 6 Transition table for High Technology, 1995-2019

a. Developed countries			b. Developing countries		
y1995	**y2019**	**countries**	**y1995**	**y2019**	**countries**
under	under	FIN	under	within	LAO, MYS, PAK, THA
under	within	HUN	under	over	JOR, MEX, SAU
under	over	AUT, BGR, CZE, DEU	within	under	CHL, CIV, CRI, IDN, ISR, PHL
within	under	SWE	within	within	ARG, BRA, CHN, CMR, COL, EGY, KHM, MAR, MMR, NGA, PER, SGP, TUN, TWN
within	within	BEL, BLR, BRN, CHE, ESP, FRA, IRL, ISL, JPN, LTU, LVA, NLD, NZL, POL, PRT, ROU, RUS	within	over	KAZ, VNM
within	over	CYP, DNK, ITA, KOR, SVK, SVN	over	under	ZAF
over	under	AUS, CAN, HRV, MLT, NOR, UKR	over	within	BGD, IND, SEN
over	within	EST, GBR, GRC, USA	over	over	TUR

Note: see Table 8

Among developed economies, most countries remain stable inliers. Transitions into under or over-performance are recent and concentrated after 2010, suggesting that they may reflect post-crisis adjustment rather than long-run divergence from expected industrial patterns.

Despite strong structural heterogeneity, most developing countries remain inliers throughout the period. However, three structurally and geographically dissimilar countries—Jordan, Mexico and Saudi Arabia—transition from under- to over-performance by 2019. In Jordan and Saudi Arabia, this shift marks a clear break after a long period of under-performance, whereas Mexico's trajectory is more uneven but places it among the over-performer group in the most recent years.

On the negative side, South Africa exhibits a consistent downward trajectory, moving from over-performance in the late 1990s to sustained under-performance after 2010. Similar, though less pronounced, patterns are observed for Côte d'Ivoire and the Philippines. Several apparent under-performances in 2019 (e.g. Israel, Costa Rica, Chile) follow long periods as inliers and are likely to reflect short-term fluctuations rather than structural shifts.

- **Medium-technology manufacturing**

Table 7 Transition table for Medium Technology, 1995-2019

a. Developed countries

y1995	y2019	countries
under	under	ISL
under	within	AUT
under	over	BGR, IRL, LTU
within	under	BRN, FIN, GRC
within	within	BEL, BLR, CAN, CHE, CYP, CZE, DEU, DNK, ESP, EST, FRA, HRV, ITA, KOR, LVA, NLD, NOR, NZL, POL, PRT, SVK, SWE, USA
within	over	HUN, JPN, SVN
over	under	AUS, MLT, ROU, RUS
over	within	GBR, UKR

b. Developing countries

y1995	y2019	countries
under	over	CRI, PAK, SAU
under	within	BRA, CHN, JOR, LAO
within	over	CMR, MMR
within	under	ARG, CHL, COL, IDN, SEN
within	within	BGD, CIV, EGY, ISR, KAZ, KHM, MAR, MEX, MYS, PER, SGP, THA, TUN, TUR, TWN, VNM
over	over	NGA
over	under	IND, PHL, ZAF

Note: see Table 8.

For developed countries, medium-technology manufacturing shows slightly greater dispersion than low-technology activities. The inlier group shrinks between 1995 and 2019, with a net increase in under-performers. While a few countries (notably Ireland, Bulgaria and Lithuania) move from under- to over-performance, a comparable number of countries shifts in the opposite direction, suggesting limited persistence. In several cases (e.g. Romania and Russia), repeated switches across categories point to cyclical or transitional dynamics rather than clear structural repositioning.

Among developing economies, the contraction of the inlier group is split between gains in both under- and over-performance. Three dissimilar countries—Costa Rica, Pakistan and Saudi Arabia—move from under- to over-performance, and these transitions appear relatively robust, having occurred before the end of the period. Conversely, India and South Africa display a more persistent shift from over- to under-performance, symptomatic of a relative erosion of medium-technology manufacturing intensity.

- **Low-technology manufacturing**

Table 8 Transition table for Low Technology, 1995-2019

a. Developed countries

y1995	y2019	countries
under	within	BGR, KOR, LTU
under	over	IRL
within	under	AUS, SWE
within	within	AUT, BEL, BLR, BRN, CAN, CHE, CZE, DEU, DNK, ESP, EST, FRA, GBR, GRC, HRV, ITA, JPN, NLD, PRT, ROU, RUS, SVK, SVN, USA
within	over	POL
over	under	CYP, FIN, MLT, NZL, UKR
over	within	HUN, ISL, LVA, NOR

b. Developing countries

y1995	y2019	countries
under	under	KHM
under	within	ARG, EGY, KAZ, LAO, THA
under	over	CHN, JOR, MYS, PAK, SAU, TWN, VNM
within	under	CMR, COL, IDN, PHL
within	within	BRA, CIV, ISR, MAR, PER, SGP, ZAF
within	over	BGD, MEX, MMR
over	under	CHL, CRI, IND, SEN, TUN
over	within	NGA
over	over	TUR

Note: under/within/over: Observed manufacturing share below/within/over the 0.95 confidence interval for the expected value, based on the Table 2 GAM.

Transitions among developed economies are limited. Nearly 80% of countries are inliers in 2019, with most movements reflecting convergence toward the predicted range. Only two countries stand out: Ireland, which moved from under-performance to sustained over-performance, and Poland, which joined the upper group from within the confidence interval. By contrast, several former over-performers—mainly small European economies—moved back toward or below the expected range.

Patterns are more diverse among developing countries. While the inlier group remains broadly stable, upward mobility from under- to over-performance is concentrated in East Asia (China, Malaysia, Vietnam, Taiwan), with Pakistan and Jordan as additional cases. Symmetrically, Chile, Costa Rica, Senegal and Tunisia shifted from over- to under-performance, though in most cases this reversal occurs only at the end of the period and is preceded by frequent reclassifications. These late-period downgrades should therefore be interpreted with caution.

3. Employment, Industrialisation and Outsourcing

Most researchers define deindustrialisation as a relative decline in manufacturing employment (Kollmeyer, 2009). Actually, it is usually the main topic of concern, due to its social implications, particularly when this trend is rapid and translates into high incidence of unemployment in affected regions. But concentrating on employment alone to diagnose deindustrialisation is not universally accepted (Przywara, 2019). In our view, the renewed interest in reshoring industries, after the COVID–19 pandemic and the return of geopolitical tensions in the 2020s, has probably more to do with securing access to critical inputs and components than creating new manufacturing jobs for workers.

In the 2020s, reindustrialisation is often seen as a strategic component of "industrial security" not too different from the concept of "food security" as it is understood in modern agricultural economics. Food security does not inherently require conserving agricultural jobs, but stresses the importance of making sure enough food is produced or securely imported.[14] Similarly, most reindustrialisation policies in a geopolitically fragmented world privilege strengthening the resilience of domestic supply chains through reshoring or "friend–shoring", also called "security–shoring".

1) Industry Employment in Perspective, 1995-2019

The present chapter contributes to the empirical analysis of the deindustrialisation in the course of economic maturing by searching for tipping points in manufacturing employment, with a special attention to the role of outsourcing in an international context. We also control for the existence of the statistical bias introduced by value-chain optimisation business models, when some non-core support manufacturing tasks are outsourced to manufacturing services suppliers. Tregenna (2008) professes that deindustrialisation is often a statistical illusion arising from outsourcing activities to specialised service providers. As a result, manufacturing employment would be reduced proportionately more than would manufacturing output.

An important step in the analysis was to recalculate the input-output tables to impute the labour content of the monetary flows in supply and demand. The jobs embodied in production can be direct, represented by the total number of employees in the industry producing the output, or can be indirect,

[14] Food security is supported by four key pillars: Availability (sufficient quantities of food are available on a consistent basis); Access (people can obtain appropriate food); Utilisation (adequate diet, clean water, sanitation); and Stability (access to food is maintained, even during sudden shocks or economic/climatic crises). The analogy between food security and industrial security is mainly related to "availability" and "stability". In a GVC context, "availability" translates into "supply chain resistance (or robustness)", the ability to withstand or avoid disruptions to maintain normal operations, while "stability" is expressed by "supply chain resilience", the capacity to adapt, recover, and restore after a disruption occurs.

representing the jobs from other branches of activity embodied in the inputs purchased by the industry. Annex 2 present the methodology used to calculates these indirect jobs. [15]

Table 9 illustrates the general declining trend in the relative weight of factory–sector employment. This share decreased by 2.1 percentage point (ppt) in average of all regions over the 1995-2019 period, before the COVID-19 years. The drop is much larger for female workers (-2.7ppt) than males (-1.5ppt), reflecting, among other things, better employment opportunities for women in services and the higher incidence of labour–saving technical progress. Actually, in 2019, the factory sector employed about or less than 10% of female workers in most developed region, except EU13 and East Asia and Pacific. Comparable low rates of female employment at about 10% are found in Africa (North and Sub-Sahara as well as in the Middle-East region).

Table 9 Share of manufacturing employment by regions and sex, 1995-2022 (selected years)

Female manufacturing jobs/ Total female employment

Region	1995	2007	2010	2019	All years [a]
EAP_DVD	19.5%	12.6%	11.0%	9.7%	12.9%
ECA	16.2%	13.3%	12.1%	10.7%	13.0%
EU13	21.7%	19.1%	15.9%	16.6%	18.0%
EU15	14.7%	10.8%	8.7%	8.2%	10.5%
NAM	10.3%	7.5%	6.2%	6.3%	7.6%
CHN [b]	25.9%	26.8%	27.9%	27.6%	26.3%
EAP_DVG	13.7%	14.5%	14.4%	16.5%	14.8%
LAC	13.6%	12.7%	11.9%	10.9%	12.3%
MNA	14.3%	9.6%	8.8%	9.4%	10.3%
SAS	8.5%	12.1%	11.6%	13.1%	11.8%
SSA	10.9%	10.6%	9.9%	10.0%	10.5%
Average [c]	15.4%	13.6%	12.6%	12.6%	13.5%

Total manufacturing jobs / Total employment

Region	1995	2007	2010	2019	All years [a]
EAP_DVD	22.0%	17.2%	15.8%	14.8%	17.2%
ECA	18.2%	16.5%	15.1%	14.2%	15.9%
EU13	23.5%	21.9%	19.4%	20.8%	21.2%
EU15	21.2%	17.1%	14.8%	14.0%	16.7%
NAM	15.3%	11.8%	10.7%	10.3%	12.0%
CHN [b]	18.4%	20.1%	21.0%	21.5%	19.8%
EAP_DVG	12.5%	13.1%	13.0%	14.7%	13.4%
LAC	15.2%	14.7%	13.7%	12.7%	14.0%
MNA	14.1%	11.8%	11.8%	11.7%	11.9%
SAS	10.1%	12.1%	11.7%	12.9%	12.0%
SSA	10.6%	9.7%	8.4%	10.3%	9.9%
Average [c]	16.5%	15.1%	14.1%	14.3%	14.9%

Male manufacturing jobs/ Total male employment

Region	1995	2007	2010	2019	All years [a]
EAP_DVD	23.7%	20.6%	19.3%	18.8%	20.3%
ECA	19.8%	19.2%	17.7%	17.1%	18.4%
EU13	24.9%	24.2%	22.2%	24.2%	23.7%
EU15	25.8%	22.1%	19.8%	18.9%	21.6%
NAM	19.6%	15.6%	14.6%	13.7%	15.8%
CHN [b]	12.1%	14.5%	15.4%	16.4%	14.4%
EAP_DVG	11.6%	12.2%	12.0%	13.5%	12.4%
LAC	16.1%	16.0%	15.0%	13.9%	15.1%
MNA	14.1%	12.4%	12.7%	12.2%	12.4%
SAS	10.6%	12.2%	11.7%	12.8%	12.0%
SSA	10.2%	8.9%	7.1%	10.6%	9.4%
Average [c]	**17.1%**	**16.2%**	**15.2%**	**15.6%**	**16.0%**

Notes: The data refer to the 76 countries covered by the present study.
a/ All years: average over the 1995–2022 period; b/ China, considered as a region by itself considering its weight in World manufacturing production.
c/ Simple average of regions and China.

Sources: Author, on the basis of ILO data

2) Regional Specificities

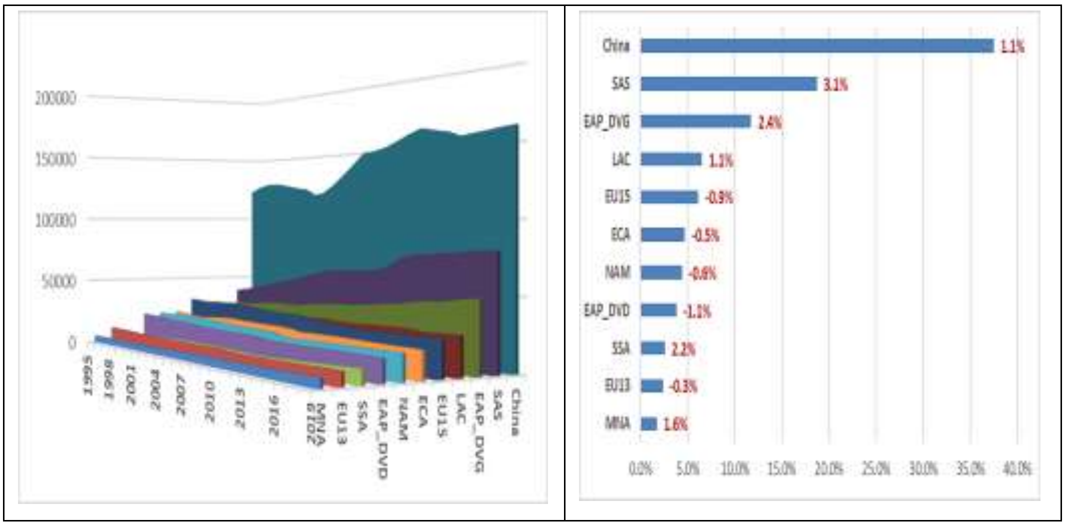
Not all regions followed similar trends. Actually, the decrease in manufacturing employment is mainly concentrated in developed economies, with regional variations of -5.2ppt, -6.2ppt and -4.2ppt for total, female and male employees respectively. These indictors compare unfavourably with the positive changes observed in average of developing regions (0,5ppt, 0.1ppt and 0.8ppt, respectively). But these averages hide a structural rebalancing within this group of countries: industrial employment increased markedly in Eastern and Southern Asian countries while stagnated in Sub-Sahara Africa and decreased in Latin America or in Middle-East and North Africa.

Thus, in addition to a global North to South redistribution of World manufacturing employment, we observe a West to East movement. Moreover, the regions where manufacturing employment is growing

[15] We consider here only the indirect jobs induced by the direct input requirements (first-tier suppliers). The total number of indirect jobs induced by the production of an industry is larger and would include all the jobs generated in the supply chain (total input requirements). Because our main interest is on deindustrialisation, we chose to limit ourselves to direct requirements as they directly result from business decisions made by the producing industry and reflect better changes in business models (e.g. "make or buy" decisions).

is also where the female participation is higher. The share is at its maximum in China, with almost 28% of female employees working in the factory sectors.

Figure 7 Evolution of total manufacturing employment, world share and annual growth rates, 1995-2019 (thousands and percentages)



Notes: Based on 76 countries. Left panel: total number of employees in manufacturing sectors. Right panel: blue bar: share in total (2019) and percentage in red: 1995–2019 CAGR.
Source: Based on ILO modelled estimates of employment by sex and economic activity.

China and Southern Asia factory employees dominate our sample in terms of number (Figure 7). Over a total number of about 428.6 million workers in the 76 countries covered by the study, about 37.5% were in China and 18.7% in Southern Asia. The latter was also the fastest growing one, with an annual average growth rate of 3.1%, followed by 2.4% for Eastern-Asian developing countries (China excluded). Negative growth rates are the norm in most developed countries.

4. Income-Related Turning Points in Industrial Employment

The present section investigates the existence of an inverted U relationship between average per capita income in a country and its share of manufacturing employment. We will distinguish total, female and male employment.

As before in section 1), we build a general non-linear model (GAM) linking the share of industrial employment to per capita income. [16] We also compare in Annex the results with a more traditional quadratic regression, for robustness. The share of manufacturing employment "depends" on a sum of smooth functions of our predictor (GDP/capita), including dummy predictors (time, countries, regions).

1) Total Industrial Employment

The results we present here are those obtained with a "reasonably flexible" GAM parameter K=8. The response variable (the variable to be fitted) is the share of manufacturing employment in total labour force in a given country. The data are collected for 1995, 2000, 2005, 2007, 2010, 2015 and 2019. Our predictor is the logarithm of real income per capita, based on GDP at constant US dollar of 2015 and total

[16] The most appropriate Beta family of GAM failed here, due to boundary values and optimizer instability. We opted for the more robust Gaussian family with K=8 and K=15, even if in the present case our variables are bounded. In this second-best approach, fitted values can theoretically wander outside]0,1[for its predictions. It was not the case in practice and does not affect the shape of the Kuznets curve.

population. The model is fitted by modelling time as a fixed factor and country and regions as random effects. We took that option to include some flexibility in the estimation of country and region specificities, considering the possible fluctuations in data coverage and compilations. [17]

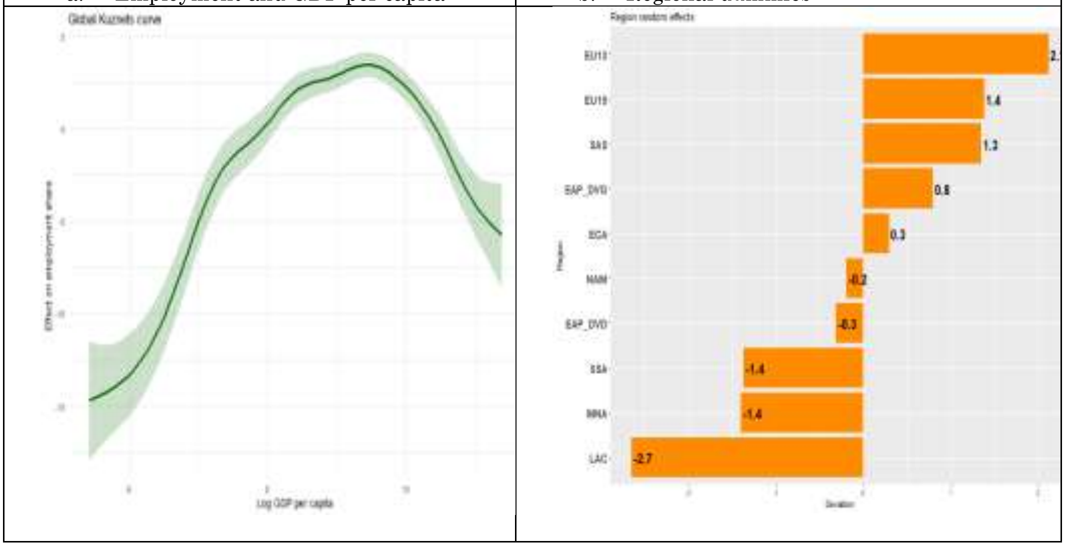
Figure 8 (panel a) reveals a clear inverted U in the relationship between the share of factory–sector employment and real GDP/capita. The positive effect peaks at about $12,000, after controlling for country, regional and time effects. These effects are actually quite significant.

The inverted U is in line with Rowthorn's framework and subsequent empirical tests. Przywara (2019) suggests that the maximum point of manufacturing employment relative to GDP per capita follows different functional forms in developed and in developing countries. He explains the difference by differences in the density and productivity of domestic suppliers (Diegues and Ferreira, 2024).

The time trend is strongly negative. On a base 1995 = 0, it gradually drops to -4.5 in 2019. This trend is consistent with a situation of labour-saving technical progress; a hypothesis commonly accepted in the literature. This trend matches findings in de Souza (2014) and ongoing processes reported in OECD (2019), which document labour-saving technical progress as a driver of declining manufacturing employment, especially in the middle-skilled jobs segment. This labour-saving hypothesis is widely accepted in both historical and contemporary Industry 4.0 contexts. In their review of the literature, Staccioli and Virgillito (2021) look at the issue from the perspective of long-waves labour-saving innovations, starting with the First Industrial Revolution. Baldwin and Forslid (2020) extend this trend into the future, with a very pessimistic prediction for manufacturing jobs.

Figure 8 Relationship industrial employment share and GDP/capita, All employees

a. Employment and GDP per capita	b. Regional dummies



Note: Based on a hybrid K=15 GAM model with Country and Region random effects and fixed effect time dummies. Predictor: log (GDP per capita) in dollar at constant 2015 prices.
Source: Author, based on ILO and UNIDO data

Country dummies are not significant at 0.10; their influence being probably captured by the regional groupings. The coefficients affecting regional variables (panel b) are of particular interest from the perspective of (de)industrialisation in developed and developing countries. Developed countries of legacy

[17] More specifically, the model in R package "mgcv" was formulated as:
share employment ~ s (log_gdp_pc, k = 8) + factor (Years) + s (ISO3, bs = 're') + s (Region, bs = 're').

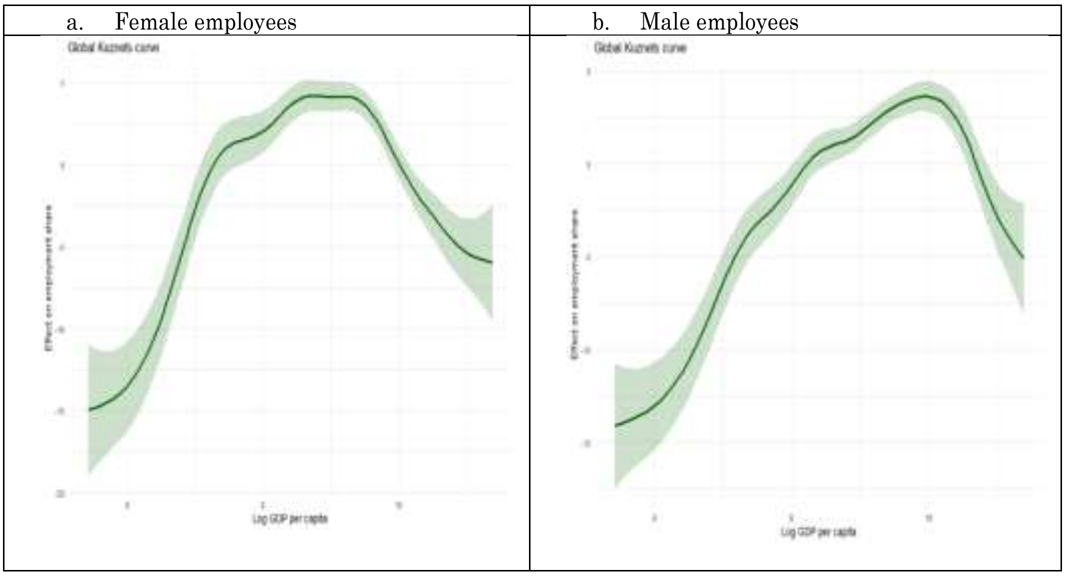
industrialisation benefit from a positive effect, after controlling for GDP/capita and other contextual variables. European countries, in particular, benefit from a positive impact. This may reflect inheritance from the past, in particular in the EU13 group which comes from an history of a central planning economies where services were under-represented and manufacturing was of relatively low-productivity. The existence of a dense network of domestic sub-contractors and a large domestic market allows local producers in legacy industries to face more effectively the globalisation challenges.

Among the developing countries, Southern Asia is also in this positive group of dummies. On the negative side, we find Latin America with a strongly negative effect. It means that industrial employment tends to be about 2.7% lower than what could be expected from the income data, irrespective of the year. A similar situation is observed in Middle East and North Africa and in Sub-Saharan Africa, albeit with smaller negative impact.

2) Comparing Female and Male Employment

This section compares the proportion of female and male employment in manufacturing, calculated relative to each group's total employment. The share of industrial employees in the female population peaks when a typical country reaches a per capita income of about $10,000 at 2015 prices. The corresponding peak is much higher for male employees, reached at about $19,000 level of income. On the other hand, the fall after the tipping point is steepest in the case of the male population.

Figure 9 Manufacturing employment share vs. GDP per capita, by sex

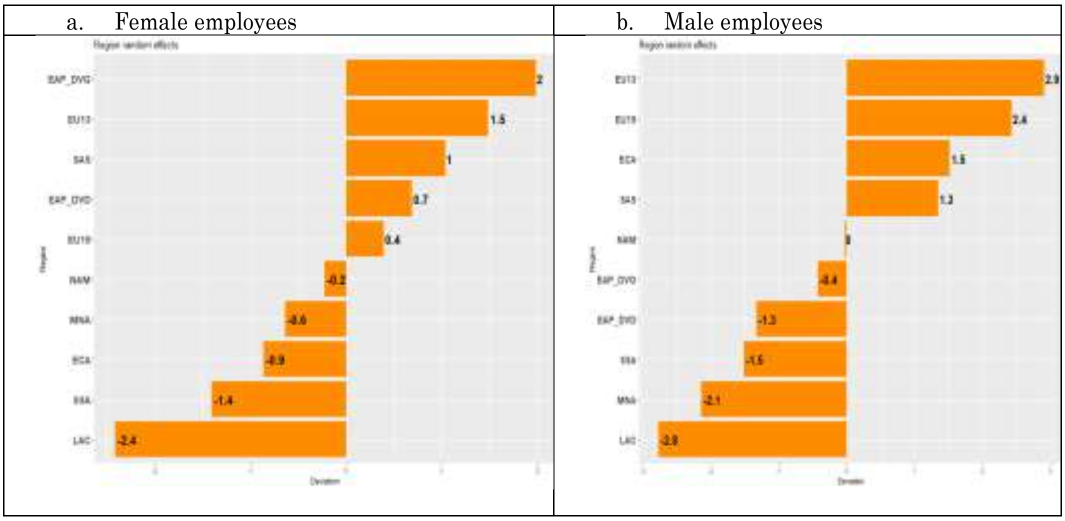


Note: Based on a hybrid K=15 GAM model with Country and Region random effects and fixed effect time dummies. Predictor: log (GDP per capita) in dollar at constant 2015 prices. Response: proportion of total female or male employment in manufacturing.
Source: Author, based on ILO and UNIDO data

There are also clear differences between regions (Figure 10). This coincides with Tejani and Milberg (2016) who highlighted the wide regional discrepancies in female employment. The incidence of manufacturing employment in the female population is particularly high in the Eastern Asia developing countries (EAP_DVG). This regional dummy is slightly negative in the case male employment. The high incidence observed for female employment in developing Asia is probably related with the weight of textile and apparel production as well as electronic appliances in these countries.

In contrast, EU15 stands out for its higher share of male employees, while the respective dummy for female employment is close to 0. We can possibly relate this higher incidence to the weight of legacy industries such as automobile and other transport equipment in this region.

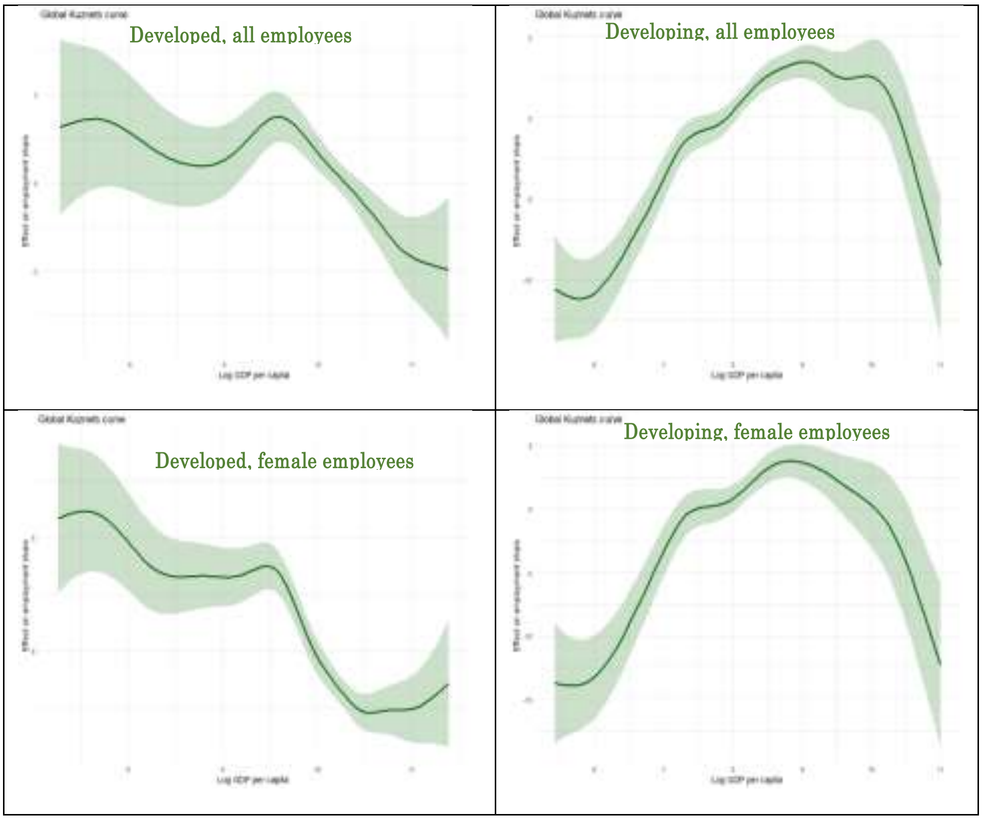
Figure 10 Regional differences in female and male shares of industrial employment

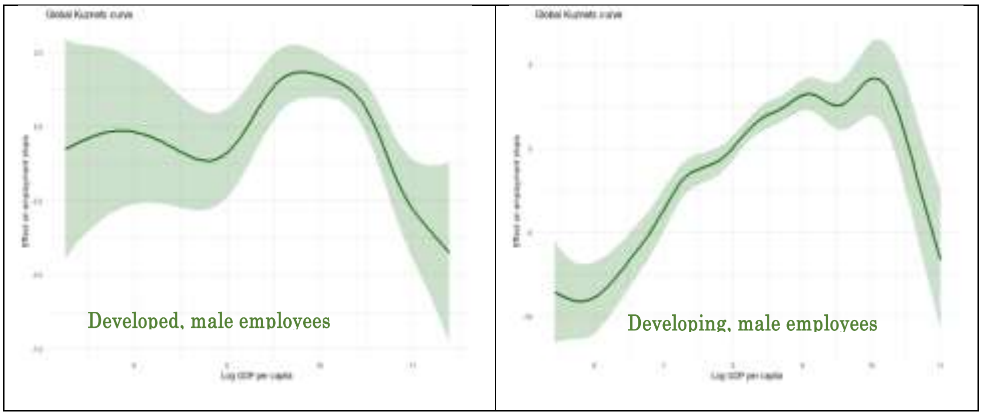


Note and sources: see Figure 9

As before, we find large divergences between developed and developing economies. Actually, the group of developing economies mostly validate the hump-shaped relationship between manufacture employment and GDP per capita, while developed economies display a more diverse profile. The difference is particularly striking in the case of female employment (Figure 11).

Figure 11 Manufacturing employment share vs. GDP per capita, by sex and development status





Note and sources: see Figure 9

In developing economies, female manufacturing employment follows a Kuznets–type trajectory, with a peak occurring at lower income levels than for men, consistent with the standard structural–transformation narrative. However, among high–income economies, the relationship departs markedly from this pattern and exhibits a non–monotonic shape, with pronounced declines over a narrow income range and increased heterogeneity thereafter.

Sorgner (2021) in her extensive review of the literature and evidences from developing countries indicates that the feminisation of labour in manufacturing is primarily related to labour–intensive industries. Technological upgrading leads to higher growth in capital intensive industries, which is associated with the defeminisation of labour. It may provide an explanation to the lower peak observed in developing countries, increase in per capita income being often associated with a shift to higher–value added (i.e., more technologically intensive) types of industries.

The resulting pattern for female employment in developed economies resembles an "elephant" whose contours vary depending on the analytical perspective adopted. Like the parable of the seven blind experts, different strands of the literature — structural transformation, deindustrialisation, technological change, institutional constraints — grasp distinct parts of the phenomenon, none of which alone provides a complete account.

The literature has identified several developments that can produce these non-monotonic patterns. Besides cultural barriers in some traditional communities, institutional bias such as progressive marginal tax rates that affect secondary earners in high–tax economies may be an obstacle to female employment (Carranza, Das, and Kotikula, 2023).

Olivetti and Petrongolo (2016) hypothesis is that the growth in the service sector has created jobs for which women have a natural comparative advantage related to the more intensive use of communication and interpersonal skills. This may explain an historical downside trend in industrial employment, but not the brutal fall observed at around $12,500 per capita GDP in high–income countries. The recuperation observed at the higher income levels is accompanied by a much higher variance, indicating that the trend reversal affects only some countries while other continue on their decreasing path.

Our data do not allow to control for the effect of manufacturing "*servicification*" when non-core manufacturing tasks are outsourced to specialised business services providers. But one may presume that outsourcing may affect women more strongly in developed economies if they are employed in labour–intensive activities such as textiles and apparel, or electronics assembly. These segments are more frequently outsourced to low-income countries as income (and therefore, wages) rises in developed countries. That can cause sharp drops in female manufacturing employment in the relatively narrow income band around $12,500.

Box 3 Disaggregating female employment by industries

We use an exploratory OLS regression to identify the sectors that have an influence on the employment of women in the factory sector. [18] To do so, we applied the same model on the share of female and male employment in manufacturing in a country. The regressors correspond to the share of individual sectors in the total industrial value-added. The regression fit is better for male employment than for the female one, indicating greater heterogeneity in the latter case. Actually, there are fewer sector with "significant" coefficients in the case of female employment compared to male workers.

The results do not validate the hypothesis that female employment is concentrated in the low-technology sector. The industries with a stronger propension to recruit female employees are the low-tech C13T15 (Textiles, textile products, leather and footwear), but also the high-tech C26 (Electronic and optical equipment) and C27 (Electrical equipment). On the other side, the lower female propensities are found in C22 (Rubber and plastics products) and C29 (Motor vehicles, trailers and semi-trailers). Other coefficients have too large a standard error for the difference to be meaningful.

In both cases, we observe a significative decreasing time trend, with slightly more negative impacts for women employment. In developed regions, we find a stronger propensity to recruit female workers in EU13; this bias is even greater in China, which show the highest female contribution to the manufacturing workforce (10.3) while the coefficient is significantly negative for male employment (-6.2). Nevertheless, when interpreting the positive results for developing region, one must take into consideration the broader negative dummy associated with development status.

Table 10 Female employment and the structure of industrial activity.

Variable	Female Estimate	SE	Signif.	Male Estimate	SE		Industries: Short label and technology
(Intercept)	−22.3	15.8		−21.1	11.7	.	
share_C10T12	33.0	16.4	*	28.8	12.2	*	Food products...(L)
share_C13T15	52.0	15.9	**	35.4	11.8	**	Textile products, ...(L)
share_C16_17_18	51.3	32.3		81.3	24.0	***	Wood products(L)
share_C19	28.0	16.1	.	27.2	11.9	*	Coke and refined petroleum(L)
share_C20	25.5	18.9		55.0	14.0	***	Chemical, products(H)
share_C21	5.3	16.0		16.9	11.9		Pharmaceuticals products(H)
share_C22	108.6	30.8	***	137.0	22.9	***	Rubber and plastics products(M)
share_C23	30.0	21.1		3.0	15.6		Non−metallic mineral products(M
share_C24	29.1	16.3	.	32.0	12.1	**	Basic metals(M)
share_C25	−5.6	23.8		46.8	17.7	**	Fabricated metal products(L)
share_C26	62.6	17.2	***	60.5	12.8	***	Electronic and optical equipment
share_C27	92.5	23.0	***	71.3	17.1	***	Electrical equipment(H)
share_C28	56.0	19.5	**	56.8	14.5	***	Machinery and equipment, nec(H)
share_C29	33.6	17.0	*	43.6	12.6	***	Motor vehicles H)
share_C31T33	−11.6	20.7		11.6	15.3		Manufacturing nec, repair(M)
(Year)2000	−1.4	0.7	.	−1.0	0.5	.	
(Year)2005	−2.0	0.7	**	−1.7	0.5	**	
(Year)2010	−3.6	0.7	***	−3.0	0.5	***	
(Year)2015	−3.7	0.7	***	−3.3	0.5	***	
(Year)2019	−3.6	0.7	***	−3.4	0.5	***	
(Region)EAP_DVG	0.5	1.2		−4.8	0.9		
(Region)ECA	4.1	1.2	***	4.5	0.9	***	
(Region)EU13	9.0	1.1	***	5.9	0.8	***	
(Region)EU15	2.6	1.1	*	3.5	0.8	***	
(Region)LAC	3.5	1.2	**	−0.6	0.9		
(Region)MNA	3.6	1.3	**	−1.0	1.0		
(Region)NAM	0.3	1.6		−1.5	1.2		
(Region)PRC	10.3	2.2	***	−6.2	1.6	***	
(Region)SAS	0.8	1.4		−2.0	1.1	.	
(Region)SSA	2.0	1.4		−0.6	1.0		
Adjusted R2	0.54			0.76			

Note: Excluding Hong Kong and Luxembourg. The smallest sector C30 (Other transport equipment) was excluded to avoid perfect collinearity. Dummies for year (1995) and Region EAP_DVD are used as base and set to 0. (H): High and Medium High technology; (M): Medium technology; (L) Low and Medium−Low technology.
The significance level codes ('***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ") are only indicative (see foot note 18).

[18] We call it "exploratory" because the regression equation does not correspond to a well specified model (among other things, both the regressand and the regressors are bounded [0,1] and not gaussian). As a consequence, results should be considered only as illustrative.

This differentiation between men and women employed in industries reveals the importance of sex-disaggregated data in employment. The limited evidence available does not allow to offer conclusive explanations on the differences observed, in particular to explain the "elephant" shape in rich countries vs a plain Kuznets in poorer ones. The main long-term causality is probably the rise of services that occur in the process of economic development and its accompanying between–industries reallocation. While skill-biased and task-biased technological change may probably favour female employment from the long-term perspective, the more recent offshoring of female–intensive low–tech manufacturing segments to developing economies and the domestic outsourcing of some support tasks to the business services sector has probably weighted negatively on the indicator in advanced economies.

In Annex, we conduct a robustness exercise comparing GAM results with more traditional OLS regression. These results broadly align with the GAM. Both approaches confirm the hump-shaped relationship between manufacturing employment and GDP per capita, with significant gender differences. The negative time trend is also significant in both cases. The regional contrasts, while generally aligned, should be interpreted with caution as OLS may exaggerate discrete effects while GAM provides a smoother baseline.

Finally, we apply in Box 3 (next section) another OLS model to analyse the relative incidence of disaggregated industrial activity on female and male employment. The results show a concentration of the former on some sectors, in a context of larger heterogeneity between country concerning female employment. The sectors that are more intensive in female workers are usually associated with downstream final products: Textiles, textile products, leather and footwear, Electronic and optical equipment), and Electrical equipment.

3) (De)Industrialisation, Outsourcing and Manufacturing Employment

This section complements this macro analysis, adopting the more microeconomic focus we develop in Vol. II. We will use input–output data to look at the labour implications of the arbitrages realised when adjusting through time the production function [14] in Vol.II.

First, we compare the number of jobs being outsourced to domestic or to foreign suppliers to the total employment in the country. This indicator will tell us if outsourcing did explain, or not, the general declining trend observed for manufacturing employment in most countries. In a second step, we relate this number to the size of employment in the industry itself. This second indicator indicates the extent of outsourcing in specific sectors.

i. Conceptual reframing of input–output data

Our analytical cornerstone here is to replace monetary flows in the ICIO tables by their equivalent in terms of jobs. The calculation is based on an imputation of jobs embodied into intermediate and final products, based on input-output and employment data. The methodology is presented in Annex in Volume II.

The results are estimates, themselves based on hypothetical imputations: they should not be considered as "hard data". In–line with the warning expressed by Rowthorn and Ramaswamy (1999), input–output coefficients are used here purely as an accounting device to trace employment embodied in trade flows, not as behavioural parameters in predictive models. As they note, fixed-coefficient models tend to overstate displacement effects when interpreted causally. Therefore, our results, useful for measuring structural decomposition in terms of embodied labour, are reported merely to identify patterns and should be interpreted with caution. With these caveats in mind, the objective of this section is to delimit robust regularities once employment is measured consistently across production systems.

The calculation of total jobs embodied in the production of any given sectoral output in this producer-based accounting framework (PBA) is equal to the number of direct jobs employed by the sector plus those embodied into the inputs required for producing the output. [19] Labour productivity differs from sector to sector and from country to country, and the same monetary value for a product at a given time may embody different numbers of jobs depending on the composition of the sectoral production function and the origin of the inputs required. Similarly, it is not a "constant weight" type of calculation: it follows the evolution though time of labour productivity.

In other words, labour content is not an invariant measure. Because the same good can be produced by different technologies, the labour content of similarly priced traded products may change from country to country. Shiozawa (2018) argues that international specialisation across firms in different countries depends on business decisions in which wage rates shape the feasible strategies. In an approach similar to equation [4] of Vol. II, in his framework, firms choose the cost-minimizing technique. The production cost (and the unit price, in his mark-up pricing approach) depends on wage rates, input prices (domestic and international), and productivity coefficients.

We cannot rely on credible data to separate female and male employment for our disaggregated I-O tables. The results presented below were calculated on total PBA employment, without differentiating by sex.

Accounting for embodied jobs allows to partially control for nominal fluctuations in input prices. It is particularly relevant in the case of domestic services inputs, as the price of industrial goods relative to services has decreased in most countries, resulting in an increasing weight of the cost of these services even in absence of additional outsourcing. Conversely, it corrects for the bias due to the lower price of inputs imported from low-cost, but low-productivity, producers.

We will focus our review of the regional perspective to developed economies of legacy industrialisation (Europe and North America) and two developing regions, Latin America and Sub-Saharan Africa, that have been identified in the literature as being at risk of premature deindustrialisation (Rodrick, 2016).

Finally, for simplifying the exposition, we will call "direct jobs" those generated within the industry itself and remunerated by its value-added, and we call "indirect jobs" those created by the suppliers when the industry purchased the inputs required to produce the output. The qualification of "indirect" applies only to direct suppliers contracted by the firm and do not include all the other jobs that would have been indirectly created by these first–tier suppliers. This corresponds to the PBA logic adopted here and may differ from the more systemic "indirect" effects found in the literature based on a full Leontief model. We restrict the coverage to industrial and manufacturing suppliers, excluding primary sectors and other services.

[19] The calculation is based on the direct requirement Input-Output matrix "A", showing the inputs purchased directly by an industry for $1 of output. An alternative, not explored in this paper, would base the calculation on the total requirement matrix $(I-A)^{-1}$. This alternative sub-system approach would capture the entire chain of direct and indirect inputs and jobs required to produce a good. It usually applies only to final goods, as all intermediate inputs are included in the total requirement coefficients. See d'Angelo et al. (2025) for an application.

ii. All manufacturing sectors and related business services

Manufacturing employment declined in all regions, with the exception of Southern Asia, where it increased, and Sub-Sahara Africa where it remained stable in percentage of the total employment. The largest drop in direct factory-sector employment over the 1995-2019 period took place in the EU15 region (-7.5 ppt). The decrease in other developed regions was also consequent: -5.7ppt in EU13 and -5.2ppt in North America.

Table 11 Manufacturing employment and related business services jobs, 1995-2019

:	EU13	EU15	NAM	ECA	EAP [a]	LAC	MNA	SAS	SSA
				Direct jobs					
- 1995	24.9%	20.6%	15.2%	18.4%	15.7%	15.4%	16.1%	11.3%	10.4%
- 2019	19.2%	13.0%	10.1%	12.9%	13.2%	11.8%	12.5%	14.5%	10.3%
				Direct and associated Business Services jobs [b]					
- 1995	27.7%	24.1%	18.6%	21.3%	18.0%	18.0%	18.4%	12.5%	11.6%
- o/w services	*2.8%*	*3.5%*	*3.4%*	*2.9%*	*2.4%*	*2.6%*	*2.4%*	*1.2%*	*1.2%*
- 2019	22.6%	16.5%	12.5%	15.8%	16.3%	14.4%	14.9%	16.6%	11.9%
- o/w services	*3.4%*	*3.5%*	*2.5%*	*2.9%*	*3.1%*	*2.6%*	*2.4%*	*2.1%*	*1.6%*

Notes: Simple average of country results, in percentage of total employment; a/ Includes both developed and developing economies; b/ include the jobs embodied in the business services inputs required for producing the industrial output, most of them being domestically procured.
Source: Annex Table 13

A first an important conclusion emerges from the results: accounting for the loss of direct jobs due to the *servicification* of manufacturing production does not change the overall picture. Actually, our estimates of embodied labour do not validate the hypothesis of a statistical bias in the deindustrialisation trend in developed economies. With the exception of EU13 region, the share of business services in total employment remained stable or even decreased in the developed regions. It increased in Eastern and Southern Asia, and to a lesser extent in Sub-Saharan Africa. But regional averages may hide large heterogeneity between countries and between industries. Actually, the picture is more contrasted when we disaggregate industries by technological level.

iii. High-Technology industries

We will develop more in details the review of this sector, as it probably allows for a cleaner comparison of developed industrial economies (theoretically endowed with comparative advantages in this capital and skill intensive sector) vs. developed countries. The data contradict many naïve expectations; in particular they show cases of rapid catching-up. The latter usually takes place in a context of rapid integration into regional and global value chains, as is the case of EU13 countries. Manufacturing had remained important in these countries, as it played a large role in centrally planned economies. By 1995 the privatisation and structural change was already advanced in EU13. Structural changes and industrial upgrading continued through most of the 1995-2019 period, thanks to the former state-owned enterprises regaining and increasing their productive capacity, many of them through foreign direct investment, especially from Germany.

The results show also the risks of being marginalised from this global trend, as in Latin America and Sub-Saharan Africa. Chapter 2 of ADB et al. (2025) focuses precisely on these two regions, offering a detailed assessment of their competitiveness from a GVC perspective.

- Developed vs. developing countries

In developed economies, the weight of High-Tech manufacturing in the total jobs created by this sector according to the PBA approach fell continuously between 1995 (5.7%) to 2019 (4.5%) in weighted average. The median value, more representative of economies with a smaller High-Tech manufacturing sector, indicates a sharper drop, from 6.1% to 4.1%. This erosion did not benefit the developing economies High-Tech sector. In these countries, High-Tech employment stagnated at about 3%, showing even a deterioration in the smaller countries (the median value for developing countries fell from 2.4% to 1.6% during the period).

Table 12 High-Tech manufacturing employment, selected indicators developed and developing economies.

	1995	2000	2005	2010	2015	2019
	Sector share (pct of total employment) a/					
DVD	**5.7%**	**5.4%**	**5.0%**	**4.5%**	**4.5%**	**4.5%**
- U15	6.0%	5.9%	5.2%	4.4%	4.3%	4.2%
- U13	5.5%	5.2%	5.2%	4.9%	5.3%	5.6%
-North Am.	5.4%	5.3%	4.5%	3.7%	3.7%	3.6%
DVG	**3.1%**	**3.0%**	**2.9%**	**2.8%**	**2.8%**	**2.7%**
- Latin Am.	2.7%	2.7%	2.6%	2.4%	2.5%	2.5%
- S.S. Africa	1.2%	1.2%	1.2%	0.9%	0.9%	0.8%
	Sector plus Outsourced business services (pct of total employment) b/					
DVD	**6.8%**	**6.5%**	**6.2%**	**5.6%**	**5.7%**	**5.7%**
- U15	7.3%	7.3%	6.6%	5.7%	5.6%	5.5%
- U13	6.2%	5.9%	6.1%	6.0%	6.4%	6.8%
-North Am.	6.8%	6.7%	5.8%	4.7%	4.7%	4.6%
DVG	**3.8%**	**3.7%**	**3.7%**	**3.6%**	**3.5%**	**3.5%**
- Latin Am.	3.3%	3.5%	3.4%	3.2%	3.3%	3.3%
- S.S. Africa	1.4%	1.5%	1.5%	1.2%	1.1%	1.0%

Notes: Weighted average of countries' indicators, after aggregation of gross data by sub-group. a/ share in total home country employment; b/ share of sectoral factory employment plus the business services domestic jobs embodied in the industrial sectoral production
Source: Annex Table 13

The results take another dimension when we compare the jobs outsourced to direct suppliers of industrial inputs and business services to the direct factory employment, rather than the total national data. High-tech industries in developed countries increasingly outsourced production tasks to domestic and foreign suppliers, and the share of indirect jobs embodied in the production rose from 40.4% in 1995 to 49.7% in 2019. In other term, in 2019, each job in manufacturing sustained an additional job in another sector in average of developed countries. Outsourcing to business services (mainly to domestic suppliers) was part of the trend, with its share increasing from 18.0% to 26.5% of all direct and indirect employment generated by High-Tech industries. But this was not enough to compensate the erosion of direct manufacturing employment. During the period under review, the share of High-Tech manufacturing jobs and related business services ones decreased from 6.8% to 5.7% of total employment, in average of developed economies. The erosion was faster in the "typical" cases, and the median decreased from 7.2% to 5.2% from 1995 to 2019.

A similar pattern is also observed in developing countries, where indirect jobs rose from 44.4% of total direct and indirect sectoral employment to 50.6% in 2019. Employment in business services benefited from this outsourcing trend. Starting from a lower point than developed economies (22.2%), it rose to 29.7%, a higher percentage than the developed economies average (26.5%). Imputing the indirect business services jobs to the industrial eco-system somehow mitigates the decline in high-tech employment. The share of High-Tech industries and related indirect business services employment moved only slightly down from 1995 to 2019, from 3.8% of total employment to 3.5% in average of the developing countries.

- Regions of legacy industrialisation

High-Tech employment decreased in both EU15 and North America in proportion of total employment (see Annex Table 13). The shares from 1995 to 2019 dropped from 6.0% to 4.2% in EU15 and from 5.4% to 3.6% in North America. Outsourcing tasks to business services was stronger in EU15, this sector representing 32.7% of direct and indirect employment in 2019, against 20.7% in 1995. The respective data for North America were 28.2% in 2019, marginally above the 27.2% observed in 1995.

Even in the EU15 case, the outsourcing of tasks to the business services sector does not compensate for the loss in direct jobs. Even after including the related business services ones, the weight of this sector in total employment decreased from 7.3% in 1993 to 5.5% in 2019. The median followed a similar trend, down from 8.1% to 5.0%. In North America, the mean dropped from 6.8% in 1995 to 4.6% in 2019 (no median value as only two members: Canada and the USA).

The East Asia and Pacific developed countries were not an exception, and high-tech employment declined 1.1ppt (direct) and 1.3 ppt, after including business services. As mentioned, this decline may also reflect productivity improvement in the business services.

- Catching up within the European region

The EU13 are mostly countries of Eastern Europa that join the EU after the fall of the Berlin wall. Comparing them with EU15 provides interesting information on the integration process. High-Tech direct employment declined in EU15, but remained roughly constant for the EU13 countries. EU13 industries rapidly incorporated business services tasks in their production function. As a result, the weight of manufacturing plus related business services jobs increased slightly in average of the EU13, from 6.2% in 1995 to 6.8% in 2019.

No such trend appears in the case of non-EU European and Central Asian countries, a very heterogenous sub-sample: the High-Tech manufacturing jobs declined during the period (from 5.2% to 3.6%), as did the sum of direct plus related business services employment (from 6.1% to 4.5%). This indicate that EU13 industries benefited from joining the EU common market, probably through increased direct investment by EU15 firms and fast integration into EU supply chains.

- Developing countries at risk of deindustrialisation

Latin America and Sub-Sahara Africa are often identified in the literature as vulnerable to premature deindustrialisation. The share of High-Tech industries in Latin America went down slightly from a low 2.7% in 1995 to 2.5% in 2019, according to results in Annex Table 13. In Africa, the respective figures are even lower, with 1.2% and 0.8%. Imputing the outsourced services manufacturing–support tasks does not change the picture.

The number of direct factory and related business services jobs in 2019 represented 3.3% of total employment in Latin America and 1.4% in Africa. They remained at this level in Latin America, after a peak at 3.5% in 2000. In Africa, we observe a similar pattern, from 1.4% in 1995 to 1.0% in 2019, after a moderate increase.

- No clear trend is observed in other developing regions

The weight of direct and indirect high–tech employment increased in Southern Asia by 0.3ppt and 0.6ppt while it decreased in developing Eastern Asia (-1 ppt and -0.6 ppt) and in the Middle East and North Africa region (-0.6 ppt in both instances).

iv. Medium-and Low Technology industries

The evolution of employment in the sub-sector of Medium-Tech industries is quite similar to what we observed in the case of High-Tech. In average of the developed countries, this sector represented only 3.5% of total employment in 2019, down from 6.3% in 1995. The evolution is very homogeneous within countries, larger or smaller. Actually, there was even more convergence occurring through time, with a within group standard deviation dropping from a low 1.7% to an even lower 1.4%.

In both developed and developing economies, we observe an increased (but limited) reliance on business services, which represent 20% of all direct and indirect jobs involved in the production of middle-tech industries. Even after imputing these jobs, the weight of the sector has declined in total employment. There are structural differences between regions, with a larger share of Medium-Tech employment in EU13, followed by EU15.

In average, developing countries show lower employment shares than developed economies, also with differences between regions. This is perhaps surprising considering that this production process is less dependent of the availability of highly skilled workers. Developing countries show also a significant reliance on business services, comparable or even higher than what exists in EU13 countries. Considering that this indicator is often interpreted as a path to value–added upgrading in the industrial process, this is a positive outcome. In Volume II we shall put this "*Porterian*" interpretation of outsourcing in question and introduce a less favourable "*Post–Porterian*" case, at least from the perspective of mature industries.

Low-Tech activities such as textile and apparels are the most labour–intensive industries. Their weight in total employment has been decreasing in developed economies, losing four percentage points between 1995 and 2019. Even if reliance on business services inputs has been increasing, the extent of outsourcing does not compensate the loss in direct employment. Direct and embodied business services jobs dropped from 12.2% of total employment in average of developed economies in 1995 to 8.0% in 2019.

The sector fared much better in developing economies in average of the countries surveyed. This is particularly the case when we include the embodied business services jobs. Yet, this hides important regional differences, as shown by the diverging trends observed in Latin America and in Sub-Sahara Africa.

v. International Outsourcing and Employment

Most, if not all, outsourcing of tasks to business services is done domestically. It is not the case of industrial intermediate goods that are much more tradeable. In Box3 (Vol. II) we look at the weight of imported inputs in monetary terms. International outsourcing of industrial inputs increased in developed countries, either due to North–North trade or imported from China. In the case of developing countries, the main source of imported intermediate products was China. Annex Table 13 shows the implications in terms of the number of jobs embodied into these imported inputs. In this table, jobs are expressed in percentage of the importing country's total employment.

We should be cautious not to understand these results as measuring the specific contribution of trade to the (de)industrialisation process. Often, international outsourcing is a two–way trade, especially between developed economies. As shown in Box 2 in Vol. II, outsourcing competitive inputs from an efficient producer whether domestic or foreign, enhances a firm's competitiveness and helps it maintaining or gaining market shares.

Finally, we express in this table the number of jobs created in the exporting country as a percentage of the total employment in the importing country. As long as the outsourced tasks are labour intensive and the foreign provider is located in a labour abundant country (the typical case of a North-South outsourcing contract), the incidence of potential job losses is overstated due to differences in labour productivity.

- Low incidence of international outsourcing on domestic employment

Despite this probable upward bias in estimating the impact of outsourcing in terms of domestic employment, it remains relatively low, below 1% of total jobs. Moreover, even in regions where the incidence of outsourcing increased between 1995 and 2019, as in the case of EU13 high-tech, it remained moderate

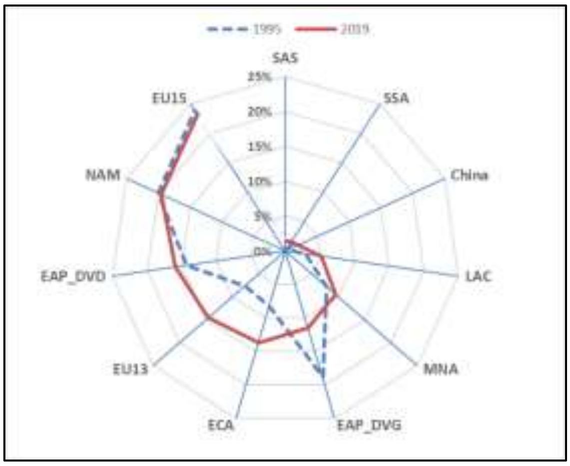
(+0.3ppt, reported to total employment) and cannot be the root-cause of the 1.9ppt drop of domestic industrial employment. The exception is EU15, where outsourcing to foreign industries amounted to 1.6% of total employment in average of manufacturing sectors in 1995. But even in this region, the incidence on domestic employment gradually declined: this value dropped to 1.0% of total employment in 2019.

- Regional and sectoral heterogeneity

Reporting offshored jobs in terms of total domestic employment tells only part of the story. In situation where industrial jobs may now represent less than 10% of total employment in some industries, a more relevant perspective is to compare this number to the sole number of workers employed in the home industry.

The incidence of international outsourcing remains moderate even when relating the number of "exported" manufacturing jobs to the number of jobs in each domestic industry. The highest incidence is found in developed economies, as seen on Figure 12. In EU15, the number of outsourced jobs represented almost one-fourth of the home manufacturing employment, with little change over the period. In all developing countries, they never surpass 15% of domestic factory sector employment; their weight is even below 2% in Southern Asia and Sub-Saharan Africa

Figure 12 Embodied jobs in imported manufactured inputs, in percent of domestic factory sector employment, 1995-2019.



Notes: For each region, simple average of all industries and all countries. Developing East Asia and Pacific countries (EAP_DVG) does not include China.
Source: Annex Table 13

In a few regions, normalising embodied jobs in relation to domestic manufacturing employment points to an increase of their incidence, entirely due to the decrease in domestic factory sector employment between 21995 and 2019. The highest incidence is observed in EU13, as a result of their increased integration into EU15 value chains that implied higher reliance on imported inputs. The highest decrease is found in developing East Asia, a consequence of the rapid development of their domestic supply chain is some countries such as Vietnam.

Outsourcing of jobs affected industries differently according to their sector of activity. The highest incidence is found in high-tech industries, followed by medium-tech ones. Compared to the direct high-tech sectoral employment, their weigh increased by 3.9ppt in average of all regions, driven by a large increase in developed countries (7.7ppt). This result is mainly due to a double-digit surge in EU13 and ECA countries (15.9ppt and 10.0ppt, respectively), many of them embarked in a structural transformation when transiting from a centrally-planned economy in the 1990s. Most developing economies registered small positive changes, the exception being developing East Asia, with a 11.1ppt drop. This reflects the rapid development of domestic supply chain in some countries such as Vietnam.

The impact of international outsourcing on medium-tech industries employment was much more limited in amplitude. The share of outsourced jobs in proportion to domestic sectoral employment increased by 2.3ppt in developed economies and 0.8ppt in developing ones. The impact was even negative in the case of low-tech industries in a majority of cases.

But regional averages can hide diverging patterns between countries. We often observed a divergence in both trend and levels measured by the mean and the median. When measured by the standard deviation, heterogeneity has increased in most cases, sometimes importantly. Nevertheless, the average trends do convey important information.

The strong tendency towards relying on foreign embodied labour in Europe is probably linked to the strong impetus towards regional integration in 1995. The North American region has also been affected by the implementation of the NAFTA treaty in 1995, but to a lesser extent because Canada and the USA were already closely associated through a bilateral free-trade agreement. We observed in a separate analysis on I-O data in monetary flows (Box3, Vol. II) an increase in North-North trade in intermediate inputs while purchases from low-cost labour abundant countries (except China) remained low.

The increased reliance on Chinese inputs does not explain deindustrialisation in developed economies. Actually, during most of the period under review, China specialised in exporting downstream final products, most of them final goods for mass consumption (apparels, electric and electronic appliances). Its impact on developed countries industries would better be analysed in terms of effective demand and delocalisation of downstream production rather than outsourcing of inputs (see Vol. II).

vi. Main Takeaway: Deindustrialisation from the Employment Perspective

Building on the earlier examination of deindustrialisation through value-added, this chapter showed that the employment perspective reveals complementary but distinct dynamics. Between 1995 and 2019, manufacturing employment declined globally by about two percentage points, with sharper reductions in developed economies and among women, who increasingly shifted into services. In contrast, China and Southern Asia absorbed a growing share of global manufacturing jobs, producing both a North–South and West–East redistribution of industrial labour.

The strong relationship between domestic income and manufacturing employment follows a robust inverted-U pattern: employment shares rise with per capita income until a threshold is reached—around $10,000 for women and $19,000 for men. Outsourcing and global value chains further reshape employment composition, shifting jobs into services rather than preserving manufacturing. High-technology sectors in developed economies saw declining direct employment but rising indirect service jobs, while medium- and low-technology industries contracted more sharply.

5. Preliminary Conclusions

Our findings highlight three stylised facts: deindustrialisation is structural but uneven across regions; its gendered impacts are significant; and outsourcing alters the composition of industrial output and labour without halting their overall relative decline. Heterogeneity dominates at regional level; the process is global in its drivers yet local in its manifestations.

As the World economy became closer to a free-trade situation during the 1995-2007 hyper–globalisation period, a series of structural changes took place. Manufacturing specialisation based on the prediction of the standard Heckscher–Ohlin–Samuelson model does not fully explain the redistribution of revealed comparative advantages after 1995. While the evolution of manufacturing in developed economies, be it measured by production or employment, roughly follows the predictions, the outcome for developing countries was much more heterogeneous.

Another implication of the "global village" created by hyper-globalisation is that, for many aspects except employment, the industrial economy functions like a world–wide closed economy. With two implications in terms of deindustrialisation. The first one is that creative destruction may not happen anymore in the same national territory. This "Schumpeterian Unbundling" creates winners and losers, contrary to what the happy globalisation models were anticipating. The second aspect is that the old issue of demand constraints returns as a limiting factor. Industrial production benefitted from incredible productivity improvement with the advance of technology and the implementation of new business models that optimised value–added creation at global scale. But demand for manufactured goods, almost by definition, is limited by the Engel's Law.

When trade deficits became unsustainable in large developed countries after the Global Financial Crisis of 2008-2009 and protectionist policies kicked on to reduce their imports, global demand for (imported) manufactured goods was constrained. Industrialisation was truncated in many developing countries that were unable to compete for international market share against the new industrial hegemons in large emerging economies. In some sense, for these developing countries, China, more than any other emerging countries, can be analysed as "the new centre" from a centre-periphery perspective, thanks to its technological leadership, productive sophistication, and the ability to meet global demand patterns We develop more directly this interpretative hypothesis in Vol. II where it becomes a critical indicator to identify pathological cases of deindustrialisation.

Our results confirm that deindustrialisation, when viewed through the lens of employment, is both structural and yet uneven across regions. Between 1995 and 2019, manufacturing employment declined markedly in developed economies, with sharper reductions among women, who may have found greater opportunities in the expanding service sectors. In contrast, parts of Asia—particularly China and Southern Asia—absorbed a growing share of global manufacturing jobs, producing a dual shift: from North to South and from West to East. This redistribution highlights the global rebalancing of industrial activity, but also the persistence of regional disparities, as Latin America, the Middle East, and Sub-Saharan Africa experienced stagnation or premature decline.

The relationship between income and manufacturing employment follows a clear inverted-U trajectory. Employment shares rise with per capita income until a threshold is reached—around \$10,000 for women and \$19,000 for men—after which labour-saving technical progress drives a steep decline. This pattern is robust across both flexible GAM specifications and traditional OLS regressions, though the latter exaggerates regional dummy effects. The gendered differences are striking: women reach their industrial employment peak earlier, while men sustain higher shares until later stages of development, before experiencing sharper declines.

Outsourcing and the expansion of global value chains further reshape employment dynamics. In high-technology industries, the share of direct jobs fell steadily in developed economies, while indirect embodied jobs from services providers grew, reflecting the outsourcing of non-core activities. Medium- and low-technology sectors experienced even sharper declines, with the *servicification* of manufacturing limiting —but not reversing— the erosion of manufacturing employment. Developing economies did not uniformly benefit: while Asia integrated successfully into global production networks, Latin America and

Sub-Saharan Africa struggled to capture sustained gains, reinforcing concerns about premature deindustrialisation.

If we could not find cases where international outsourcing did significantly erode industrial employment, the sectoral results highlight the importance of the domestic value chain. Legacy industries in developed economies were often able to maintain a higher-then-expected share of manufacturing jobs while successful emerging countries based their achievement on densifying the domestic inter–industrial relationships. Achieving this outcome is obviously more difficult for the smaller developing economies that must rely more intensively on integrating into international (global or regional) value chains. This integration was crucial in promoting industrial up–grading of the new member states of the European Union (EU13). It means also that, if deindustrialisation may be slower in developed economies in its initial stages, reindustrialisation may become more difficult when the domestic industrial network becomes too weak and passes a tipping point.

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7. Annexes

A: List Of Sectors By Technological Level

High and Medium–High Technology	**Medium technology**
C20 Chemical and chemical products C21 Pharmaceuticals, medicinal chemical and botanical products C26 Computer, electronic and optical equipment C27 Electrical equipment C28 Machinery and equipment, not elsewhere classified (nec) C29 Motor vehicles, trailers and semi–trailers C30 Other transport equipment	C22 Rubber and plastics products C23 Other non–metallic mineral products C24 Basic metals C31T33 Manufacturing nec; repair and installation of machinery and equipment **Low and Medium–Low technology** C10T12 Food products, beverages and tobacco C13T15 Textiles, textile products, leather and footwear C16 Wood and products of wood and cork C17_18 Paper products and printing C19 Coke and refined petroleum products C25 Fabricated metal products

The C codes refer to the coding system used in OECD Inter–country Input–Output tables.

B: Countries included

Country	ISO3	DevClas	Region	Country	ISO3	DeClas	Region
Argentina	ARG	DVG	LAC	Kazakhstan	KAZ	DVG	ECA
Australia	AUS	DVD	EAP_DVD	Lao People's Democratic Republic	LAO	DVG	EAP_DVG
Austria	AUT	DVD	EU15	Latvia	LVA	DVD	EU13
Bangladesh	BGD	DVG	SAS	Lithuania	LTU	DVD	EU13
Belarus	BLR	DVD	ECA	Luxembourg	LUX	DVD	EU15
Belgium	BEL	DVD	EU15	Malaysia	MYS	DVG	EAP_DVG
Brazil	BRA	DVG	LAC	Malta	MLT	DVD	EU13
Brunei Darussalam	BRN	DVD	EAP_DVD	Mexico	MEX	DVG	LAC
Bulgaria	BGR	DVD	EU13	Morocco	MAR	DVG	MNA
Cambodia	KHM	DVG	EAP_DVG	Myanmar	MMR	DVG	EAP_DVG

Cameroon	CMR	DVG	SSA	Netherlands	NLD	DVD	EU15
Canada	CAN	DVD	NAM	New Zealand	NZL	DVD	EAP_DVD
Chile	CHL	DVG	LAC	Nigeria	NGA	DVG	SSA
China [a/]	CHN	DVG	PRC/EAP_DVD	Norway	NOR	DVD	ECA
China, Hong Kong SAR	HKG	DVG	EAP_DVG	Pakistan	PAK	DVG	SAS
China, Taiwan Province	TWN	DVG	EAP_DVG	Peru	PER	DVG	LAC
Colombia	COL	DVG	LAC	Philippines	PHL	DVG	EAP_DVG
Costa Rica	CRI	DVG	LAC	Poland	POL	DVD	EU13
Croatia	HRV	DVD	EU13	Portugal	PRT	DVD	EU15
Cyprus	CYP	DVD	EU13	Republic of Korea	KOR	DVD	EAP_DVD
Czechia	CZE	DVD	EU13	Romania	ROU	DVD	EU13
Côte d'Ivoire	CIV	DVG	SSA	Russian Federation	RUS	DVD	ECA
Denmark	DNK	DVD	EU15	Saudi Arabia	SAU	DVG	MNA
Egypt	EGY	DVG	MNA	Senegal	SEN	DVG	SSA
Estonia	EST	DVD	EU13	Singapore	SGP	DVG	EAP_DVG
Finland	FIN	DVD	EU15	Slovakia	SVK	DVD	EU13
France	FRA	DVD	EU15	Slovenia	SVN	DVD	EU13
Germany	DEU	DVD	EU15	South Africa	ZAF	DVG	SSA
Greece	GRC	DVD	EU15	Spain	ESP	DVD	EU15
Hungary	HUN	DVD	EU13	Sweden	SWE	DVD	EU15
Iceland	ISL	DVD	ECA	Switzerland	CHE	DVD	ECA
India	IND	DVG	SAS	Thailand	THA	DVG	EAP_DVG
Indonesia	IDN	DVG	EAP_DVG	Tunisia	TUN	DVG	MNA
Ireland	IRL	DVD	EU15	Türkiye	TUR	DVG	ECA
Israel	ISR	DVG	MNA	Ukraine	UKR	DVD	ECA
Italy	ITA	DVD	EU15	United Kingdom	GBR	DVD	EU15
Japan	JPN	DVD	EAP_DVD	United States of America	USA	DVD	NAM
Jordan	JOR	DVG	MNA	Viet Nam	VNM	DVG	EAP_DVG

Note: DVD: developed; DVG: developing; a/: China, a developing country in East Asia and Pacific region, is treated as a single region in dues to the sheer size of its manufacturing sector.

Annex Table 13 Manufacturing Direct and related business services jobs, by region (1995 and 2019)

Origin	Same sector			Sector & embodied Business Services			Embodied in imported manufactured inputs		
Manuf. sector	High Tech.	Medium Tech.	Low Tech.	High Tech.	Medium Tech.	Low Tech.	High Tech.	Medium Tech.	Low Tech.
EAP_DVD									
1995	5.1%	3.6%	8.4%	6.8%	4.4%	10.7%	0.7%	0.4%	1.3%
2019	3.9%	2.3%	4.7%	5.5%	2.9%	6.5%	0.8%	0.3%	0.6%
EAP_DVG									
1995	4.7%	2.8%	7.0%	6.1%	3.2%	8.6%	1.6%	0.4%	0.7%
2019	3.7%	2.4%	7.6%	5.5%	3.0%	9.8%	0.9%	0.3%	0.4%
ECA									
1995	5.0%	4.4%	8.9%	6.2%	5.3%	10.9%	0.6%	0.4%	0.6%
2019	3.7%	3.1%	6.5%	4.9%	4.2%	8.5%	0.8%	0.5%	0.6%
EU13									
1995	5.5%	5.7%	13.7%	6.2%	6.3%	15.7%	0.6%	0.4%	1.0%
2019	5.6%	4.7%	8.9%	6.8%	5.4%	10.5%	1.5%	0.5%	0.8%
EU15									
1995	6.0%	5.0%	9.5%	7.4%	5.7%	11.6%	1.8%	1.2%	1.9%
2019	4.1%	3.1%	5.6%	5.4%	3.7%	7.1%	1.4%	0.6%	1.0%
LAC									
1995	2.7%	3.5%	9.2%	3.9%	4.2%	12.3%	0.2%	0.1%	0.2%
2019	2.5%	2.7%	6.5%	3.8%	3.5%	9.3%	0.3%	0.1%	0.2%
MNA									
1995	3.0%	3.5%	9.5%	3.9%	4.0%	11.4%	0.3%	0.3%	0.7%
2019	2.4%	2.7%	7.3%	3.4%	3.3%	9.3%	0.4%	0.3%	0.5%
NAM									
1995	5.4%	3.2%	6.7%	7.5%	4.0%	8.8%	1.4%	0.5%	1.1%
2019	3.6%	2.3%	4.1%	4.8%	3.0%	5.5%	1.0%	0.4%	0.5%
China									
1995	7.2%	6.6%	7.3%	8.8%	7.4%	8.8%	0.0%	0.0%	0.0%
2019	8.6%	4.5%	6.8%	12.0%	5.9%	9.4%	0.2%	0.1%	0.1%
SAS									
1995	1.0%	2.2%	8.1%	1.6%	2.6%	9.8%	0.0%	0.0%	0.1%
2019	1.3%	2.7%	10.4%	2.2%	3.4%	13.0%	0.0%	0.0%	0.1%
SSA									
1995	1.2%	1.9%	7.2%	1.7%	2.3%	9.3%	0.1%	0.0%	0.1%
2019	0.8%	1.8%	7.7%	1.2%	2.2%	9.7%	0.1%	0.0%	0.1%

Notes: In percent of total country employment, simple average of country indicators.

C: Robustness Checks on the GAM Results

To check if the GAM approach was not too flexible and hallucinating, we re-estimate the "employment / income" relationships using standard econometric models. The parametric estimates obtained have more familiar statistical properties than GAM results and are easier to interpret. They serve as a robustness check and baseline for comparison. We use a quadratic model for the predictor (log of GDP per capita), with regional and time dummies. Table 14 presents the results obtained for the manufacturing employment, with or without sex differentiation.

Table 14 Quadratic modelling of manufacturing employment shares

	All			**Female**			**Male**		
Coefficients:	Estimate	SE		Estimate	SE		Estimate	SE	
(Intercept)	−94.6	10.6	***	−100.7	13.0	***	−84.2	11.7	***
log_gdp_pc	24.4	2.4	***	27.6	2.9	***	20.6	2.6	***
(log_gdp_pc^2)	−1.3	0.1	***	−1.6	0.2	***	−1.0	0.1	***
RegionEAP_DVG	2.1	0.9	*	1.8	1.1		2.3	1.0	*
RegionECA	0.9	0.8		−1.7	1.0	.	3.1	0.9	***
RegionEU13	4.7	0.8	***	2.2	1.0	*	6.8	0.9	***
RegionEU15	1.9	0.8	*	−0.9	0.9		4.4	0.8	***
RegionLAC	−2.5	0.9	**	−4.4	1.1	***	−1.2	1.0	
RegionMNA	−1.0	0.9		−2.1	1.2	.	−0.2	1.0	
RegionNAM	−1.2	1.3		−2.4	1.6		0.1	1.4	
RegionSAS	3.7	1.3	**	0.4	1.6		5.6	1.5	***
RegionSSA	−1.6	1.1		−4.6	1.3	***	0.4	1.2	
Year2000	−1.1	0.7		−1.1	0.8		−1.0	0.7	
Year2005	−2.2	0.7	**	−2.1	0.8	*	−2.2	0.7	**
Year2007	−2.6	0.7	***	−2.5	0.8	**	−2.7	0.7	***
Year2010	−4.0	0.7	***	−4.0	0.8	***	−4.0	0.7	***
Year2015	−4.4	0.7	***	−4.2	0.8	***	−4.4	0.7	***
Year2019	−4.7	0.7	***	−4.2	0.8	***	−4.8	0.8	***
Adjusted R2	*0.44*			*0.37*			*0.52*		

Notes: OLS estimates. Signif. Codes and Pr(>|t|) based on standard errors: '***': 0.001; '**': 0.01; '*': 0.05: '.' 0.10. By construction, the coefficients associated with region EAP_DVD and year 1995 are equal to 0 (baseline cases).

The econometric results confirm the GAM analysis. The share of industrial jobs as a function of GDP per capita exhibits a clear inverted U "à la Kuznets", and the negative coefficient associated with the quadratic term [(log_GDPper capita)^2] is highly significant. This coefficient is larger in absolute value for female workers (-1.6 vs. -1.0 for male workers). This coincides with the GAM profile observed in Figure 9. Nevertheless, the implied "peak" for female employment is reached much sooner (less than $6,000 vs. $10,000) when coercing a simple quadratic function. Actually, the quadratic peak is in-between the two local optima observed in GAM (Figure 9). Conversely, the quadratic peak for male employment is at about $22,500, above the GAM estimate of $19,000. It appears that a simple quadratic function forced on the data may be unable to capture the complex non-linearities in the association GDP per capita and employment share, but confirms it existence.

The decreasing trend is also present and very significative in all cases, with similar incidence for both female and male populations. The coefficients are comparable to those obtained with the GAM methodology. There are more differences in the case of regional dummies. The OLS specification tends to assign larger absolute values to regional dummies. This difference reflects methodological construction rather than substantive contradiction: the GAM framework distributes part of this variation into smooth terms, yielding more moderate coefficients.