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The labour share along global value chains
Perspectives and evidence from sectoral interdependence*

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Abstract. This article proposes a novel framework to investigate how globalisation affects workers' share of value added. We explore functional income distribution by looking at industrial interdependence and thus identifying GVCs as the unit of analysis; we then track inputs composition and their labour share evolution along the value chains. First, we find widespread heterogeneous patterns across value chains components, accounting for the direct, domestic and foreign requirements of the chains, inside an overall declining trend. Second, we study the evolution of the vertical labour share along development stages. Finally, by means of a shift-share analysis, we investigate what drives such decline in the vertical labour share: albeit country-sector idiosyncratic factors accounted by the within-input component contribute the most, between-input reallocation – GVCs restructuring – matters particularly to detect the role played by foreign contributions. In essence, we provide evidence of a recombination of inputs toward emerging economies and service-based activities. Such recombination negatively impacts upon the overall labour share dynamics. Overall, our methodology contributes to better understanding the process of fragmentation of production and international division of labour by developing a series of novel and fine-grained indicators; in addition, it allows to study the ensuing implication for functional income distribution.

Keywords: Structural Change · Global Value Chains · Labour Share
JEL classification: F14; J31; O14

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1 Introduction

A constant functional income distribution has been considered one of the characteristics of advanced capitalist economies, enough to be listed as the first Kaldor (1957)'s stylised facts on growth. Yet, since the '70s, a consistent drop in the labour share has been documented across major economies (Karabarbounis and Neiman, 2014; Bivens and Mishel, 2015; Dosi and Virgillito, 2019).

Mostly investigated determinants of declining labour share are institutions, technology and globalisation, insofar as they directly or indirectly affect workers' bargaining power. For instance, the weakening of labour market institutions, such as unionisation or minimum wage legislation (Card and DiNardo, 2002), reduces workers strength and position in the wage negotiation process (Mishel, 2022). Technology has been at the centre of the theory of polarisation in wage income impacting asymmetrically on different tasks (Autor et al., 2008). Globalisation increases the side options for capitals that might take advantage of lower labour costs in foreign countries (Stockhammer, 2013). In addition, international trade, and even more Global Value Chains (GVCs thereafter) participation, have accelerated productive specialisation which, in turns, affects labour share dynamics reshaping the international division of labour (Kaplinsky, 2000; Dimova, 2019).

The rise in GVCs has altered both where firms produce and how they do so. International fragmentation of production has influenced the relationship between capital inputs, inherently more mobile, and labour inputs, far stickier, therefore affecting functional income distribution at the global scale. Indeed, the positioning of firms and countries along different stages of GVCs (high-value vs low-value added phases) exerts contrasting impacts on productivity and wage structures. The smile curve literature (Shin et al., 2012; Meng et al., 2020; Stöllinger, 2021) has provided empirical evidence of heterogeneous participation of countries in conceptualisation and R&D, fabrication, and commercialisation phases of the production process, according to the underlining capabilities and market power they possess. Therefore, for example, China has gradually upgraded its positioning in the GVCs ladder, moving from fabrication to conceptualisation and R&D phases, even in complex manufacturing products as microprocessors and computer equipment. At the opposite, other countries mainly specialised in the fabrication phases, stick in such peripheral positions (Pavlínek, 2020). Indeed, GVCs imply not only that the production processes are fragmented but that also the underlining division of labour occurs along different production stages. This very process of fragmentation of the production activity indeed might impair labour income. Therefore, the account of sectoral level interdependence allows to consider the extent to which vertical integration affects input remuneration of the factors of production. In addition, it allows advancing beyond the "horizontal" sectoral dimension, evaluating input intermediaries coming from interdependent countries and sectors.

How has the functional income distribution changed along GVCs? To what extent do countries' development stages affect the vertical labour share dynamics? Is the within or rather the between inputs component driving such patterns? This paper contributes to these questions by analysing the geographical and sectoral evolution of the *vertical labour share* by leveraging on two distinct streams of research, namely the labour share and the GVCs literature. Overcoming the horizontal level perspective, we propose the novel concept of the vertical labour share to measure functional income distribution, and therefore the ensuing labour remuneration, along the international production structure. The latter structure is mapped by the World Input-Output Database (WIOD), reporting information for the period 2000-2014, covering 43 countries (plus one Rest of the World) and 56 2-digit sectors, including information from

the Socio-Economic Account (SEA), allowing to measure value added and employment flows across countries and industries (Timmer et al., 2015). This framework enables to track the evolution of the labour share across the inputs of production of each given international value chain. Although our unit of observation is represented by industries, such integrated vertical approach is consistent with firm-level decision processes in terms of input requirements, externalisation choices, location abroad of some specific production stages. In that, it offers a worthy lens to investigate outsourcing and offshoring processes and their impacts on the labour share.

According to our results, first, the vertical labour share when compared to its horizontal counterpart presents distinct patterns, therefore motivating the relevance of looking at its own dynamics; second, linking the evolution of the vertical labour share to countries' development stages we decompose the direct, domestic and foreign components, finding a non-linear concave relationship with income per capita, signalling how the benefits for labour inputs from participation in GVCs across development stages are not monotonically increasing. Finally, by means of a shift-share analysis, we provide evidence that the *between* component, namely structural change across productive inputs, is crucial in determining the labour share dynamics. A recombination of productive inputs toward cheaper labour requirements coming from abroad is visible, in line with an overall negative variation of the vertical labour share. Heterogeneous patterns emerge between domestic and foreign inputs, with domestic intermediaries leading to the vertical labour share decline both in manufacturing and in services in advanced countries, and with foreign inputs gaining mainly in service activities in developing non-EU countries.

The structure of the paper is as follows: Section 2 presents the literature review on labour share and global value chains. After describing the data and methodology, Section 3 presents some descriptive statistics on the dynamics of the vertical labour share. Section 4 investigates the relationship between the vertical labour share, decomposed in direct, domestic and foreign components, and development stages. Section 5 proposes a shift-share analysis of the vertical labour share variation that distinguishes within and between inputs components by their geographical and country origin. Section 6 concludes.

2 Labour share and GVCs

In this section we review the literature documenting trends in the labour share dynamics and determinants that have been so far identified, the rise in GVCs participation, mechanisms of productive and employment upgrading to evaluate potential benefits or alternatively lack of them questioning strategies of GVCs participation.

2.1 Labour share: trends and determinants

During the last decades, there has been a growing empirical evidence showing the steady decline in the labour share, recorded across both developing and developed countries (Atkinson, 2009; Dao et al., 2019; Dimova, 2019). Notably, Karabarbounis and Neiman (2013) report a declining trend in corporate labour share beginning in the '70s in 42 out 59 countries analysed in the period 1975-2012, encompassing both service and manufacturing activities. Such trends intensified during the '90s. The evidence is mixed for developing countries due to a lack of reliable data. Yet, Rodriguez and Jayadev (2010), Reinbold and Restrepo-Echavarria (2018) and van Treeck (2020) find declining trends similar to those witnessed by advanced countries. Investigating labour share trends along development stages, Maarek and Orgiazzi (2020) find evidence of a U-shaped pattern in the manufacturing sector. They employ the UNIDO dataset

which covers mainly developing countries from 1960s to 2000. Especially in developing countries, measurement problems might confound the results. Indeed, in countries where informal labour markets play an important role, actual wages might be well lower than those recorded in formal labour markets. In addition, self-employed workers constitute an increasing share of the overall employment, not only in developing countries. The lack of accounting of self-employed income can indeed underestimate the actual labour share (Gollin, 2002).

Such declining tendency, from a classical political economy perspective (Smith, 1776; Ricardo, 1819), is nothing more than the reflection of the struggle between the relative (bargaining) power between capital and labour, to the extent that Ricardo himself enlists this as one of the aims of his whole work:

> It has been one of the objects of this work to shew, that with every fall in the real value of necessaries, the wages of labour would fall, and that the profits of stock would rise—in other words, that of any given annual value a less portion would be paid to the labouring class, and a larger portion to those whose funds employed this class.
>
> [Ricardo 1817, p. 132]

and more:

> It has been my endeavour to shew throughout this work, that the rate of profits can never be increased but by a fall in wages.
>
> [Ricardo 1817, p. 511]

With the marginalist revolution, factor income shares have been postulated to be constant and no more space for the investigation of their dynamics was left in the neoclassical perspective. Differently from the postulated behaviour, however, with the end of the *Glorious Thirties*, the contrasting empirical evidence is calling for some explanations. The literature investigates several determinants of the labour share dynamics, yet, a consensus is still lacking. In the following, we shall briefly consider those determinants affecting both the relative power of capital and labour and their potential interaction.

Labour market institutions and declining labour-power in the negotiation process are the most direct determinants that might have eroded labour income remuneration. While the evidence of labour market institutions as inequality-reducing mechanisms start to be acknowledged (Farber et al., 2018), new evidence shows that the decline in the unionisation rate has increased top income shares by reducing the bargaining power of average wage earners (Jaumotte and Osorio Buitron, 2019). Different labour market institutions have been studied: Stockhammer (2017) and Guschanski and Onaran (2021a) find positive effects of unionisation rate in influencing the labour share; the European Commission (2007) attributes a significant role to minimum wage legislation; while Kristal (2010) measures the impact of workforce organisational power and finds positive effects of striking activities on labour share dynamics.

The second determinant analysed in the literature is technical change. Karabarbounis and Neiman (2013) find that the declining relative price of investment goods has given strong incentives to automate routine tasks explaining more than half of the decline in labour share. However, their results crucially rely on an elasticity of substitution grater than one, a very high level and in contrast with the empirical evidence (Stockhammer, 2017; Guschanski and Onaran, 2021b; Cette et al., 2019) and more comprehensive meta-analyses (Knoblach and Stöckl, 2020). Beyond the relative price channel, other studies highlight the direction of technical change as

biased versus capital-augmenting techniques squeezing the labour share (Bassanini and Manfredi, 2012; Dao et al., 2019). In contrast, Tytell and Jaumotte (2007) find no significant impact of technological progress on labour share. Post-Keynesian authors have instead focused on financialisation, a channel that increases the side option for capital (Kohler et al., 2018; Guschanski and Onaran, 2021b). Finally, superstar firms and rising market concentration have been recently found to be associated with the fall in labour share (Autor et al., 2020; Barkai, 2020).

Less investigated but closer to our work is the role of structural change. The intersectoral reallocation of resources typical of the development process (de Serres et al., 2002; Ngai and Pissarides, 2007; Dosi et al., 2021), pushes the workforce first from labour intensive traditional sectors to modern industrial activities, and then to services. Notably, deindustrialisation might play a major role in labour share dynamics since manufacturing industries have always been characterised both by higher remuneration of workers and higher unionisation rates compared to services (Dao et al., 2019). The evidence on workforce polarisation, although always interpreted as the result of routine-biased technical change, points in the same direction highlighting the decline in routine tasks and in their remuneration and, more in general, the hollowing out of the occupational distribution in advanced countries which might be indeed the result of structural change (Bárány and Siegel, 2018). In contrast, Karabarbounis and Neiman (2013) show that most of the decline in labour share can be explained by within sector dynamics. Shifts in the occupational/task structure constitute another unfolding of structural change. While the wage-productivity pass-through is still at work for professional occupations which manage to keep up their labour share, elementary workers have positively contributed to the overall labour share decline (Dimova, 2019).

Finally, globalisation influences labour share under several channels. First, since capital are inherently more mobile than workers, globalisation reduces the bargaining power of the latter, under the threat of delocalisation and offshoring. In fact, international integration makes firing threats more credible, reducing offshoring costs (Rodríguez and Rodrik, 1999). In line, Jayadev (2007) finds that increasing capital account openness depresses labour share in advanced countries; Harrison (2005) shows that rising trade penetration and exchange rate crises reduce the labour share, while capital controls and expansionary fiscal policies have the opposite effect. In addition, the enlargement of international markets towards low-wage labour-abundant economies increases import competitions in labour-intensive sectors, potentially pushing advanced countries for a reallocation toward more capital-intensive industries (Dao et al., 2019).

Related, the rise in GVCs participation leading to international integration since the 1990s amplified the impact of globalisation on labour share dynamics both in developing and developed countries (Dao et al., 2019). In fact, the emergence of GVCs has also led to a global reallocation of jobs and a new international division of labour, with labour-intensive manufacturing jobs and business services increasingly outsourced from advanced economies to low-wage developing countries, especially in China (Amiti and Wei, 2009; Elsby et al., 2013). Moreover, by forcing specialisation in phases, rather than in industries, GVCs participation leads to a transformations of the functions performed across different occupations (Grossman and Rossi-Hansberg, 2006). Although the interaction of GVCs participation and labour share dynamics is gaining attention, the evidence is still not conclusive (Guschanski and Onaran, 2021a).

2.2 The Rise in GVCs

With the 'globalisation's second unbundling' (Baldwin, 2011), the fragmentation of production has been steadily increasing across-borders and international trade went beyond final goods encompassing intermediate production stages. GVCs penetration reshaped the geography of production and how goods are produced (Johnson and Noguera, 2012a; Baldwin and Lopez-Gonzalez, 2013). In addition, ICT and improvements in logistics have eroded transportation costs and eased communication, enabling firms to segment production into specific tasks off-shored around the globe (Rodrik, 2018).

In principle, both developed and emerging economies could benefit from GVCs participation and by increasing productivity. Advanced countries can reduce costs by specialising in technologically rich segments of production and offshoring labour-intensive tasks to developing countries (Grossman and Rossi-Hansberg, 2006; Antràs and de Gortari, 2020). In addition, they can develop new technologies to export and adopt in foreign countries. Emerging economies can catch-up along the development ladder, overcoming the "industrialisation gap" and instead importing complex intermediaries that they are not able to produce. Beyond, international cooperation within GVCs enhances technological spillovers, allowing some emerging markets to catch up with the frontier and improve workforce's skills and wages (Koren and Csillag, 2011). Finally, it is easier for developing countries to enter already existent foreign GVCs than building up a domestic production from scratch (Rodrik, 2018).

However, recent literature has focused on the adverse effects of GVCs participation on income distribution, recognising that trade integration increases wage inequality (Antràs et al., 2006; Grossman and Rossi-Hansberg, 2006; Goldberg and Pavcnik, 2007). The way in which the international fragmentation of production is currently structured has implied that low-wage production stages off-shored by advanced economies toward less advanced countries have attracted massive workers inflow, mainly migrant ones, from less developed regions, exerting downward pressure on low-wage workers both in advanced and developing countries (Feenstra and Hanson, 1996; Vivarelli, 2014; Dosi et al., 2020). In addition, gains from trade have not been as expected for workers employed in exporting firms part of GVCs integration. This is the case of workers employed in Chinese manufacturing firms exporting abroad in the period of WTO accession, whose gains from productivity increases (i.e. pass-through) have not experienced any different benefit when compared to similar workers employed in non-exporting firms (Dosi et al., 2022).

2.3 Productivity upgrading within GVCs

The *smile curve* literature has highlighted a novel perspective on intra- and inter-country inequality stemming from GVCs participation (Shin et al., 2012; Mudambi, 2008; Meng et al., 2020; Stöllinger, 2021). Such an approach allowing to track the content of value added along the entire production process, although at a relative high-level of aggregation, shows evidence that high-value added activities, such as R&D and commercialisation, are usually produced in advanced economies. On the opposite, developing countries enter the supply chains in the standardised manufacturing stages of production, characterised by low wages and low-value added. Advanced countries, after conceptualising the product, finalise commercialisation providing service-based marketing activities and post-sale assistance. Representing on the y-axis the value added content of the entire activities carried out and on the x-axis the stage of production, a U-shaped curve, also known as the *'smile curve'*, emerges. Such division of labour

accelerates deindustrialisation in rich countries, while at the same time, it segregates developing countries in the low value added (and low-technological) space of production, creating dependence on advanced countries' high-tech activities.

An apparent neutrality in GVCs participation might instead mask deeper asymmetries and forms of dependence of developing countries vs developed ones. Indeed GVCs might represent crystallised structure of power relations across actors (countries and firms) differently positioned along the chain: leading countries/firms exert a different power along the chain, in terms of definition of the production processes and contents, when compared to lagging countries/peripheral production nodes. Thus, one of the primary concerns for developing countries is, first, upgrading within value chains and then possibly sharing those benefits with the rest of the economy. Upgrading is generally defined as the producers' ability 'to make better products, make products more efficiently, or move into more skilled activities' (Pietrobelli and Rabellotti, 2010). According to Engel and Taglioni (2017), looking at GVCs upgrading in developing experiences, just a handful of countries already engaged in industrial development are ripping the benefits of integration. While GVCs participation can be beneficial for middle-income countries, a certain level of industrial development is a *conditio sine qua non* gaining from GVCs participation is achievable. The majority of middle-income countries lack the institutional and production requirements to prosper within GVCs. Closing technological gaps, and abating market and IPRs barriers become increasingly difficult for developing countries, hampering the possibility to escape the middle-income trap by entering and then upgrading within GVCs. Indeed, technological upgrades require increasingly more complex capabilities and institutional settings (Taglioni and Winkler, 2016; Rodrik, 2018).

2.4 Employment upgrading within GVCs

Fewer studies have inquired the consequences of GVCs participation for workers and working conditions, a dimension sometimes referred to as social upgrading, showing that the link between social upgrading and greater integration in GVCs is even weaker when compared to economic upgrading (Flanagan, 2006; Milberg and Winkler, 2011; Rossi, 2011; Barrientos et al., 2011). However, looking at a sample of 127 countries, Kucera (2002) finds that increased labour standards do not impact the ability to attract FDI.

More recently, employment upgrading (Reinbold and Restrepo-Echavarria, 2018; Bontadini et al., 2020) and functional specialisation upgrading (Blazek, 2015; Timmer et al., 2019) have started to be investigated. Indeed, shifts in functional specialisation might involve employment upgrading, by moving the workforce structure from fabrication to R&D and managerial activities. However, Timmer et al. (2019) show little sign of convergence in functional specialisation through GVCs participation, documenting that advanced countries are increasing their relative employment share in managerial and R&D occupations while developing countries are specialising in low-value added jobs. Foster-McGregor et al. (2013) highlight that offshoring has affected negatively all skill types, with the largest impacts exerted toward medium-skilled workers. Finally, Reinbold and Restrepo-Echavarria (2018) find that the interplay between technological diffusion (i.e. robotisation) and offshoring decisions has led to a fall of the employment share of routine manual jobs in advanced countries.

Given the extant literature, in this paper taking a vertical perspective, we investigate how the changing value chains' input structure impacts upon the evolution of functional income distribution. Following this strategy, we isolate the contribution of country-sector idiosyncratic labour share dynamics from the one due to shifts in inputs composition.

3 Data, methodology and selected evidence

3.1 Data

We employ industry-by-industry Input-Output tables $\boldsymbol{Z}$ from the World Input-Output Database (WIOD) (Timmer et al., 2015) also including the Socio and Economic Account (SEA) dataset, providing variables at the 2-digit level of aggregation (NACE Rev. 2 classification) as employment, value added, gross fixed capital formation, labour compensation, matched with I-O tables. The WIOD (2016 Release) is available for the period 2000-2014, for 43 countries (plus one Rest of the World) and 56 sectors.[1] We exclude from the analyses agriculture (A), electricity (E), mining activities (B), fuel related productions (C19), construction (F), and non-market service activities as public administration (O), education (P), health activities (Q) and extra-territorial activities (U).[2]

We use 'Labour compensation' and 'Value added' to construct our variable of interest, the vertical labour share ls. Final demand d is directly provided by WIOD tables and computed by summing up five categories: final consumption expenditure by households, non-profit organisations, government, gross fixed capital formation and changes in inventories and valuables. Gross output x is provided from WIOD tables. All values are in US dollars at 2010 prices, using the exchange rates provided in the WIOD website and the price indexes contained in the SEA (2016) dataset for deflation. WIOD tables are provided in current prices, therefore we adopt a specific deflation method to transform them in constant prices (2010 base year) in order to rule out price dynamics. Appendix A describes in detail the deflation procedure.

Additionally, we use data on GDP at constant 2011 US dollars and population from Penn World Table 9.1 (Feenstra et al., 2015).

3.2 Construction of the vertical labour share

In order to construct the vertical labour share we rely on Leontief (1951)'s Input-Output analysis and on the identification of vertically integrated sectors proposed by Momigliano and Siniscalco (1982) and Siniscalco (1982) developing the theoretical underpinnings of Pasinetti (1973). Such methodology is nowadays largely employed in the Global Value Chain literature using global Input-Output (I-O) tables (Feenstra and Hanson, 1996; Timmer et al., 2013, 2014; Johnson, 2018; Pahl and Timmer, 2019), and recently adopted also by the European Commission's reports on trade in employment and in value added (Arto et al., 2020, 2020).

Since the seminal works by Hummels et al. (2001) and Johnson and Noguera (2012b), this stream of research has been largely relying on World Input-Output Tables (Timmer et al., 2015) to construct indicators of value added embodied in intermediate trade flows, then turned into trade statistics as the OECD/WTO Trade-in-value added (TiVA) initiative. TiVA indicators quickly expanded into a wider set of GVC measures.[3] However, currently, there are very few attempts in investigating how the factor share distribution unfolds along global value chains. Early attempts are in Chen et al. (2017) and Reshef et al. (2019). The former proposed a disentanglement of value added in trade across income shares of labour, tangible and intangible assets.

[1] See http://www.wiod.org/home for further details on the country coverage and data availability.

[2] The exclusion involves both rows and columns meaning that we do not consider neither GVCs of agricultural activities, for instance, nor the inputs that such sector gives to others. We also exclude inputs coming from the Rest of the World before the construction of the value added matrix V as the SEA dataset does not contain information for it.

[3] Timmer et al. (2019) provide some criticisms toward this generation of statistics being essentially silent on the heterogeneous nature of activities performed along value chains.

The latter, closer to our approach, directly tracks the factor shares in value added with respect to labour and capital. We advance with respect to the literature proposing a novel approach to measure the vertical dimension of labour share, that is, along backward linkages.

We start with the construction of the matrix of embodied value added in inter-sectoral trade flows. Such matrix allows decomposing the value added embodied in each final good according to the industry and country of origin of the inputs required. In order to obtain such matrix, few algebraic transformations of the raw data are performed. First, we compute the Leontief Inverse matrix, allowing the quantification of the sequential effects in each production stage of one-unit increase in the demand of a final good, thus enabling to account for both the *direct* (deriving from the same sector of activity) and the *indirect* contributions (deriving from the other sectors of activity) (Pasinetti, 1977; Miller and Blair, 2009).[4] Given the input-output matrix $\boldsymbol{Z}$ of intermediate flows and the diagonal matrix of sectoral output $\hat{x}$, the matrix $\boldsymbol{A}$ of direct inter-industry coefficients is derived by the dot product of $\boldsymbol{Z}$ by the inverse of the diagonal matrix $\hat{x}^{-1}$:[5]

$$\boldsymbol{A} = \boldsymbol{Z}\hat{x}^{-1} \tag{1}$$

The matrix $\boldsymbol{A}$ allows solving the accounting equation according to which the gross output of each industry (in each country) (x), is given by the sum of intermediate demand ($\boldsymbol{A}x$), from other industries, and final demand (d) (Leontief, 1951; Pasinetti, 1977; Miller and Blair, 2009). In matrix notation:

$$x = \boldsymbol{A}x + d \tag{2}$$

Solving by x, where $\boldsymbol{I}$ is the identity matrix and assuming the existence of the inverse of $(\boldsymbol{I} - \boldsymbol{A})$, it yields:

$$(\boldsymbol{I} - \boldsymbol{A})x = d \tag{3}$$

$$x = (\boldsymbol{I} - \boldsymbol{A})^{-1}d \tag{4}$$

The so-called *Leontief Inverse matrix*, or 'total requirements matrix', is given by:

$$\boldsymbol{L} = (\boldsymbol{I} - \boldsymbol{A})^{-1} \tag{5}$$

Considering the international flows accounted for by the World Input-Output Tables (WIOT), every element $l_{ic,jk}$ of the Leontief matrix captures the direct and indirect requirements in output of industry i in country c to produce one additional unit of final good in industry j in country k. By adopting the vertically integrated sectors framework (Momigliano and Siniscalco, 1982), we then construct the matrix of direct and indirect contributions in terms of value added of each industry to produce the goods in the economy activated by final demand. Given the diagonal matrix of the final demand $\hat{d}$, of value added $\hat{va}$ and of gross output $\hat{x}$, we get matrix V, accounting for value added in trade requirements of final demand:

$$\boldsymbol{V} = \hat{va}\ \hat{x}^{-1}\ \boldsymbol{L}\ \hat{d} \tag{6}$$

Every element $v_{ic,jk}$ stands for the amount of value added activated in industry i for country c by the effective component of final production for subsystem j for country k. Given n total

[4] Available Input-Output tables measure trade flows in monetary terms, usually in million of US dollars. As a result, in the Leontief Inverse framework, one-unit of final demand stands for one million of US dollars.

[5] The hat over variables stands for the transformation from vector to a diagonalised matrix.

number of industries (for rows) and subsystems (for columns) and m total number of countries, $\boldsymbol{V}$ can be represented as an nm x nm matrix:

$$\boldsymbol{V}_{nm,nm} = \begin{bmatrix} v_{11,11} & \cdots & v_{11,jk} & & \\ \vdots & \ddots & & & \\ v_{ic,11} & & v_{ic,jk} & & \\ & & & \ddots & \\ & & & & v_{nm,nm} \end{bmatrix}$$

The columns of this matrix are defined as international production subsystems, or vertically integrated sectors (Pasinetti, 1973; Momigliano and Siniscalco, 1982) and represent the value added incorporated in intermediate production stages induced by the production of final goods. The main diagonal represents the amount of value added embodied in inputs generated internally within the same industry. The row sum of the elements of column (j,k) represents the entire value added generated by the subsystem j in country k required to satisfy the final demand for the goods it produces. In I-O analysis the columns represent *backward* linkages, while the rows represent *forward* linkages.

Given the construction of the matrix $\boldsymbol{V}$, it is possible to calculate vertically integrated (or subsystems) industry labour shares. Using the elements of the value added matrix as weights ($v_{i,c}/\sum_{(i,c)\in(j,k)} v_{i,c}$), we can derive the labour share LS of subsystem j in country k as follows:

$$LS_{j,k} = \sum_{(i,c)\in(j,k)} \frac{v_{i,c}}{\sum_{(i,c)\in(j,k)} v_{i,c}} ls_{i,c} = \sum_{(i,c)\in(j,k)} vash_{i,c} ls_{i,c} \tag{7}$$

where the element (i,c) represents the input from industry i in country c contributing to the value chain of subsystem j in country k. Therefore, $LS_{j,k}$ - the labour share of the subsystem (j,k) - is computed as the weighted sum, in terms of valued added shares $vash_{i,c}$, of the labour shares across industries inside the vertically integrated sector ($(i,c) \in (j,k)$).

Building upon the Employment Multipliers approach (Bivens, 2003; Bivens, 2019) we distinguish three main components of $LS_{j,k}$. We define *direct* contributions as production inputs that the element (i,c) produces for itself, while *indirect* contributions are the inputs coming from other industries. The indirect component can in addition be distinguished in *domestic indirect*, corresponding to inputs coming from other domestic industries (i.e. $i \neq j$ and $c = k$), and in *foreign indirect*, corresponding to inputs coming from abroad industries ($c \neq k$). In the following, we shall distinguish in terms of broad countries (e.g. Advanced vs. Developing) and broad sectors (e.g. Manufacturing vs. Service), to further disentangle heterogeneity.

3.3 Vertical labour share: preliminary trends

Accounting for the 'vertical dimension' of the labour share means examining how value added is distributed between capital and labour along the mix of inputs from different countries and sectors participating in GVCs. In the following, we link the concurrent rise of GVCs participation to the worldwide fall in the labour share and contribute to the literature investigating the labour share dynamics in backward linkages. Our approach allows to take into account the increasing fragmentation of production processes and goes beyond the standard sector-specific

(i.e. horizontal) analysis which undervalues the role of widespread interdependence characterising modern production processes. Thus, we embrace a vertical perspective tracking on the one hand the changing inputs composition of final productions, and on the other hand the functional income distribution. In so doing, we match, from a meso-level viewpoint, the actual decisions firms face in terms of combinations of inputs of production.

Figure 1 shows the impressive negative correlation (correlation coefficient -0.88) between the rise of foreign value added in domestic production (red line) and the fall in aggregate labour share (blue line) in the period 1970-2010.

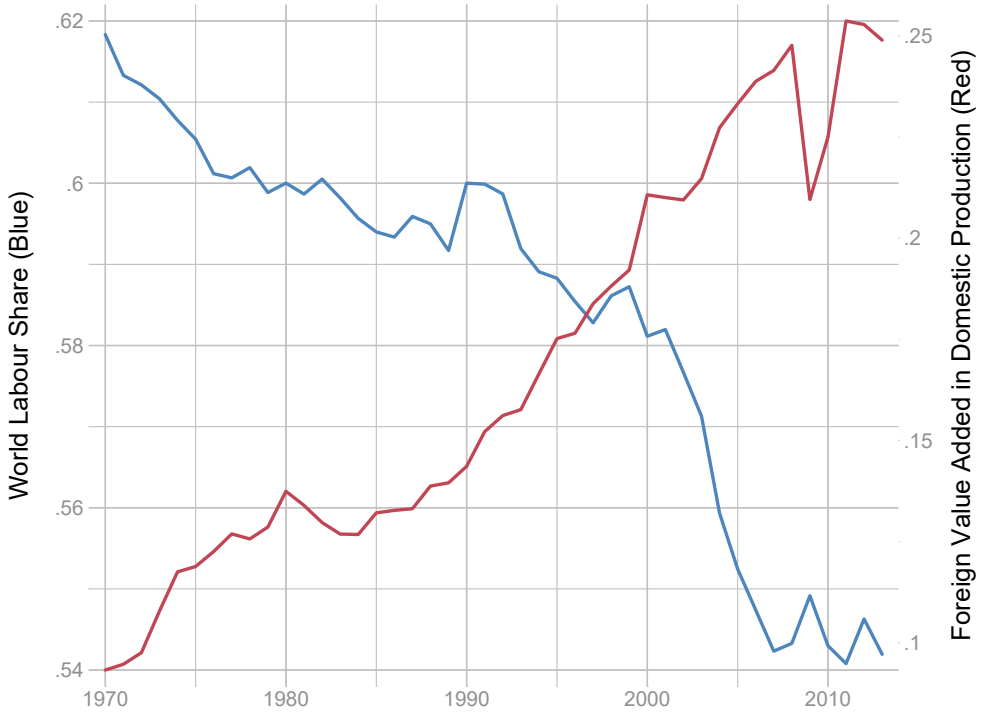

Fig. 1. Comparison between worldwide labour share (blue) and foreign value added in domestic production (red). Labour share data comes from PWT 9.1 while the foreign value added ratio is computed using Pahl and Timmer (2019) data and methodology.

Investigating the vertical dimension of the labour share dynamics is more complex than looking at industry or country-level evidence. Indeed, we are not considering a single sector-country with well-defined characteristics but a mix of inputs coming from countries with different development levels and institutional settings. Inputs come from both manufacturing and service industries having different technological and labour-capital complementarity. In addition, the input composition changes over time, with an increasing contribution of developing countries characterised by lower labour shares. Differently from the extant literature, instead of inspecting the impact of within and between sector transformations in countries' labour share dynamics, we take single GVCs as the unit of analysis tackling structural change tendencies from a backward-linkages perspective.

The top panel of Table 1[6] compares country-level vertical and horizontal labour shares for selected countries and sectors (mean, standard deviation, changes pre- and post-crisis), while

[6] Appendix A2 and A3 present the correspondent tables covering all sectors.

Sector	Code	*Vertical Labour Share*				*Horizontal Labour Share*				*GVCs Integration*	
		Mean	SD	Δ 2000-2007	Δ 2008-2014	Mean	SD	Δ 2000-2007	Δ2008-2014	Foreign Va share	Δ2000-2014
Country Evidence											
Germany	DEU	0.614	0.069	-0.057	0.016	0.675	0.129	-0.062	0.010	0.143	0.025
Japan	JPN	0.604	0.105	-0.040	0.005	0.631	0.217	0.001	0.009	0.070	0.047
China	CHN	0.500	0.090	-0.017	0.089	0.513	0.144	-0.016	0.101	0.070	-0.011
Poland	POL	0.495	0.066	-0.061	-0.014	0.471	0.111	-0.075	-0.050	0.231	0.089
Mexico	MEX	0.368	0.121	-0.033	-0.030	0.305	0.167	-0.046	-0.035	0.274	0.042
United States	USA	0.547	0.081	-0.028	-0.025	0.597	0.138	-0.021	-0.038	0.061	0.022
Sectoral Evidence											
Textile	C13-15	0.549	0.095	-0.013	0.032	0.629	0.152	0.024	0.045	0.110	-0.013
Pharmaceutical	C21	0.408	0.066	-0.031	0.010	0.341	0.115	-0.032	0.026	0.170	0.063
Automotive	C29	0.534	0.092	-0.030	-0.006	0.443	0.161	-0.006	-0.002	0.213	0.040
Transportation	H	0.552	0.109	-0.029	0.017	0.586	0.090	-0.045	0.083	0.165	0.032
Financial Service	K	0.536	0.079	-0.020	-0.020	0.395	0.121	-0.028	0.005	0.060	0.012
Scientific Activities	M	0.607	0.057	-0.010	0.016	0.576	0.251	0.058	0.054	0.110	0.037

Table 1. Descriptive statistics on country-level and sectoral-level Labour Share. Vertical and Horizontal Labour shares refer to 2014. Changes refer to the period 2000-2014. Appendix B presents the whole tables with country-level and sectoral evidence. We exclude from the computation non-market services (P, Q and U), construction (F), natural resources based activities (A, B, C19 and D) and real estate (L). GVCs integration is measured as the percentage of value added produced in foreign countries.

the last two columns display average dependence on indirect foreign inputs (and its change). First, dependence on indirect inputs is growing almost across all countries, both developing and developed ones, with China being an exception. As a consequence, the value added coming from the direct contribution of a sector to its final production is progressively decreasing. Thus, as time goes by, the horizontal and the vertical labour share diverge. On average, developing countries' vertical labour share is higher than their horizontal counterpart, while the opposite holds for advanced economies. This is in line with the different positions countries exert on the international division of labour. Finally, within-country dispersion is greater in horizontal sectors rather than in vertical GVCs.

As a counterpart, the bottom panel in Table 1 presents the sectoral level descriptive statistics. The differences between the vertical and the horizontal dimensions are now more evident. The automotive and pharmaceutical industries are more reliant on foreign inputs than services, and thus, the vertical and the horizontal dimensions more significantly diverge. Again, within-sector vertical labour shares are less volatile than horizontal ones, especially services. Finally, while labour share drops virtually in all vertical sectors, the horizontal picture is more nuanced.

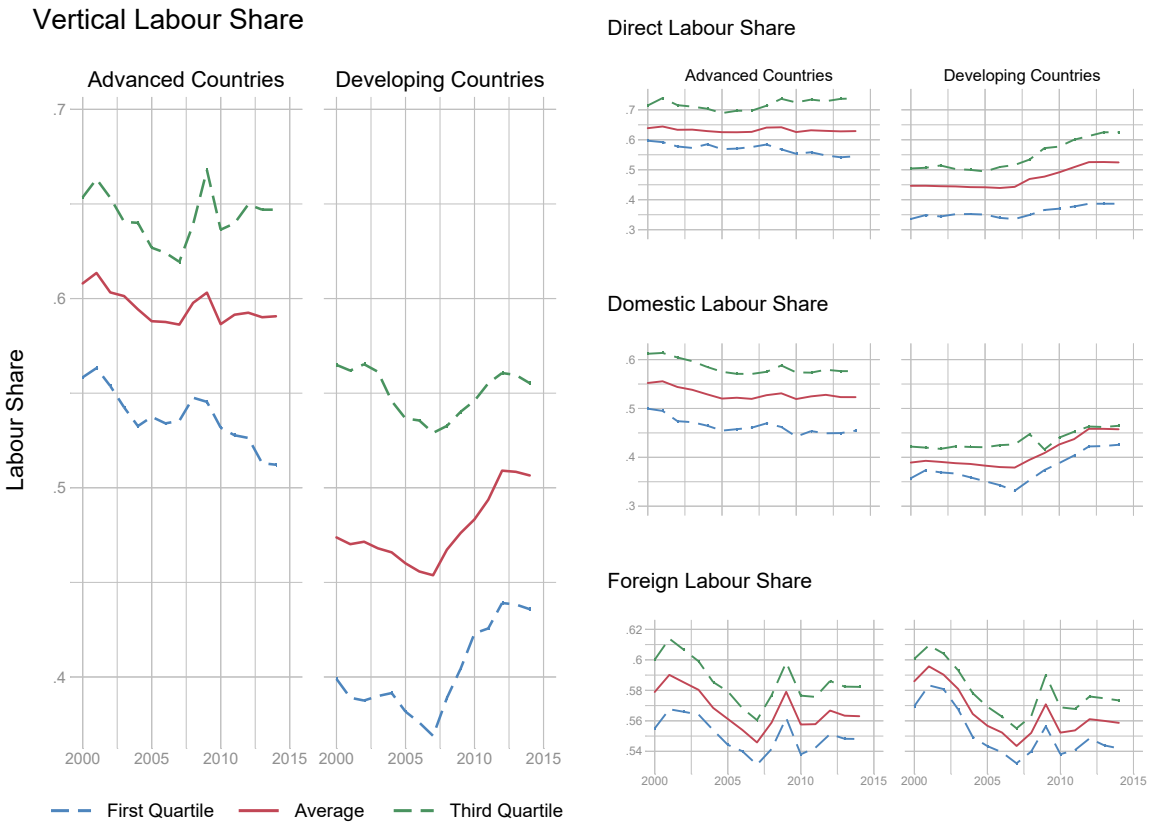

Fig. 2. Labour share trends in advanced and developing countries. Labour share distribution is weighted by real value added.

The left panel of Figure 2 presents the trends of whole GVCs labour share comparing advanced and developing countries. The unit of analysis is the single value chain (e.g., the automotive vertical sector in Italy) then aggregated in broad geographical areas using real value added as weights. First, advanced countries' labour shares are greater than developing countries' ones, with narrow overlapping support between the bottom and the top of the two distributions respectively. Second, two divergent time trends emerge: a pre-crisis declining one until 2007, when most chains observe a consistent drop, and a post-crisis period in which several developing countries, and especially China, witness a labour share boom, while advanced countries stagnate. Interestingly enough, while the first and third quartiles of the distribution of the labour share of developing countries follow similar trends, advanced countries show contrasting tendencies, with the top quartile showing a growing/stagnating labour share in the final period while the bottom one keeps declining.

The right panel of Figure 2 presents the vertical labour share now decomposed into three components, namely direct, domestic and foreign contributions. Direct contributions constitute the lion's share of total inputs, and therefore, their dynamics closely mimic the whole chain. However, the direct component is on average higher than its aggregate counterpart and witnesses a minor decline, while a steepest declining trend is visible in the foreign component. Again, contrasting tendencies emerge among the third stable quartile and the declining first one. The domestic contribution of advanced countries falls on average by about 5% in the

period under scrutiny with reference to the third quartile. Developing countries' direct and domestic inputs are stable in the pre-crisis period while their labour share increases steadily in the last seven years. Finally, foreign inputs' labour share declines steadily in the whole period, with a post-crisis rebound in 2009. Notably, the differences between developed and advanced countries shrink in the foreign component, and the distributions have narrower supports. Furthermore, the dynamics in the domestic and foreign components are increasingly relevant in explaining the whole pattern since increasing GVCs integration maps into higher weights of vertical value added.

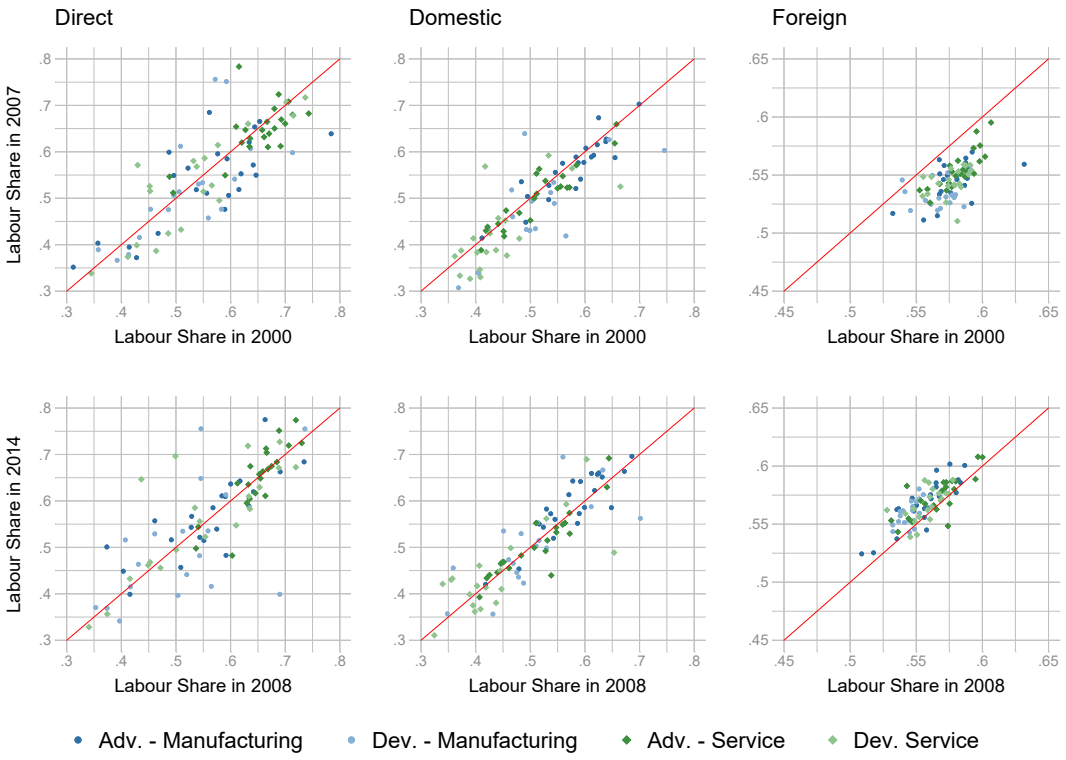

Fig. 3. Vertical labour share shift in the pre- and post-crisis periods by macro-sector, country development level and GVCs components.

Figure 3 offers a more disaggregated picture tracking GVCs changes pre-crisis (top plot) and post-crisis (bottom plot), distinguishing by macro-sector, country development level and GVCs components. First, value chains in service activities have a higher direct component of the labour share, independently from the country aggregation. The opposite holds in the domestic segment with manufacturing productions that activate domestic labour inputs embedding higher labour share than those of service industries. Second, a typical pattern in all categories is a higher incidence of a declining labour share along value chains in the pre-crisis period, both in advanced and developing countries, particularly in the foreign component. This trend is similar across macro-sectors. The most striking evidence concerns foreign input contributions that show a pervasive drop in the pre-crisis period and a partial recovery in the post-crisis one. Such a remarkable drop in conjunction with the crisis year is consistent with

the evidence of the trade collapse (Levchenko et al., 2010) according to which the reduction in intermediate input trade flows was the main determinant of such dynamics.

3.4 Sectoral and country dynamics: selected evidence

We now propose some illustrative evidence on specific sectors and countries to pinpoint insights on the vertical labour share dynamics. Figure 4 shows the dynamics of six chains characterised by distinct technological attributes, employment structures and market conditions. The left panel presents the evolution of the labour share in three manufacturing (textile, pharmaceutical, automotive) and three services value chains (logistics, finance, scientific activities) distinguishing between developing and advanced countries; the central panel decomposes the labour share in terms of direct, domestic and foreign components; the right panel accounts for the GVCs composition in the sixth sectors of interest in terms of value added. In this respect, we track both the evolution of the remuneration of labour inputs over time but also the value added contribution of such inputs (e.g., price and quantity effects).

The textile sector goes through a widespread and steady decline up to the financial crisis, especially in developing economies. In the post-crisis period, advanced and developing countries have opposite dynamics resulting in an overall stagnation of average labour share. The central panel shows that the direct contributions sustain the labour share while the domestic component stagnates and foreign contributions fall. Jointly evaluating the temporal dynamics together with the textile value chain composition, in initial and final years of the time span (2000 and 2014), in the right panel, we detect a concurrent expansion in relative production by developing countries in all GVCs' segments.

The pharmaceutical chain displays a lower vertical labour share in advanced and developing countries. This evidence is in line with Chen et al. (2018) showing that intangible capitals (i.e. trademarks and patents) have an increasingly important role in the pharmaceutical industries. This points to the rise of intangibles as a concurrent determinant of the labour share drop. Interestingly, advanced and developing countries' labour share converge to a similar level due to the opposite dynamics in the post-crisis period. The right panel of Figure 4 shows, however, that the restructuring of the value chain composition is due to a change in the weights of the three components rather than to an expansion of developing countries' markets.

Automotive value chains are the most reactive to the financial crisis, with a positive jump in advanced countries just afterwords. However, the decline in the labour share keeps ongoing immediately after the crisis. Developing countries show a reasonably constant labour share with a slightly positive trend in the final years. Looking at the dynamics of GVCs components in the central panel, advanced countries experienced ubiquitous negative trends, while developing countries only in the foreign component (driven mainly by imports from advanced countries). Finally, the right panel witnesses a broad expansion of developing countries in the automotive sector in all segments of production.

The bottom panel of the figure shows the labour share dynamics of selected service value chains, namely Logistics, Finance and Scientific Activities. Opposing patterns again emerge across the international geographical division of services: while until the 2008 crisis a common decline characterises both developing and advanced countries, after the financial crisis a swift increase in the remuneration of service inputs in developing countries is quite visible, signalling that the post-crisis period has represented a restructuring event. Focusing on the dynamics of the components (central panel), the most striking evidence is, again, that foreign

inputs labour shares decline in all sectors and countries. This occurs in contrast with the increasing role played by the value added deriving from foreign services, both originating from advanced but particularly from developing countries, in all sectors.

The bottom line of this sectoral overview is that advanced countries are witnessing a decline in the vertical labour share, particularly in manufacturing sectors, while the opposite holds for developing countries. More precisely, advanced and developing labour share dynamics appear similar and fall in the pre-crisis period, while they diverge afterwards. Finally, service sectors' labour share dynamics appear to be more similar (within the same development status) than manufacturing industries.

Moving to selected GVCs at the country-level of aggregation and decomposing now the contributions in terms of their sectoral origins, the left panel of Figure 5 distinguishes between average productions in service and manufacturing activities in six selected countries (US, Japan, Germany, Mexico, Poland, China). Indeed, country-specific characteristics in terms of development stages but also patterns of production and specialization are critical in explaining the labour share decline.

The United States and Mexico lead the fall in manufacturing and services with an overall drop greater than 5%. In both manufacturing and service, Japan and Germany's labour shares fall in the pre-crisis period, while in the post-crisis period, divergent dynamics emerge. Japan's manufacturing industries keep falling, and service sectors slightly grow, while the opposite holds for Germany. China has the most striking labour share performance with a jump in the post-crisis period in both manufacturing and service sectors. On the opposite side, Poland and Mexico decline in the whole period. Such contrasting developing countries' experiences might reflect different competitive strategies in GVCs participation: Poland and Mexico appear to rely more on productivity upgrading, compressing wages to gain market shares, while China focuses on both quality upgrading, to increase the overall competitiveness, but also on the extensive margins increasing domestic and direct labour shares. In the central panel, GVCs contributions are displayed. Again, the ubiquitous decline in foreign components' labour share emerges. Domestic and direct components largely follow similar dynamics. The main evidence is that China's manufacturing sectors are the only ones witnessing increasing vertical labour share among the selected countries, while, on average, all the others fall.

The right panel of Figure 5 shows a progressive and widespread servitisation of the economy, with expanding direct and domestic components in terms of value added composition of the GVCs. This pattern holds in all countries, even China, with the only exception of Poland in our sample. On the other hand, manufacturing still accounts for the lion's share of foreign inputs value added.

To sum up, countries' characteristics are more relevant than sectoral attributes in understanding the vertical labour share dynamics, as shown by narrower labour share distributions. Further, manufacturing sectors witness a ubiquitous fall in labour share, especially in advanced countries in the pre-crisis period. Finally, developing countries' labour share follows idiosyncratic paths, with China standing out in the post-crisis period with an impressive upsurge in domestic and direct components.

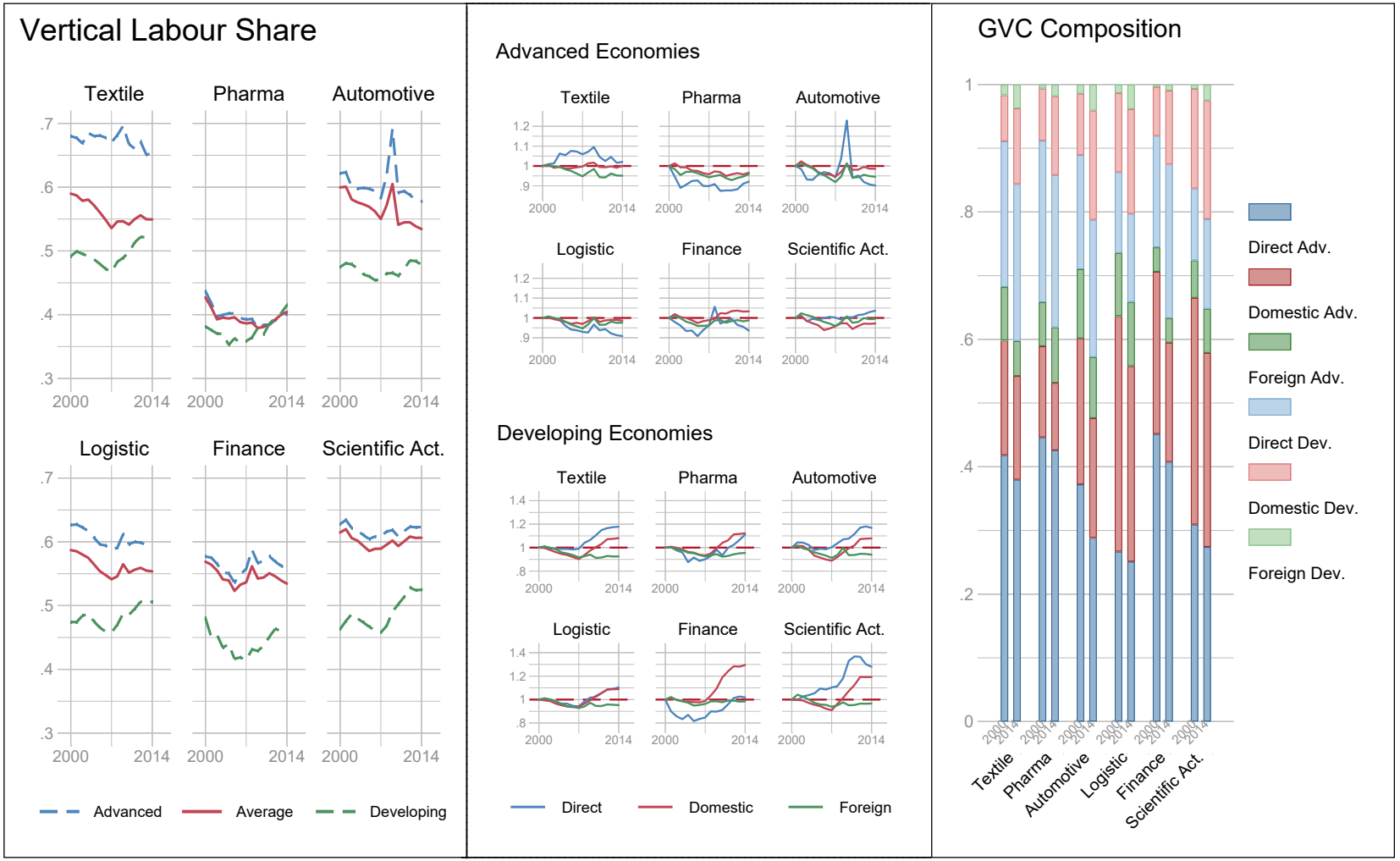

Fig. 4. *Left Panel*: aggregate labour share trends in six selected industries. The figure displays weighted averages across advanced, developing countries and the whole sample vertical labour share. *Central panel*: evolution of direct, domestic and foreign contributions' labour share (2000=1). *Right panel*: sectoral GVCs value added composition. All variables are aggregated using value added as weight.

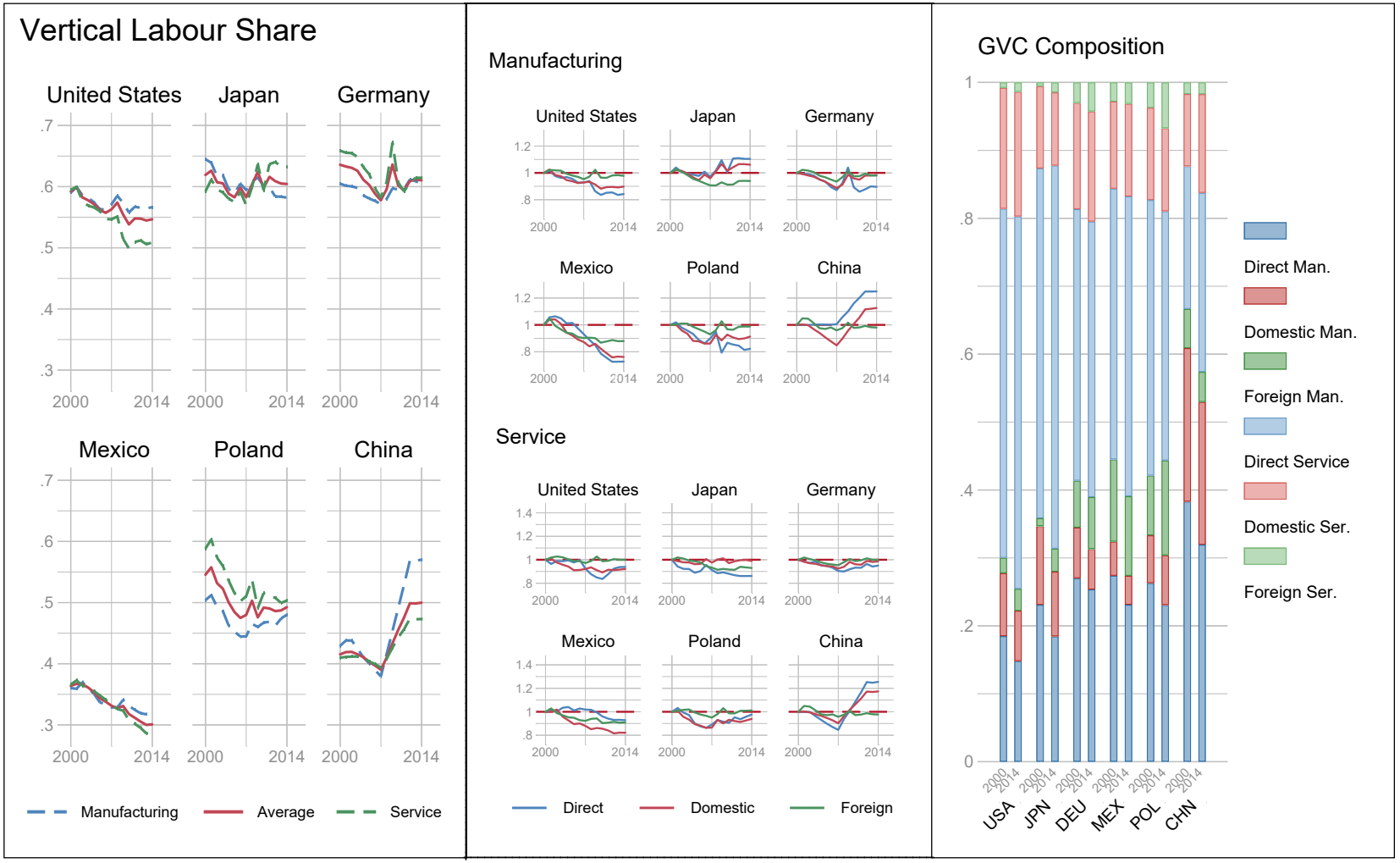

Fig. 5. *Left Panel*: aggregate labour share trends in six selected countries. The figure displays weighted averages across manufacturing industries, service activities and the whole economy vertical labour share. *Central panel*: evolution of direct, domestic and foreign contributions' labour share (2000=1). *Right panel*: country-level GVCs value added composition. All variables are aggregated using value added as weight.

4 Vertical labour share and development stages

The evidence presented so far suggests that according to their development stages, countries differently participate in GVCs, and in doing so, also, the input remuneration is differently affected. How is the vertical labour share evolving across development stages? Development studies have highlighted the potential inverted U-shape relationship linking inequality and income per capita, at least since the Kuznets curve (Kuznets, 1973). Further, deindustrialisation studies have shown a similar inverted-U pattern looking at the evolution of manufacturing shares (Rodrik, 2016; Dosi et al., 2021). On the contrary, Maarek and Orgiazzi (2020) show that a U-shape relationship holds between the labour share in manufacturing industries and income per capita. While industrial and economic upgrading might explain the rising part of the U, with an increasing fraction of the labour force employed in the formal sector experiencing higher wages, less clear are the reasons for a declining initial phase. The authors argue that it might be explained by an initial tiny fraction of high-productivity firms rising wages, and the majority low-productivity firms compressing them.

Hereby, we look at both manufacturing and service macro-aggregates, and we investigate the vertical dimension of the labour share distinguishing among direct, indirect domestic and foreign contributions. We use the sectoral level information to estimate a country-industry panel regression. We perform the estimation for the labour share relative to the whole GVCs, and then restrict the analysis to the three components. Further, we control for population and its square, capital per worker, productivity, and the share of foreign inputs on total value added. We add a series of fixed effects (country-sector and year fixed effects).

$$LS_{(j,k),t} = \alpha_0 + \alpha_1 LnGDP/c_{k,t} + \alpha_2 LnGDP/c^2_{k,t} + \alpha_5 X_{(j,k),t} + \theta_{(j,k)} + \gamma_t + \epsilon_{(j,k),t} \qquad (8)$$

where (j,k) identifies GVC j in country k, at time t, while $LnGDP/c$ stands for the logarithm of income per capita of country k, $X_{(j,k),t}$ represents a set of control variables while γ_t and $\theta_{(j,k)}$ are time and GVCs fixed effects respectively. Additionally, as a way of comparison, we estimate both a quadratic and a linear relationship between labour share and GDP/c. The introduction of a quadratic relationship is meant to detect whether any peak dynamics emerge, also in line with the evidence of a declining labour share dynamics occurring in the recent years, as documented above.

Table 2 presents the results for both the linear (only GDP/c term) and the quadratic estimations (both GDP/c and its square) of eq. 8. We show the results pooling all manufacturing and service sectors (top panel) and for the two separated macro-aggregates. Further, we estimate both linear and quadratic specifications on four different dependent variables: the first two columns present the results relative to the whole GVCs, the third and fourth columns the direct component, the fifth and sixth columns the domestic contribution, and finally the foreign one.

Starting with the pooled estimation (top panel), the quadratic specification fits all GVCs aggregates better, except domestic contributions, where a positive linear relationship is better estimated. Differently from Maarek and Orgiazzi (2020), whenever significant, we find a hump-shaped relation, quite in line with results in the deindustrialisation literature. Splitting the sample in macro-aggregates (central and bottom panels), we observe that manufacturing industries mainly drive the hump-shaped relationships between vertical labour share and development stages. Conversely, a positive linear relationship better describes the labour share in

the service activities. Furthermore, estimations for the manufacturing sector display always a better fit.

Proving the importance of the vertical dimension to account for international fragmentation of production, and ensuing impacts on the remuneration of labour inputs, the estimations for the foreign components, independently from the macro-aggregate of interest, always have a greater R^2. This result signals that the most affected component by the development stage of the country is the one providing inputs for international production chains.

All Vertical Sectors								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Aggregate GVC		Direct		Domestic		Foreign	
	Linear	*Quadratic*	*Linear*	*Quadratic*	*Linear*	*Quadratic*	*Linear*	*Quadratic*
Log GDP/c	0.04***	0.33**	0.03	0.73***	0.02**	-0.10	0.01***	0.14***
	(0.014)	(0.148)	(0.023)	(0.234)	(0.009)	(0.101)	(0.003)	(0.028)
Log GDP/c^2		-0.02**		-0.04***		0.01		-0.01***
		(0.008)		(0.012)		(0.006)		(0.001)
Obs.	17,083	17,083	17,083	17,083	17,083	17,083	17,083	17,083
R^2	0.091	0.092	0.089	0.092	0.031	0.031	0.520	0.522
Country-Sector FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Manufacturing								
	Aggregate GVC		Direct		Domestic		Foreign	
Log GDP/c	0.02	0.28*	-0.00	0.69**	0.01	-0.11	0.01***	0.17***
	(0.015)	(0.169)	(0.027)	(0.276)	(0.010)	(0.118)	(0.004)	(0.036)
Log GDP/c^2		-0.01		-0.04**		0.01		-0.01***
		(0.009)		(0.015)		(0.006)		(0.002)
Obs	11,338	11,338	11,338	11,338	11,338	11,338	11,338	11,338
R^2	0.130	0.131	0.130	0.133	0.040	0.041	0.543	0.547
Country-Sector FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Service								
	Aggregate GVC		Direct		Domestic		Foreign	
Log GDP/c	0.08***	0.42	0.10**	0.79**	0.03*	-0.07	0.02***	0.07*
	(0.025)	(0.265)	(0.040)	(0.371)	(0.016)	(0.186)	(0.004)	(0.040)
Log GDP/c^2		-0.02		-0.04*		0.01		-0.00
		(0.014)		(0.019)		(0.010)		(0.002)
Obs.	5,745	5,745	5,745	5,745	5,745	5,745	5,745	5,745
R^2	0.079	0.081	0.076	0.081	0.040	0.040	0.506	0.506
Country-Sector FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓

Table 2. Regression results for eq. 8. Standard error in parentheses, clustered at the country-industry level. * p<0.1, ** p<0.05, *** p<0.01. All regressions control for population and its square, capital per worker, productivity and GVCs integration.

Figure 6 displays the predicted labour shares derived by the estimations performed in the top panel of Table 2. Starting with the whole GVCs, a weak converging dynamics at approximately 60% emerges, which, however, is a composition effect deriving from the interaction of the three components. The direct component, in line with the deindustrialisation literature, presents a clear peak dynamic. Here an important caveat is that, differently from other studies in the literature, both country and time heterogeneity are quite limited; therefore, results are also less effective. In line with increasing outsourcing trends and fragmentation of the produc-

tion activity (recall that the domestic component collects the indirect inputs coming from the same country), the domestic component reflects a linearly increasing trend. This means that the remuneration of indirect domestic labour activities increases with the country's development stage. After reaching a peak at around 32thousands dollars per capita, the foreign component remains stuck at 57% of the vertical labour share. The absence of an overall increasing pattern in the foreign component able to counterbalance the declining direct component suggests that the gains for labour in participating in international value chains come to a halt. Note that the foreign components' confidence intervals are quite tiny compared to the other components. In addition, it has to be noted that the absolute peaks are quite different. While the peak in the direct component is the highest at 0.62, both domestic and foreign components reach a maximum of respectively 0.55 and 0.57.

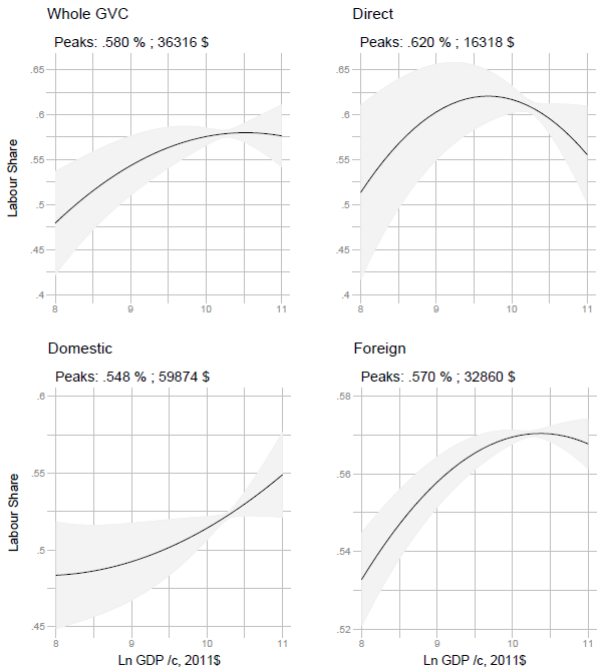

Fig. 6. Predicted labour shares for the whole GVCs and components estimated through eq. (8). Country fixed effects are averaged and covariates are set to the sample average. The subtitle of each graph shows peak share and the correspondent GDP per capita at the turning point.

Figure 7 displays the year fixed effects relative to the top panel of Table 2 for the three GVCs components. First, while the absolute values of year fixed effects in the three estimations largely co-move, the direct components fail to be significantly different from zero due to the large confidence intervals. Second, year fixed effects of the other two components highlight three phases: a first declining trend until the 2008 crisis, a short window of rebounding due to the short-run counter-cyclical nature of the labour share (2008-2009), and a new declining phase after 2009 and in line with the secular declining trend (Growiec et al., 2018).

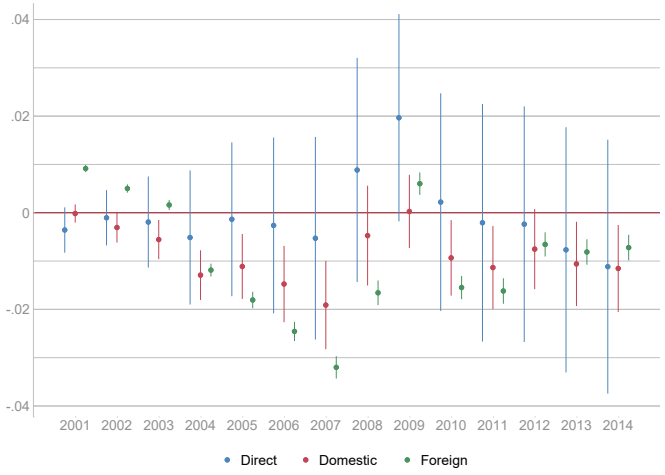

Fig. 7. Year fixed effects and 5% significance level confidence intervals estimated through eq. 8.

To sum up, the analysis of the vertical labour share dynamics along development stages has proven that, first, the direct components closely mimic the results in the deindustrialisation literature, with a clear peaking behaviour, while the indirect components, both domestic and foreign, experience increasing labour share patterns. However, the peak in the indirect components is lower than in the direct one. Second, the remuneration of foreign contributions, the best estimated from our regression, come to a halt, signalling that the gains for labour inputs in participating in GVCs are not long-lasting. In terms of time shifts, we do find evidence of a medium-run declining trend in the period of analysis, except for the short-run rebounding after the crisis.

5 Shift-share analysis

The final section develops a shift-share analysis to investigate how inputs from different origins (e.g. country development levels, sectoral macro-aggregates) are responsible for changes in the vertical labour share of a given GVC. We move, therefore, from a comparative static framework to a dynamic one in which we look at input changes from 2000 to 2014. In practice, variations in the vertical labour share might arise either from a change in the labour share of the inputs used, keeping constant their composition, or alternatively from the reshuffling of inputs' composition, assuming a stable functional income distribution. Thus, we decompose the vertical labour share in a *within-inputs component*, capturing the evolution of the functional income distribution keeping constant the input requirements, and a *between-inputs component*, capturing how the change in the bundle of input requirements, e.g., toward cheaper labour from another sector/country, might affect the dynamics of the vertical labour share in a given chain. Therefore, we can interpret the within component as informative about the distribution of the gains of productivity to wages along the chain, and the between component as informative of the change in the firm decisions to perform outsourcing and/or offshoring of labour requirements.

The shift-share analysis reads as follows:

$$\Delta LS^{GVC}_{(j,k),t} = \overbrace{\sum_{(i,c)\in(j,k)} (\Delta ls_{(i,c),t} * \tilde{v}_{(i,c),t})}^{\textit{Within Inputs}} + \overbrace{\sum_{(i,c)\in(j,k)} (\Delta v_{(i,c),t} * \tilde{ls}_{(i,c),t})}^{\textit{Between Inputs}} \tag{9}$$

where (j, k) identifies the subsystems j ending in country k; (i, c) the inputs from industry i in country c, and t the year. Δ refers to the change in the variable under scrutiny, while $\tilde{ls}$ and $\tilde{v}$ are respectively average labour and value added shares across the time period.

Figure 8 shows the results of the shift-share decomposition splitting the analysis into two sub-periods: 2000-2007 (left) and 2008-2014 (right). The two periods are distinct because of the evidence suggesting a breaking behaviour of the labour share during the crisis. The bars report the average within- and between-input components across country groups and macro-sectors, weighted by value chains' value added. While macro-sectors still refer to the manufacturing-service category, country aggregates are further disentangled into four groups: Advanced EU, Advanced Non-EU, Developing Non-EU and Emerging EU. This distinction has been adopted to allow the emergence of different integration strategies occurring worldwide, particularly the integration of the Visegrad Group in 2004.

First, the within-input dynamics is the most relevant in explaining overall changes in both periods, while the between components, in general, exert a negative contribution to the change, signalling that input re-composition occurs at the cost of the labour share. The pre-crisis period (2000-2007) is marked by a ubiquitous and robust decline in the vertical labour share both in advanced and developing countries, mainly driven by the within component. This drop encompasses both manufacturing and service activities with a greater impact on the former. Notably, the negative between-input components in manufacturing and services in both advanced EU and non-EU countries might reflect strategies of labour cost reductions through production fragmentation operated by advanced economies.

In the post-crisis period, the only group of countries recording a substantial rebound in the labour share are developing non-EU countries, driven by China. The negative change experienced by emerging EU countries is evident, particularly in the within-component of the manufacturing activities. Coupled with the negative between-input component of the manufacturing sector in the 2000-2007 period experienced by advanced EU countries, the negative within-labour share in EU emerging countries is another confirmation of wage compression strategies put forward by processes of international fragmentation, operated even by backward countries who should have in principle benefited from participation in GVCs. However, the distinct dynamics between emerging EU and developing non-EU countries is quite interesting, the latter instead recording a positive within dynamics.

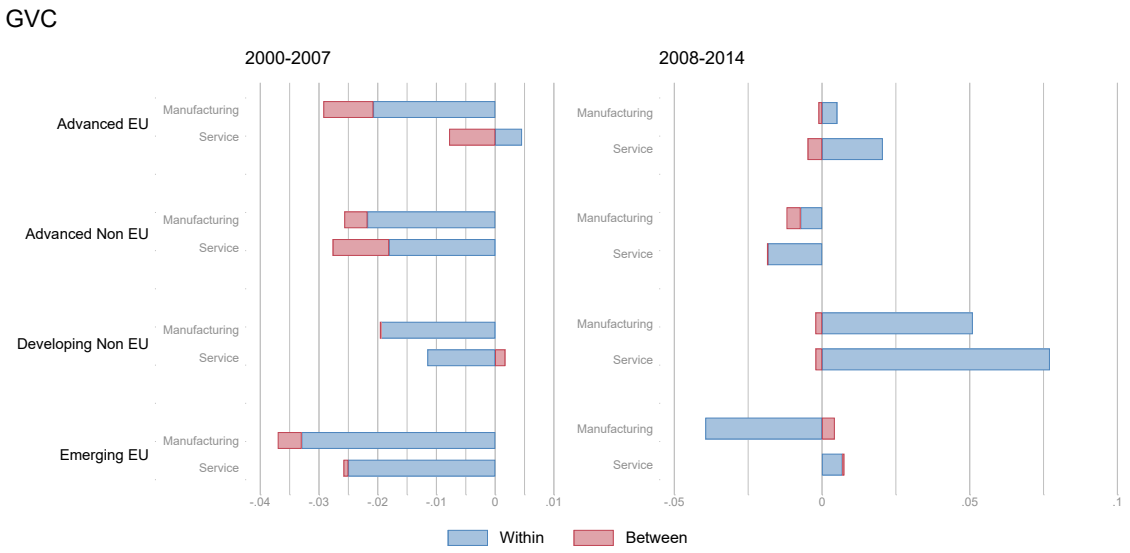

Fig. 8. Shift-share analysis by vertically integrated sectors on whole GVCs labour share. Results are computed at the GVCs-level and then averages across sectors weighted by real value added.

While the within-input components appear to play a major role in the change of vertical labour share, disentangling the effects across GVCs segments unveils a more complex interplay. Indeed, the shift-share decomposition allows for the disentangling of *within-input* and *between-input* changes in value chain's contributions (s), namely direct inputs (i.e. $Dir : (j,k) = (i,c)$), domestic indirect contributions (i.e. $Dom : j \neq i$ and $k = c$), and foreign indirect contributions (i.e. $For : k \neq c$). Thus, adapting eq. 9, changes in $\Delta LS^{Dir,Dom,For}_{(j,k),t}$ can be further decomposed in:

$$\Delta LS^{GVC}_{(j,k),t} = \frac{\tilde{va^{dir}_{(j,k),t}}}{va^{gvc}_{(j,k),t}} \Delta LS^{dir}_{(j,k),t} + \frac{\tilde{va^{dom}_{(j,k),t}}}{va^{gvc}_{(j,k),t}} \Delta LS^{dom}_{(j,k),t} + \frac{\tilde{va^{for}_{(j,k),t}}}{va^{gvc}_{(j,k),t}} \Delta LS^{for}_{(j,k),t} =$$

$$= \sum_{s \in (Dir,Dom,For)} \tilde{v}^{s}_{(j,k),t} \Bigg[\underbrace{\sum_{(i,c) \in s} (\Delta ls_{(i,c),t} * \tilde{v}_{(i,c),t})}_{\textit{Within Inputs}} + \underbrace{\sum_{(i,c) \in s} (\Delta v_{(i,c),t} * \tilde{ls}_{(i,c),t})}_{\textit{Between Inputs}} \Bigg] \tag{10}$$

where s stands for the three components of GVCs (i.e.direct, domestic and foreign contributions respectively) and $\tilde{v}^{s}_{(j,k),t}$ for the value added shares of each chain contribution averaged across the period. Thus, following the decomposition of eq. 10, we replicate the analysis now accounting for the three components and show results in Table 3. Direct components largely outweigh the other two, in line with the higher role of direct value added. In the pre-crisis period, all three within-input components are negative, almost in all chains signalling capital shares gaining against labour ones.

On the contrary, the between components have heterogeneous dynamics. Looking at manufacturing chains, the between components are negative in all direct contributions, while positive in indirect domestic and foreign ones, also in line with the increasing indirect labour share patterns documented so far. This evidence shows that the fragmentation of production upsurged in the years under consideration, increasing the share of value added indirectly pro-

duced domestically and, even more, abroad. On the other hand, those patterns are less evident in the service chains. Direct contributions between components are largely positive, while domestic and foreign ones are negative. However, all service sectors between components are relatively smaller than their manufacturing counterparts. Given the overall negative values of within components and contrasting signs in between contributions, the net effect in Figure 8 shows the prevalence of the within-component.

Moving to the post-crisis panel, direct within components are negative in all chains except developing non-European countries. In contrast, foreign and domestic within-contributions are either positive or close to zero. Across advanced economies, as a result of the counter-cyclical impact of the 2008 crisis and the reduction in inter-industries trade with the great collapse, both within and between components are smaller in absolute values than in the previous period. While looking at developing countries, two patterns emerge: non-European developing countries, driven by the direct and domestic components, more than recover the fall of the previous period ending with a positive change in the labour share; on the opposite, European emerging manufacturing sectors record negative changes in the direct and domestic components, while services stagnate. These divergent patterns across developing countries again recall the sign of different integration strategies, one based more on internal wage compression (the eastern EU one), and another based more on employment expansion and technological upgrading, mainly driven by China (Dosi et al., 2020).

		2000-2007							***2008-2014***						
		Direct		**Domestic**		**Foreign**		**Tot.**	**Direct**		**Domestic**		**Foreign**		**Tot.**
		w	*b*	*w*	*b*	*w*	*b*		*w*	*b*	*w*	*b*	*w*	*b*	
Advanced EU	*Manufacturing*	-0,014	-0,016	-0,002	0,002	-0,005	0,005	**-0,029**	-0,005	0,007	0,006	-0,018	0,004	0,009	**0,004**
	Service	0,004	0,002	0,002	-0,006	-0,001	-0,003	**-0,003**	0,015	-0,003	0,004	-0,006	0,001	0,004	**0,016**
Advanced Non-EU	*Manufacturing*	-0,013	-0,016	-0,007	0,001	-0,002	0,011	**-0,026**	-0,009	0,001	-0,001	-0,009	0,003	0,003	**-0,012**
	Service	-0,014	-0,006	-0,004	-0,006	0,000	0,003	**-0,028**	-0,017	0,004	-0,001	-0,007	0,001	0,002	**-0,019**
Developing Non-EU	*Manufacturing*	-0,005	-0,022	-0,012	0,007	-0,003	0,015	**-0,020**	0,026	-0,004	0,024	0,015	0,002	-0,013	**0,049**
	Service	-0,009	0,010	-0,002	-0,004	-0,001	-0,004	**-0,010**	0,056	0,004	0,020	0,000	0,001	-0,006	**0,075**
Emerging EU	*Manufacturing*	-0,016	-0,025	-0,008	-0,001	-0,009	0,022	**-0,037**	-0,043	-0,009	-0,002	-0,008	0,006	0,021	**-0,035**
	Service	-0,014	0,008	-0,008	-0,008	-0,003	-0,001	**-0,026**	0,006	-0,003	-0,002	-0,004	0,003	0,008	**0,008**

Table 3. Shift-share analysis by vertically integrated sectors on whole GVCs labour share following equation 10. Results are computed at the GVCs-level and then averaged across macro-sectors and country groups weighting by value added.

We finally restrict the analysis on the indirect components (i.e., domestic and foreign contributions) to understand which sources, whether outsourcing or offshoring, drive our results. First, we investigate the sectoral origin of the input requirements, distinguishing manufacturing and service contributions. Then, focusing on foreign components, we investigate the labour share dynamics of inputs from advanced *versus* developing countries. In Figure 9 we decompose domestic and foreign inputs separately (i.e., value added shares sum up to one in each segment).

Fig. 9. Shift-share analysis on domestic and foreign components following eq. 9. Results are computed at the GVCs-level and then averaged across industries and country groups using value added as weights. The analyses highlight the sectoral origin of inputs along the value chains.

Notably, in both periods, most of the positive contributions are due to service inputs. More precisely, between-input components are greater in the pre-crisis, while within-input components prevails in the post-crisis. These positive contributions hold both in domestic and foreign inputs, confirming a progressive servitisation of the chains, but also the increased tradability of services (Baldwin and Freeman, 2021).

Contrarily, manufacturing inputs are characterised by negative within and between components, especially in the pre-crisis period. In the post-crisis period, a small rebound signals some gains for the within-manufacturing component in developing non-EU countries. Overall, notwithstanding the positive contribution of service inputs, the rise of service labour share is not sufficient to compensate for the drop in manufacturing industries' inputs labour share, neither in domestic nor in foreign components.

To conclude, Figure 10 deals with backward linkages' origin distinguishing between inputs from advanced and developing countries. Introducing the origin dimension allows for the detection of new patterns concealed in previous analyses. While foreign inputs from advanced countries record a negative labour share shift, in all components, foreign inputs from developing economies register sustained gains in labour share, driven by their between-component. This suggests an international restructuring of labour requirements toward developing countries that increased their participation in GVCs. However, the labour share falls in inputs from advanced countries is greater than the rise in developing countries, resulting in an overall decline in the labour share.

Thanks to the sectoral and geographical origins of the input composition, the shift-share analysis pinpoints that along GVCs, service inputs' labour share is gaining while manufacturing is falling. Foreign labour from non-EU emerging economies benefits at the cost of inputs from advanced countries (opposite between-input dynamics). However, such gains already strongly decrease in the second period, also questioning the duration of the benefits of the labour share from GVCs participation.

Fig. 10. Shift-share analysis on foreign components following eq. 9. Results are computed at the GVCs-level and then averaged across industries and country groups weighting by value added. Left panel accounts for inputs from advanced countries while the right panel with developing countries.

6 Concluding remarks

Investigating how globalisation affects functional income distribution is crucial to understand why advanced and developing economies are experiencing a dramatic drop in the labour share. In this work, we focus on a particular type of globalisation, namely the rise in GVCs and the ensuing progressive fragmentation of the production processes, studying their impact on the share of remuneration accruing to labour. Indeed, there exists the risk that international restructurings of GVCs limit how the gains from globalisation and technological advances are shared between capital and labour. Firms have increasingly greater options in choosing inputs in international markets and can reorient their strategies versus acquiring labour inputs less remunerated.

Instead of relying on traditionally horizontal sectors as units of analysis, we propose the novel concept of the vertical labour share, shifting the focus from country-sector specific dynamics to GVCs integration. Using worldwide I-O tables for the 2000-2014 period and the definition of vertically integrated sectors, we are able to investigate supply chains' labour share, emerging from the combination of intermediaries entering in the production of the final output. Thus, we do not limit our analysis to standard synthetic indicators of GVCs participation, but rather we explore a new broad spectrum of measures able to capture the heterogeneity characterising the supply chains.

First, we find that the pre-crisis period is characterised by the drop in labour share in virtually all vertically integrated sectors. While the post-crisis period witnesses heterogeneous dynamics. Among advanced countries, European vertical labour shares stagnate while non-European economies, led by the US, keep falling. Developing countries witness contrasting patterns as well: ex-Soviet countries increased their international competitiveness at the cost of the labour share. This resulted in an economic upgrading within GVCs that led to greater integration in international production networks. On the opposite, developing non-European countries went through a post-crisis period of labour share growth, mainly led by China, the

latter showing strategic participation in GVCs, both increasing integration and remuneration of labour inputs, given the dramatically low initial level of the labour share.

Second, we split the whole GVCs dynamics into three components, *direct* (i.e., produced in the same sector of activity), *domestic* (i.e., originating from other sectors but in the same country) and *foreign* (i.e., indirect imported inputs) contributions and investigate them separately. The remuneration of the foreign components record a drop in advanced countries while increasing in developing ones.

In order to understand the relationship between the labour share dynamics and the different stages of economic development, we estimate a panel regression analysis including a linear and a quadratic trend. We find evidence of a hump-shaped relation between GVCs labour share and GDP/c in manufacturing industries in the direct component, in line with the results expected from the deindustrialisation literature. On the contrary, the indirect domestic contribution presents a neater positive linear trend. Differently, the foreign contribution shows weak evidence of a peak dynamics. The composition of the three contributions results in a converging vertical labour share at 58%, a value much lower than the direct component one. In addition, the time shift shows a medium-run declining trend, only partially contrasted by a short-run rebound in the proximity of the crisis.

A shift-share analysis, distinguishing within- and between-input changes, shows that the contribution of the within-component has been mostly responsible for the drop. However, the between-component also played a negative role, with value chains restructuring toward cheaper labour inputs. When accounting for the sector and country of origin, service inputs have experienced a rise in the labour share in contrast with manufacturing inputs, while advanced economies have embraced restructuring processes, signalled by the negative between-component, directed versus advancing economies. Foreign labour inputs from non-EU advanced countries are among those benefiting more in terms of remuneration. However, such gains already in the post-crisis period come to a halt.

Together with providing a new perspective on GVCs dynamics focusing on labour requirements, their remuneration and functional income distribution, this paper also offers a methodological contribution to study production fragmentation, both domestically, looking at outsourcing processes, and internationally, looking at offshoring. Limitations of our results are due to the level of aggregation, being the unit of analysis not the firm taking strategic decisions but rather the 2-digit sector. However, lacking firm-level datasets of domestic and international flows, we deem our analysis still relevant to advance our understanding of the implication of the rise in GVCs for functional income distribution.

Future extensions include digging inside the labour force, distinguishing across tasks/functions performed along the chains. Indeed, occupational layers differently contribute to the overall labour share and understanding how their concentration affects the division of gains along the chains bears important implications. In addition, linking occupational and functional specialisation would allow connecting our approach more directly with the stages of production addressed in the smile curve literature. Finally, it will enable to deepen the structural capability-based theory of economic development, and the dependency theory as well, to understand the heterogeneous gains countries are accruing from asymmetric participation in GVCs.

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Appendix

A Deflation procedure

WIOD tables are provided in current prices and in previous year prices. Building upon the contribution by Dietzenbacher and Hoen (1998) and the recent insights by Los et al. (2014) and Timmer et al. (2021), among others, we implement the so-called RAS-method to deflate WIOD (2016 Release) tables moving from current to constant price (base year 2010). RAS-procedure essentially exploits the fact that all the margins of the Input-Output table are already known in constant prices (gross output, value added, final demand), as price deflators for them are largely available. What is crucially missing is the deflation of the so-called Z matrix of intermediate deliveries. The procedure consists of a bi-proportional projection method, developed originally to update a given matrix in order to satisfy exogenously row and column sums (which in I-O tables result in the aforementioned 'margins'). RAS-method proceeds iteratively, i.e., recursively updating a matrix in current prices converging to a matrix in constant prices, given row and column totals in constant prices. As such, the procedure is completed once the sums of the cells in each row and in each columns are close to the totals previously exogenously identified. Following Timmer et al. (2021), we actually use the Generalised RAS algorithm (Junius and Oosterhaven, 2003; Lenzen et al., 2007; Temurshoev et al., 2013) because the standard RAS-procedure cannot deal with negative values; moreover the row and column sums over all industries in all countries should be identical, given the I-O accounting identity (worldwide value added should equal worldwide final demand), and this is likely not to be the case given the different sources from which the price deflators originate. More information on GRAS-method can be found in Temurshoev et al. (2013).

We first deflate gross output, value added and final demand (the row and column sums of I-O tables). Price deflators for output and value added are provided by the SEA dataset, while deflators for final demand components (household consumption, government consumption and investment) are taken from United Nations (UN) National Accounts, following Timmer et al. (2021). Deflation is computed row-wise, meaning that we use deflators of the producing country. We use industry gross output deflators also to deflate intermediate consumption. All deflators have been previously converted in US dollar, being the WIOD table measured in such unit, with exchange rates that can be found on the WIOD-website (`http://www.wiod.org/home`). Once deflated all the components of the I-O table, we run the convergence algorithm iteratively to get the WIOD table in 2010 constant prices. We checked that the magnitudes of intermediaries' flows for our 2010 constant prices table (2010 base year) were equal to the 2010 table in current prices. Then, we did the same iterative check for the 2011 constant prices (2010 base year) table in comparison with the 2011 previous year prices provided by WIOD. Although impossible to obtain identical values given the various sources of deflators and an iteration algorithm at work, magnitudes were largely approximating, hinting to a satisfactory deflation procedure.

B Further evidence

	Vertical Labour Share				*Horizontal Labour Share*				*GVCs Integration*	
Country	Mean	SD	$\Delta_{2000\text{-}2007}$	$\Delta_{2008\text{-}2014}$	Mean	SD	$\Delta_{2000\text{-}2007}$	$\Delta_{2008\text{-}2014}$	Foreign Va share	$\Delta_{2000\text{-}2014}$
AUS	0.619	*0.114*	*-0.021*	0.008	0.637	0.134	-0.027	0.015	0.078	-0.023
AUT	0.575	0.056	-0.043	0.017	0.607	0.128	-0.050	0.023	0.193	0.016
BEL	0.620	0.082	-0.005	0.004	0.695	0.129	-0.003	0.010	0.280	-0.003
BGR	0.575	0.086	-0.102	0.070	0.601	0.148	-0.167	0.056	0.220	-0.013
BRA	0.572	0.115	-0.019	0.048	0.615	0.138	-0.029	0.065	0.091	-0.002
CAN	0.608	0.061	0.010	-0.007	0.653	0.108	0.067	-0.006	0.195	-0.034
CHE	0.624	0.120	-0.055	0.033	0.691	0.133	-0.065	0.033	0.191	-0.005
CHN	0.500	0.090	-0.017	0.089	0.513	0.144	-0.016	0.101	0.070	-0.011
CYP	0.544	0.106	0.010	0.005	0.631	0.174	0.041	0.052	0.151	-0.008
CZE	0.535	0.050	0.007	0.003	0.541	0.112	0.020	-0.004	0.352	0.115
DEU	0.614	0.069	-0.057	0.016	0.675	0.129	-0.062	0.010	0.143	0.025
DNK	0.615	0.109	0.024	-0.027	0.691	0.173	0.051	-0.025	0.229	0.033
ESP	0.600	0.095	-0.020	-0.031	0.645	0.137	-0.019	-0.014	0.120	-0.040
EST	0.564	0.059	-0.004	-0.026	0.620	0.106	0.009	-0.006	0.317	0.082
FIN	0.645	0.095	-0.035	0.050	0.695	0.202	-0.035	0.058	0.201	0.043
FRA	0.654	0.074	0.002	0.041	0.706	0.130	0.019	0.031	0.164	0.019
GBR	0.648	0.071	0.007	-0.011	0.694	0.107	0.036	-0.041	0.117	0.009
GRC	0.477	0.130	0.046	-0.027	0.605	0.219	0.046	0.014	0.081	-0.004
HRV	0.633	0.112	-0.088	-0.013	0.722	0.162	-0.020	0.028	0.164	-0.027
HUN	0.538	0.053	-0.018	-0.024	0.562	0.145	-0.009	-0.057	0.416	0.035
IDN	0.512	0.135	-0.012	0.010	0.470	0.202	0.044	-0.000	0.103	-0.075
IND	0.421	0.070	-0.039	0.008	0.366	0.128	-0.065	0.008	0.099	0.016
IRL	0.475	0.109	-0.022	-0.024	0.570	0.226	-0.014	-0.053	0.376	-0.018
ITA	0.633	0.095	0.021	0.027	0.687	0.109	0.026	0.037	0.128	0.018
JPN	0.604	0.105	-0.040	0.005	0.631	0.217	0.001	0.009	0.070	0.047
KOR	0.618	0.135	0.004	0.011	0.630	0.190	0.056	-0.005	0.157	0.036
LTU	0.480	0.080	0.060	-0.086	0.492	0.164	0.017	-0.094	0.149	0.042
LUX	0.625	0.076	0.008	0.017	0.708	0.190	-0.042	0.027	0.593	0.113
LVA	0.527	0.052	-0.010	-0.048	0.556	0.125	-0.007	-0.060	0.188	0.021
MEX	0.368	0.121	-0.033	-0.030	0.305	0.167	-0.046	-0.035	0.274	0.042
MLT	0.518	0.077	-0.011	-0.005	0.582	0.150	-0.013	0.042	0.417	0.025
NLD	0.604	0.074	-0.028	0.008	0.616	0.120	-0.047	0.025	0.240	0.033
NOR	0.648	0.084	-0.043	-0.003	0.718	0.112	-0.037	0.002	0.188	0.012
POL	0.495	0.066	-0.061	-0.014	0.471	0.111	-0.075	-0.050	0.231	0.089
PRT	0.577	0.104	-0.021	-0.036	0.605	0.147	-0.022	-0.030	0.166	-0.021
ROU	0.479	0.063	-0.048	-0.052	0.418	0.158	-0.018	-0.165	0.216	0.009
RUS	0.710	0.141	0.053	0.092	0.676	0.158	0.038	0.064	0.091	-0.008
SVK	0.516	0.065	-0.040	0.015	0.531	0.116	-0.050	0.020	0.398	0.111
SVN	0.636	0.088	-0.027	0.017	0.680	0.125	-0.020	-0.006	0.239	0.034
SWE	0.559	0.089	-0.012	0.006	0.586	0.165	-0.014	0.015	0.177	0.005
TUR	0.387	0.094	-0.022	-0.003	0.403	0.169	-0.003	-0.004	0.176	0.073
TWN	0.791	0.215	0.069	-0.005	0.779	0.207	0.075	-0.007	0.190	-0.009
USA	0.547	0.081	-0.028	-0.025	0.597	0.138	-0.021	-0.038	0.061	0.022

Table A2. Descriptive statistics on Labour Share at the country level. Vertical and Horizontal Labour shares refer to 2014. We exclude from the computation non-market service (P, Q and U), construction (F), natural resources based activities (A, B, C19 and D) and real estate (L). GVCs integration is measured as the percentage of Real Value added produced in foreign countries.

Sector	Code	*Vertical Labour Share*				*Horizontal Labour Share*				*GVCs Integration*	
		Mean	SD	$\Delta_{2000\text{-}2007}$	$\Delta_{2008\text{-}2014}$	Mean	SD	$\Delta_{2000\text{-}2007}$	$\Delta_{2008\text{-}2014}$	Foreign Va share	$\Delta_{2000\text{-}2014}$
Food	C10-12	*0.482*	*0.099*	0.003	0.003	0.402	0.114	-0.004	-0.019	0.099	0.020
Textile	C13-15	0.549	0.095	-0.013	0.032	0.629	0.152	0.024	0.045	0.110	-0.013
Wood	C16	0.573	0.108	-0.004	-0.007	0.519	0.136	0.038	0.004	0.118	0.014
Paper	C17	0.550	0.092	0.013	-0.008	0.517	0.101	-0.027	0.049	0.165	0.029
Printing	C18	0.596	0.082	-0.029	-0.012	0.566	0.103	-0.041	0.031	0.123	0.033
Chemicals	C20	0.415	0.110	-0.043	-0.017	0.340	0.146	-0.041	-0.006	0.147	0.016
Pharmaceutical	C21	0.408	0.066	-0.031	0.010	0.341	0.115	-0.032	0.026	0.170	0.063
Rubber & Plastic	C22	0.539	0.092	-0.014	-0.010	0.494	0.143	0.002	0.039	0.171	0.033
Mineral Products	C23	0.554	0.099	-0.046	0.018	0.464	0.129	-0.076	0.033	0.115	0.017
Basic Metals	C24	0.498	0.109	-0.087	0.047	0.386	0.160	-0.115	0.013	0.181	0.011
Fabricated Metals	C25	0.619	0.136	-0.048	0.038	0.469	0.196	-0.069	0.026	0.143	0.025
ICT & Electronics	C26	0.530	0.073	-0.007	0.028	0.478	0.158	-0.042	0.063	0.203	0.057
Electrical Eq.	C27	0.545	0.106	-0.034	0.055	0.449	0.162	-0.083	0.060	0.164	0.022
Machinery	C28	0.586	0.090	-0.053	0.038	0.522	0.135	-0.065	0.029	0.157	0.032
Automotive	C29	0.534	0.092	-0.030	-0.006	0.443	0.161	-0.006	-0.002	0.213	0.040
Oth. Transport	C30	0.591	0.063	-0.047	0.038	0.516	0.191	-0.043	0.033	0.179	0.015
Forniture	C31-32	0.568	0.116	-0.027	0.007	0.485	0.157	-0.007	0.029	0.126	0.018
Reparing	C33	0.712	0.051	-0.016	0.010	0.743	0.187	0.013	0.001	0.142	0.003
Water Collection	E	0.499	0.072	-0.014	0.002	0.525	0.110	-0.010	0.009	0.131	-0.001
Wholesale & Retail	G	0.547	0.083	-0.024	0.001	0.501	0.136	-0.032	0.028	0.072	0.016
Transportation	H	0.552	0.109	-0.029	0.017	0.586	0.090	-0.045	0.083	0.165	0.032
Accommodation	I	0.613	0.087	-0.008	0.022	0.691	0.173	-0.001	0.157	0.042	0.006
Information Services	J	0.519	0.072	-0.035	0.016	0.407	0.108	-0.021	0.049	0.114	0.036
Financial Service	K	0.536	0.079	-0.020	-0.020	0.395	0.121	-0.028	0.005	0.060	0.012
Scientific Activities	M	0.607	0.057	-0.010	0.016	0.576	0.251	0.058	0.054	0.110	0.037
Admin. Services	N	0.681	0.143	0.027	0.068	0.550	0.246	0.107	0.051	0.043	-0.000
Other Services	R-S	0.677	0.090	-0.008	0.027	0.665	0.208	-0.067	0.119	0.040	0.008
Service of Household	T	0.964	0.097	0.005	0.004	0.846	0.322	0.072	-0.012	0.005	0.001

Table A3. Descriptive statistics on sectoral Labour Share. Vertical and Horizontal Labour shares refer to 2014. Changes refer to the period 2000-2014. We exclude from the computation non-market services (P, Q and U), construction (F), natural resources based activities (A, B, C19 and E) and Real Estate (L). GVCs integration is measured as the percentage of Value Added produced in foreign countries.

Code	Description	Broad Classification
A	agriculture, forestry and fishing	Natural Resources Based
B	mining and quarrying	Natural Resources Based
	Manufacturing	
C-10	manufacture of food products	Medium Low tech Manufacturing
C-11	manufacture of beverages	Medium Low tech Manufacturing
C-12	manufacture of tobacco products	Medium Low tech Manufacturing
C-13	manufacture of textiles	Medium Low tech Manufacturing
C-14	manufacture of wearing apparel	Medium Low tech Manufacturing
C-15	manufacture of leather and related products	Medium Low tech Manufacturing
C-16	manufacture of wood and of products of wood and cork	Medium Low tech Manufacturing
C-17	manufacture of paper and paper products	Medium Low tech Manufacturing
C-18	printing and reproduction of recorded media	Medium Low tech Manufacturing
C-19	manufacture of coke and refined petroleum products	Natural Resources Based
C-20	manufacture of chemicals and chemical products	High tech Manufacturing
C-21	manufacture of basic pharmaceutical products	High tech Manufacturing
C-22	manufacture of rubber and plastic products	Medium Low tech Manufacturing
C-23	manufacture of other non-metallic mineral products	Medium Low tech Manufacturing
C-24	manufacture of basic metals	Medium Low tech Manufacturing
C-25	manufacture of fabricated metal products	Medium Low tech Manufacturing
C-26	manufacture of computer, electronic and optical products	High tech Manufacturing
C-27	manufacture of electrical equipment	High tech Manufacturing
C-28	manufacture of machinery and equipment n.e.c.	High tech Manufacturing
C-29	manufacture of motor vehicles, trailers and semi-trailers	Medium Low tech Manufacturing
C-30	manufacture of other transport equipment	Medium Low tech Manufacturing
C-31	manufacture of furniture	Medium Low tech Manufacturing
C-32	other manufacturing	Medium Low tech Manufacturing
C-33	repair and installation of machinery and equipment	Medium Low tech Manufacturing
	Services	
D	electricity	Natural Resources Based
E	water supply; sewerage, waste management	Other Services
F	construction	Construction
G	wholesale and retail trade; repair of motor vehicles	Other Services
H	transportation and storage	Other Services
I	accommodation and food service activities	Other Services
J	information and communication	Knowledge Intensive Services
K	financial and insurance activities	Other Services
L	real estate activities	Other Services
M	professional, scientific and technical activities	Knowledge Intensive Services
N	administrative and support service activities	Other Services
O	public administration and defence; compulsory social security	Non-Market Services
P	education	Knowledge Intensive Services
Q	human health and social work activities	Non-Market Services
R	arts, entertainment and recreation	Other Services
S	other service activities	Other Services
T	activities of households as employers	Other Services
U	activities of extraterritorial organisations and bodies	Non-Market Services

Table A4. Nace Rev. 2 code description

Code	Country	*Development*	*Country Group*
AUS	Australia	1	Advanced Non European
AUT	Austria	1	Advanced European
BEL	Belgium	1	Advanced European
BGR	Bulgaria	0	Emerging European
BRA	Brazil	0	Developing Non European
CAN	Canada	1	Advanced Non European
CHE	Switzerland	1	Advanced European
CHN	China	0	Developing Non European
CYP	Cyprus	0	Emerging European
CZE	Czech Republic	0	Emerging European
DEU	Germany	1	Advanced European
DNK	Denmark	1	Advanced European
ESP	Spain	1	Advanced European
EST	Estonia	0	Emerging European
FIN	Finland	1	Advanced European
FRA	France	1	Advanced European
GBR	United Kingdom	1	Advanced European
GRC	Greece	1	Advanced European
HUN	Hungary	0	Emerging European
IDN	Indonesia	0	Developing Non European
IND	India	0	Developing Non European
IRL	Ireland	1	Advanced European
ITA	Italy	1	Advanced European
JPN	Japan	1	Advanced Non European
KOR	Republic of Korea	1	Advanced Non European
LTU	Lithuania	0	Emerging European
LUX	Luxembourg	1	Advanced European
LVA	Latvia	0	Emerging European
MEX	Mexico	0	Developing Non European
MLT	Malta	1	Advanced European
NLD	Netherlands	1	Advanced European
NOR	Norway	1	Advanced European
POL	Poland	0	Emerging European
PRT	Portugal	1	Advanced European
ROU	Romania	0	Emerging European
RUS	Russian Federation	0	Emerging European
SVK	Slovakia	0	Emerging European
SVN	Slovenia	0	Emerging European
SWE	Sweden	1	Advanced European
TUR	Turkey	0	Developing Non European
USA	United States	1	Advanced Non European

Table A5. Country code, development level (1=Advanced), and country group.