Do Global Value Chains Enhance Economic Upgrading? A Long View

Stefan Pahl
(Groningen Growth and Development Centre, Netherlands)

Marcel Timmer
(Groningen Growth and Development Centre, Netherlands)

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A long View.

Stefan Pahl and Marcel Timmer

Groningen Growth and Development Centre, University of Groningen

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Abstract

Economic development requires productivity growth as well as employment generation in modern activities. Exporting through global value chains (GVC) has recently been highlighted as a panacea for weak industrialisation trends in the South. We study the long-run effects of GVC participation for a large set of countries between 1970 and 2008. We find strong evidence for the positive effects on productivity growth. This effect is stronger when the gap with the global productivity frontier is larger. However, we find no evidence for an effect on employment generation. If anything, GVC participation might be negatively correlated with job creation in the formal manufacturing sector.

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I. Introduction

Economic development relies on productivity growth driven by a reallocation of labour from less to more productive activities. Traditionally, a key role is attributed to the manufacturing sector which is argued to provide abundant opportunities for capital intensification, scale and technological change. Many studies have shown that poor countries that caught up do so by starting a long process of industrialisation. Conversely, countries lagging in manufacturing growth, or even suffering from deindustrialisation, have not been able to increase incomes over a sustained period (de Vries et al. 2015; Haraguchi et al., 2017; McMillan et al, 2014; Szirmai and Verspagen, 2015).

Exporting through global value chain (GVC) participation has recently been highlighted as a possible panacea for weak industrialisation trends (e.g. Taglioni and Winkler, 2016; World Bank, 2017). Due to improved information and communication technologies, poor countries can nowadays access global markets by carrying out only particular stages in the production process (Baldwin, 2016). Industrialisation through exporting is thus seen as more 'easy' than ever, requiring few capabilities of firms and depending more on a country's macro-economic stability and easy physical access to global markets. It is argued that participating in GVCs can stimulate productivity growth through a myriad of channels. These include benefits from specialisation in core tasks, access to imported inputs, knowledge spillovers from multinationals and pro-competitive effects of global competition (Criscuolo and Timmis, 2017). A large literature has investigated FDI spillovers and arrives at a broad consensus in favour of positive productivity spillovers to industries that supply multinationals through backward linkages (Javorcik, 2004), with little evidence for other channels though (Iršova, and Havránek, 2013). More generally, Rodrik (2013) finds in a cross-country regression that lagging countries catch up with the world productivity leader in manufacturing, *independent* of country characteristics.

Yet unconditional convergence of productivity levels in manufacturing is potentially a mixed blessing. Economic upgrading requires that productivity growth goes hand in hand with employment growth in the modern sector of the economy. Rodrik (2013) argues that it might be in particular firms in international production networks, which are good at absorbing advanced technologies but employ little labour, and thus limit the gains from convergence. GVC participation should lead to expansion of the scale of production such that also employment grows. Sen (2017), for example, finds that trade integration has a *positive* impact on manufacturing employment via scale effects, but a *negative* impact via the productivity effect. More qualitative studies on GVCs are in general also critical about the opportunities for upgrading through GVC participation (Gereffi, 1994; Kaplinsky, 2000; Barrientos et al., 2016).[1] They highlight the importance of governance structures with asymmetric power relationships between lead firms in advanced countries and suppliers from developing regions, and argue that incentives for technology and knowledge sharing are relatively weak. Overall, one can conclude that GVCs might facilitate entry into global manufacturing goods markets, but at the same time making industrialisation less meaningful as capability building is not guaranteed and long-run productivity growth might be stunted (Baldwin, 2014). Rodrik (2014) advances the hypothesis that local industrial employment generation remains limited to outsourced slices of production allocated to specific countries. Whether scale or productivity effects dominate in GVC production is an empirical question that is still open.

In this paper, we will provide for the first time a long-run study of the effects of GVC participation on economic upgrading. To investigate this issue, new data and methods are needed. Traditional indicators of economic upgrading include shares of manufacturing in a country's

[1] GVC production is not a new phenomenon and there is a venerable literature that analyses the emergence and development of GVCs (see Gereffi, 1994).

exports or relative unit-values of exported goods (see Bernhardt and Pollak, 2016). In the presence of international production fragmentation, these indicators are quickly loosing relevance as they are based on gross exports. The hallmark of GVC participation is specialisation in particular tasks. In an already classic case study, Dedrick et al. (2010) found that the Chinese contribution to its gross exports of electronics, such as Apple's iPod, was only minor. It mainly performed assembly, testing and packaging activities on imported high-tech components while relying on software, supply chain orchestration and branding from foreign companies. Koopman et al. (2012) found that in 2002, the domestic value added in Chinese exports of computer electronics was only 19.3 percent. The share of domestic value added in exports has declined in nearly all countries. For a set of more than 80 countries, Pahl and Timmer (2018) found that the average share of domestic value added in gross exports of manufactured goods decreased by about 14 percentage points since 1970 reaching 63 percent in 2008.[2] Using gross export statistics can thus be highly misleading and new initiatives have been started to measure trade in value added (see e.g. OECD Tiva project at oe.cd/tiva.). We will therefore study new measures of value added and employment related to exports that are commensurate with GVC production.

In addition, we will measure *all* manufacturing value added and employment in a country that is related to exports. Traditional studies focus only on the industry or firms that actually export. Yet with production fragmentation other domestic firms might indirectly contribute by delivering inputs to the exporting firms. One might even argue that the establishing of backward linkages into the domestic sectors is a hallmark of success in benefitting from trade. This idea is far from new, going back at least to Hirschmann (1958) (see also Chenery et al., 1986), but until now it has not

[2] See also Hummels et al. (2001); Johnson and Noguera (2017), for more evidence on international production fragmentation.

been measured for a large set of countries over a long period.[3] We will study the period from 1970 to 2008 and analyse trends in up to 58 countries, drawing on disaggregated data from UNIDO's Indstat2 (2016) and complemented by additional sources. Combined with national input-output tables from Pahl and Timmer (2018), we can trace all manufacturing value added and employment related to exports of manufacturing goods.

Through simple means testing, we document that countries with high GVC participation have on average higher growth rates of labour productivity, but not of employment. In further econometric analyses we find more robust evidence for a strong long-run association of GVC participation and labour productivity growth in exports. This result is robust to different specifications, and also holds for a subset of developing countries only. Moreover, this effect even becomes larger the further a country is from the productivity frontier. We also obtain a qualitatively similar result in short-run periods (5-year periods), rather than long-run (10-year). We conclude that GVC participation has a strong (long-run) productivity effect, especially for less developed countries. In contrast, we do not find evidence for positive effects on employment growth. If anything, we find a negative association between GVC participation and employment growth if we control for unobserved heterogeneity at the country level. Hence, the results suggest that on average GVC participation might hamper employment generation in manufacturing, confirming Rodrik's hypothesis (Rodrik, 2014).

Previous cross-country studies have also documented productivity effects from GVC participation, but have primarily focused on recent periods and short-run trends. Kummritz (2016) and Constantinescu et al. (2017) document labour productivity effects in mainly developed

[3] Feenstra and Hong (2010) estimate employment effects of exports by China taking into account backward linkages through input-output information. They find negative correlation between productivity and employment growth in the 1990s. A more recent study suggests that this turned positive in the early 2000s (Los et al., 2015).

countries in yearly variation between 1995 and 2007. Lopez-Gonzalez (2016) uses aggregate data for total manufacturing and broad sectors to study value added and employment effects in short-run periods since 1995. Focussing on eight emerging ASEAN countries and the remaining 48 countries in the OECD TiVA database, he finds positive effects from importing intermediates on both dimensions. We are the first to our knowledge that document the relation of GVC participation to productivity and employment growth in a large set of developing countries over the long run.

We would like to stress a number of caveats at this point. First, we focus on the *formal* manufacturing sector and do not study informal employment. GVC participation might lead to employment generation outside the formal sector, for example through outsourcing by formal manufacturing firms to households and small firms with irregular and informal workers. This might constitute social downgrading as working conditions and pay are usually (much) worse than in regular jobs (Gereffi, 2014). One might even argue that the success of the formal sector in exporting depends on the exploitation of informal workers. Given lack of reliable data on irregular employment, we have no way of testing this. But our focus on formal employment might also be seen as a strength as it is formal job creation that is ultimately needed for modern industrialization. Another caveat is that we use labour productivity growth as an indicator of upgrading. One might argue that (real) wage development is a more relevant indicator of upgrading.[4] Correlation between the two is positive in the medium to long-run, but not necessarily in the short-run, in particular in countries with labour markets characterised by surplus labour (Lewis, 1954). More generally, we like to emphasize that our empirical study should be seen as a complement to more qualitative case studies that do more justice to the large heterogeneity across sectors and countries, and the important idiosyncrasies in countries' institutional settings.

[4] These are used, for example, by Bernhardt and Milberg (2013) and Bernhardt and Pollak (2016).

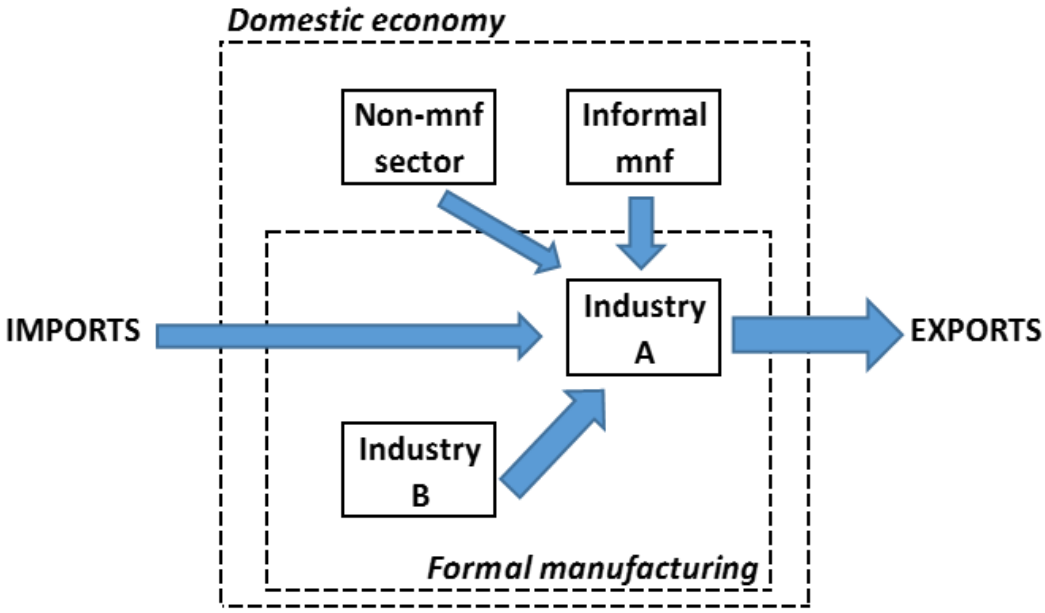
The rest of the paper is organized as follows. In section II, we discuss the methodology and section III describes the data sources and construction, which is extended in the appendix. We discuss descriptive results in section IV. Section V provides the full econometric modelling and section VI concludes.

II. Methodology

II.1. The Concept of Value Added and Employment in Exports

With the emergence of GVCs, the productivity and employment effects of exporting become less visible. As is well known by now, the value of gross exports is not a valid indicator of output anymore. When production uses high levels of imported intermediates (e.g., assembly in export-processing zones), the proper measure is domestic value added in exports (Chenery et al., 1986; Hummels et al., 2001; Koopman et al., 2012). We illustrate this in figure 1.

Figure 1. Domestic value chains in export production



Source: Authors' illustration.

Directly exporting firms in the exporting industry A generate value added by producing products exported to foreign consumers and producers. The exported value however is also composed of value added that is generated by other domestic firms. This includes indirect contributions of firms within the exporting industry, but also contributions from firms in other industries within formal manufacturing (industry B), and from informal manufacturing and non-manufacturing sectors. Domestic value added in exports (and employment in exports) is thus a composite of domestic activities by several firms in multiple industries. Those indirect contributions can be sizeable and depend on the strength of backward linkages to domestic firms. Moreover, the exported value is also composed of foreign contributions, because domestic firms import intermediates. Intermediates are directly imported by exporting firms in industry A, but also potentially by all indirectly contributing firms.

To account for these issues, we study employment and value added in exports using the notion of value chains as opposed to generic industries. We define domestic value chains by the exporting industry (industry A in figure 1). The domestic value chain includes all domestic direct and indirect contributions to these exports, but excludes the foreign content (imported intermediates). Due to data limitations, we only consider the formal manufacturing part of the chain, that is, contributions of 14 manufacturing industries (industry B in figure 1). In our data, the share of these indirect manufacturing contributions reaches more than 33 percent in the upper decile of our sample.[6] This variation matters cross-sectionally and inter-temporally. In South Korea, for example, the share of indirect formal manufacturing employment contributions to products exported by 'automotives' varies between 23 and 38 percent between 1970 and 2008.

[6] The direct effect is value added and employment generated by exporting firms only. In input-output terms, we define it as the vector of value-added to gross output ratios times the export vector.

Studies using firm-level data cannot account for these indirect contributions. Typically, importing and exporting firms themselves are considered but not their production linkages to other domestic firms. A potential effect of, say, importing is limited to the importing firm only (see Del Prete et al., 2017; Foster-McGregor et al., 2014; Okafur et al., 2017). If spillovers are considered these are typically to other firms within the same industry or geographic location, but independent of actual production linkages. In our framework, spillovers can occur from the importing firms to all firms in the domestic value chain.

The next section shows the mathematical derivation of manufacturing employment and value added in exports (pooled by 14 manufacturing industries). By dividing manufacturing value added in exports by employment in exports, we obtain manufacturing labour productivity in exports. Labour productivity growth in combination with employment growth is our measure of economic upgrading.

II.2. The Measurement of Value Added and Employment in Exports

The calculation of the main variables is based on input-output tables, which is illustrated in figure 2.[7]

In figure 2, $\mathbf{x}$ is an $nx1$ vector of gross output, $\mathbf{m}$ is an $nx1$ vector of total imports, $\mathbf{fd_{dom}}$ is an $nx1$ vector of domestic final demand for final domestic goods, $\mathbf{fd_{imp}}$ is an $nx1$ vector of domestic final demand for imported final goods, $\mathbf{e}$ is an $nx1$ vector of gross exports, $\mathbf{e_{imp}}$ is an $nx1$ vector of re-exports, $\mathbf{va}$ is an $1xn$ vector of value added, $\mathbf{Z_{dom}}$ is an nxn matrix of direct domestic input requirements, $\mathbf{Z_{imp}}$ is an nxn matrix of direct input requirement of imported goods, and n is the

[7] The following exposition obeys to standard matrix notation. Bold capital letters represent matrices, bold small letters vectors, and small letters in italics integers.

number of industries, which is three in this example. Direct input requirements can be transformed into an nxn matrix of direct input coefficients by calculating

$$\mathbf{A_{dom}} = \mathbf{Z_{dom}}(\hat{\mathbf{x}})^{(-1)}. \quad (1)$$

Figure 2. Stylized Input-Output table

	$\mathbf{D_{Agr}}$	$\mathbf{D_{Mfg}}$	$\mathbf{D_{Serv}}$	**FD**	**EXP**	**GO**
$\mathbf{D_{Agr}}$	$\mathbf{Z_{dom}}$			$\mathbf{fd_{dom}}$	**e**	**x**
$\mathbf{D_{Mfg}}$						
$\mathbf{D_{Serv}}$						
$\mathbf{M_{Agr}}$	$\mathbf{Z_{imp}}$			$\mathbf{fd_{imp}}$	$\mathbf{e_{imp}}$	**m**
$\mathbf{M_{Mfg}}$						
$\mathbf{M_{Serv}}$						
VA	**va**					
GO	$\mathbf{x'}$					

Notes: Agr, Mfg, Serv stands for Agriculture, Manufacturing, Services respectively; FD for final demand; EXP for exports; GO for gross output; D for domestic, M for imported, VA for value added.

Source: Authors' illustration.

Similarly, this can be done for $\mathbf{A_{imp}}$, which is the nxn matrix of direct foreign input coefficients. The framework is represented by three equations.

$$\mathbf{x} = \mathbf{A_{dom}x} + \mathbf{fd_{dom}} + \mathbf{e} \quad (2)$$

$$\mathbf{m} = \mathbf{A_{imp}x} + \mathbf{fd_{imp}} + \mathbf{e_{imp}} \quad (3)$$

$$\mathbf{x'} = \mathbf{x'A_{tot}} + \mathbf{va} \quad (4)$$

where $\mathbf{A_{tot}} = \mathbf{A_{dom}} + \mathbf{A_{imp}}$ and $\mathbf{A_{tot}}$ are total direct input coefficients. Equation (2) describes that total domestic output of each industry must either be sold for domestic intermediate use, to domestic demand for final goods or to exports (which include intermediates and final goods). Equation (3) specifies the same relationship for imports. All imported goods either must go to

domestic intermediate use, to domestic final demand or must be re-exported. Equation (4) specifies that all output must be equal to the sum of the costs for domestic and imported intermediates and of value added.

Solving equation (2) for **x** gives

$$\mathbf{x} = (\mathbf{I} - \mathbf{A_{dom}})^{(-1)}(\mathbf{fd_{dom}} + \mathbf{e}). \quad (5)$$

Equation (5) tells us how much output of each industry is generated in order to produce a given vector of domestic final demand and exports. The production of a final good needs intermediates that are embodied in the final good. These intermediates themselves are also produced making use of intermediates. To trace the full range of intermediates embodied in a produced good, it is necessary to trace all prior production steps, which is captured by the Leontief inverse $(\mathbf{I} - \mathbf{A_{dom}})^{(-1)}$.

If it is known how much formal manufacturing value added is generated in each industry per unit of output, this relationship can be used to calculate how much formal manufacturing value added by industry is embodied in the production of a given vector of domestic final demand or exports. This is done by pre-multiplying equation (5) by a vector $\mathbf{v_m}$ of value added over gross output by industry, $\widehat{\mathbf{v_m}} = \widehat{\mathbf{va}}_\mathbf{m}\,(\hat{\mathbf{x}})^{-1}$. If post-multiplied by gross exports for products exported by industry *i*, this gives formal manufacturing value added in exports (MVA),

$$MVA_i = \mathbf{v_m}(\mathbf{I} - \mathbf{A_{dom}})^{(-1)} \begin{pmatrix} e_i \\ 0 \\ 0 \end{pmatrix} \quad (6)$$

Similarly, creating a vector $\mathbf{b_m}$ that depicts formal manufacturing employment over gross output, we can derive MEMP, the formal manufacturing employment embodied in exports,

$$MEMP_i = \mathbf{b_m}(\mathbf{I} - \mathbf{A_{dom}})^{(-1)} \begin{pmatrix} e_i \\ 0 \\ 0 \end{pmatrix} \quad (7)$$

Labour productivity in formal manufacturing activities in exports is then

$$MLP_i = \frac{MVA_i}{MEMP_i}. \quad (8)$$

We also need a measure of GVC participation. We define this as the share of domestic value-added in gross exports of industry *i*. Following Los and Timmer (2018), we will refer to this as the VAX-D ratio. It is inversely related to GVC participation: a higher value indicates a lower dependence on imported intermediates and thus less GVC participation.[8] To calculate the VAX-D ratio, we do not focus on manufacturing value added in exports, but on all domestic value added in exports from both manufacturing and non-manufacturing. Hence, instead of pre-multiplying equation (5) by a vector of manufacturing value added, we use a vector of value added in all domestic industries, **v**.

$$VAXD_i = \mathbf{v}(\mathbf{I} - \mathbf{A_{dom}})^{(-1)} \begin{pmatrix} e_i \\ 0 \\ 0 \end{pmatrix} \quad (9)$$

The VAX-D ratio is then

$$VAXDratio_i = \frac{\boldsymbol{VAXD}}{\boldsymbol{e_i}}. \quad (10)$$

The VAX-D ratio belongs to the group of so-called backward indicators. These indicators start with a product and decompose all contributions to these products by industry and country of value generation. Such measures are well in line with our conceptualisation of value chains of direct and indirect domestic activities producing the exported good. We thus study whether importing of any of the firms along the domestic value chain has an effect on the importing firms itself and on all other firms that are linked through production linkages to the importing firms. The second set of indicators are so-called forward indicators. Forward indicators start with an *industry* and decompose that industry's value added into use categories. For example, Hummels et al. (2001) and Baldwin and Lopez-Gonzalez (2015) propose to calculate the industry's value added that is

[8] Hummels et al. (2001) were the first to introduce such a measure, called vertical specialization (VS share). VAX-D ratio is equal to one minus the VS share, see Koopman et al. (2012) and Los et al. (2016).

used abroad in export production. Hence, forward indicators are tightly linked to generic industries rather than to value chains that consist of activities in multiple industries. It is thus typically studied whether the direct and indirect engagement with foreign producers of some firms in an industry spills over to all firms within that industry, independent of production linkages between firms (see Kummritz, 2016). Our approach also differs to studies relating backward indicators to industry-level variables of the exporting industry (see Constantinescu et al., 2017; Kummritz, 2016). This implicitly assumes that the effect of importing of any firm along the domestic value chain spills over to all firms in the exporting industry, again independent of actual production linkages and only from upstream to downstream industries.

II.3. Growth of Labour Productivity and Employment in Exports as Economic Upgrading

Our measure of upgrading is labour productivity growth in export-related formal manufacturing activities in combination with employment growth in these activities. Labour productivity growth captures whether countries catch up to the productivity frontier and employment growth in these activities whether it also translates into an increase of the scale of production in employment terms. The latter is important as productivity growth in a relatively large and increasing workforce makes it meaningful for the economy as a whole (Rodrik, 2013). Labour productivity in exports increases if countries are becoming more productive in the same activities they used to perform and if they move into higher value-adding activities. We measure employment and value added of *all* activities in manufacturing export production, but do not distinguish between those. Both processes are beneficial from an aggregate perspective, as they are both raising available returns to labour and are channels for income growth.

Distinguishing between activities, however, is an important element in the conceptualisation of upgrading in the qualitative GVC literature (see Gereffi, 2005; Humphrey and

Schmitz, 2002). The macro indicators in that literature thus aim to incorporate dimensions that loosely relate to shifting into such higher value-adding activities, but these indicators are not suited for our purpose. The most widely suggested ones are export unit prices in combination with market shares (see Bernhardt and Pollak, 2016; Foster-McGregor et al., 2015; Kaplinsky and Readman, 2005), skills and business functions (for an overview, see Milberg and Winkler, 2011). Growth of relative export unit prices are taken as indications of the quality of produced products and thus the underlying capabilities and activities. As high prices might also reflect inefficiencies, this is combined with export market shares as a measure of competitiveness. Due to production fragmentation, however, export unit prices and export shares do not reflect a country's capabilities and activities anymore. Export unit prices instead reflect the prices of exported products but not of the production stages performed domestically. There is a large literature that shows the disconnect between gross export data and actually performed activities (Dedrick et al., 2010; Koopman et al, 2012). This is true in aggregated industries, but also at product-level classifications. Even a single product, such as the IPhone, consists of contributions from multiple countries and the unit price is not representative of the production stage performed in the exporting country (see Dedrick et al., 2010). To retrieve the usefulness of unit prices, price data would thus need to be collected on individual production stages through inter and intra-firm transactions. Such data however are not yet available.

Skill intensity, typically measured by educational attainment, is also used to proxy for higher value-adding activities (see Milberg and Winkler, 2011). High-skilled workers are supposed to specialise in higher value-adding activities, such as R&D, design or marketing. Lower skilled workers supposedly specialise in production activities creating less value and have fewer opportunities to perform those higher value-adding activities. However, while skilled workers tend to match to higher value-adding activities and human capital may be require to attract any of such

activities, it is a supply-side measure which does not necessarily indicate that a country attracted those activities.[9] Therefore, it is more recently advocated to measure activities or business functions directly (Sturgeon and Gereffi, 2009). Efforts are made in using tailored business surveys (on the United States, see Brown et al., 2014) and in collecting and harmonizing available cross-country data (on a set of relatively advanced countries, see de Vries and Reijnders, 2017). This is a promising avenue for future data collection for macro measures of upgrading. It allows for an assessment of upgrading as productivity growth of specific activities and of upgrading as shifts between activities. However, this is not yet feasible for a broad range of countries and long periods.

III. Data Sources

To implement our methodology, we built a new dataset by combining two data sources. We need series of formal manufacturing employment and value added, as well as national input-output tables. For the latter we rely on Pahl and Timmer (2018), which constructed national input-output tables for 92 countries between 1970 and 2008. The industry detail is 14 manufacturing industries and 5 broad sectors. For series of formal manufacturing employment and value added at the level of the 14 manufacturing industries, we use UNIDO's Indstat2 (2016). This database provides manufacturing employment and value added figures for a large set of developing countries over a long period and is therefore suited for our long-run analysis. The online appendix provides a detailed description of the data construction and a summary table on the construction for each country. However, we would like to stress two points of relevance for interpreting our results here.

Firstly, the data is based on industrial surveys and censuses, which are based on samples of manufacturing establishments. These surveys typically exclude small-scale and informal establishments. Depending on the survey, it might cover firms with at least five, or ten, *formally*

[9] Data availability is also scarce for a broad set of countries with disaggregated industries over long periods.

employed workers. In many developing countries, the informal workforce makes up a large share of manufacturing employment (often more than half), which is thus not covered in these surveys. We therefore stress that our results apply to the productivity and employment effects in formal manufacturing production. On the other hand, one might argue that because of that our employment effects indicate whether economic upgrading is taking place. Formal manufacturing jobs are the ones with good working conditions, as opposed to activities in the informal sector.

Secondly, the data makes no distinction between export-related production and production for domestic demand. This is a general caveat in estimating the employment and value-added content of exports with input-output tables, as also the inter-industrial linkages cannot be separated by destination. Koopman et al. (2012) show, for example, that firms in export-processing zones tend to use more foreign intermediates than ordinary exporters in China, and generate less domestic value added. Further improvements in data for a large cross-section of countries on both fronts would need to be awaited.

When using UNIDO's Indstat2 (2016), we need to apply harmonisation strategies. The data exhibit a large amount of gaps and changes of classifications, which make time-series comparisons erroneous and the data not readily usable. Value added is available at three different price concepts (in basic prices, in purchaser's prices and in unknown prices), and employment is available for two different measures (as persons engaged and as employees). Our construction is therefore guided to maximize intertemporal (over time), internal (between variables), and international (cross-country) consistency. To assure intertemporal consistency, which is most important in the long-run productivity comparisons of this paper, we apply linking procedures. After careful harmonization and aggregation, we start with an initial cross-section of both variables and link a series of growth rates to the respective cross-section. Hence, we obtain the initial level from the raw data, but we are able to repair breaks from changes in revisions or classifications of activities by using the trends

in the different series. When constructing these growth rates, we fill gaps (for example, due to lack of overlap) by additional data sources and assumptions, which we describe in the appendix.

Internal consistency between value added and employment is generally high as both variables come from the same sources, which are industrial censuses and surveys. Within one sampled year, the recorded employment and value added entries cover the same establishments within industry classifications across the recorded variables. The initial values to which we link the series therefore come from the same year in both variables, yielding highest internal consistency. International consistency is most difficult to achieve, but it is also least important in our analysis. We aggregate all variables to the same internationally comparable ISIC Rev.3.1 combinations, such that we cover in principle the same activities. Actual coverage of the industrial censuses may of course still differ (e.g., through different threshold levels of the minimum establishment size). It is also not possible to use the same variables across all countries. For example, some countries only report value added in basic prices and others only in market prices. In the econometric analysis, we can control for a large part of such cross-country differences by including dummies. For example, by adding country dummies, we can account for level differences that arise from the fact that some countries report in market prices, and others in basic prices.

Combined with our data set of input-output tables, this leaves us with a total of 59 countries of which 39 are developing countries, as classified by the World Bank in 1990 (that is, they are not high-income countries). Table A5 in the appendix provides an overview of countries, indicating the covered years and underlying sources. In the next section, we will discuss our results.

IV. Is GVC Participation associated with Economic Upgrading?

IV.1. Illustrative Example: Productivity and Employment Growth in Exports of 'Automotives'

Figure 3 motives our analysis by focussing on automotive value chains between 1995 and 2008. It plots the average annual growth of labour productivity of all export-related formal manufacturing contributing to exports of the 'automotive' industry on the y-axis (MLP) and the average annual growth of employment in the formal manufacturing sector (MEMP) on the x-axis. Their sum is growth of formal manufacturing value added associated with exports of automotives.[10] Points above the diagonal solid line indicate positive growth rates of value added and each dotted diagonal line a 10-percentage point increase. The solid horizontal line depicts the average annual labour productivity growth of the productivity frontier, which is always the highest productivity level of all countries for a given year. Countries above this line catch up in productivity levels. Countries are upgrading if they are increasing the size of the export-related formal manufacturing sector in employment terms and are catching up (quadrant 2). Quadrant 1 in the figure depicts countries that are converging in productivity levels, but have negative growth of employment in exports. Quadrant 3 shows countries with high growth rates of MEMP, but without convergence to the productivity frontier. Quadrant 4 indicates that countries neither increase the sector's size in employment terms nor converge in productivity levels.

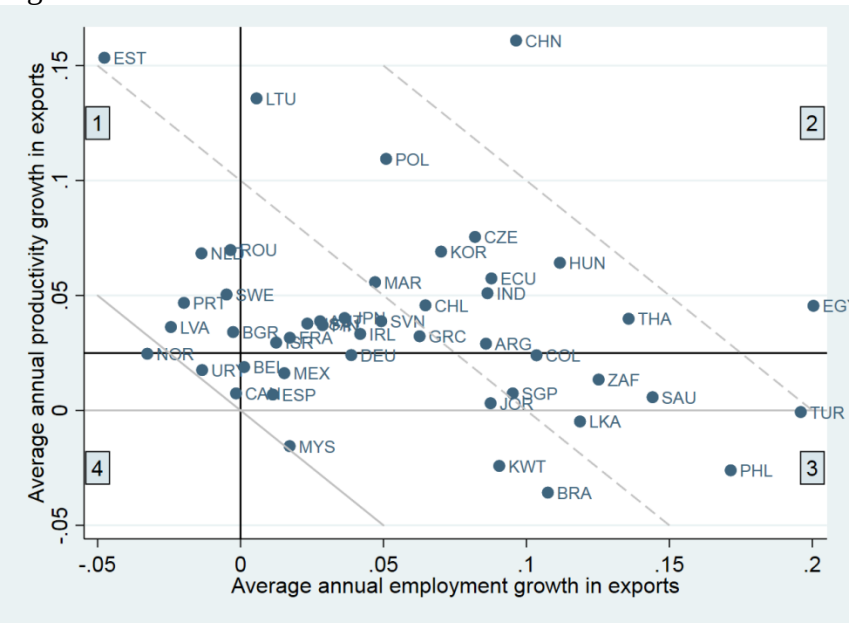
China is the most notable example of fast labour productivity growth and relatively fast employment growth. China experiences this in many manufacturing value chains, and is integrated into GVCs as is well documented (see Dedrick et al., 2010; Koopman et al., 2012). In the automotive value chain, we also find several Central and Eastern European countries that have

[10] In this figure, we deflate manufacturing value added in exports with country-specific deflators of manufacturing value added. The source is United Nations Original Country Data (UN, 2018), and Wu and Ito (2015) for China.

developed successfully (Poland, Czech Republic, Hungary). These countries have increasingly participated in European automotive value chains. Turkey, which is also well integrated into European automotive value chains, however, is classified in quadrant 3. It has experienced fast employment growth, but slow labour productivity growth. Similarly, Mexico is classified in quadrant 3 with relatively little growth on either dimension. It is neither converging to the productivity frontier nor experienced significant employment growth, despite its deep integration into North-American automotive value chains.

This example opens the question whether GVCs are driving labour productivity and employment growth. Several countries seem to have benefited from GVC integration, but this is not universal. In the next section, we investigate this relationship for the full set of GVCs.

Figure 3. Automotive value chain: 1995 to 2008



Note: For visibility, the figure does not display Bangladesh with growth of MLP of 0.22 and of MEMP of -0.03.

Source: Authors' calculation based on described data set.

IV.2. Descriptive Results

We investigate the relationship between GVC participation and employment and labour productivity in long-run periods at the level of value chains. We identify GVCs by the country-industry that exports, so in total there are 22 370 observations of GVCs. Our data set covers the period 1970 to 2008. Therefore, we use three 10-year periods going backward from 2008, and one 8-year period 1970 to 1978. This split of the data maximizes the number of observations. Our data cover 14 manufacturing value chains, as described in section II. Our data is in nominal values, but in the regression analysis, we account for price effects following Rodrik (2013), as we will describe below.

Figures 4 and 5 show kernel density plots of growth of manufacturing labour productivity and employment in exports across all GVCs. GVCs are pooled across country-industries as well as periods. The set has been split into two groups based on their initial level of the VAX-D ratio. Put otherwise, we have a subset of GVCs where the exporting country relies heavily on imported intermediates (the group 'high GVC participation' including all observations in the lowest quartile of VAX-D ratios) and a subset that relies relatively weakly on imports (the group 'low GVC participation' including all observations in the top quartile). Figure 4(a) shows the distributions of all countries of long-run growth of manufacturing labour productivity in exports, and 4(b) of developing countries. In figure 5, we repeat these graphs for employment growth. In table 1, we present t-tests for differences in means between the two groups.

The main message from these graphs and the table is the difference in the two distributions in terms of labour productivity growth, but its similarity in the case of employment growth. For productivity, the distribution with high GVC participation is further to the right, both in the full sample as well as for developing countries only. The mean of each distribution is 0.064 and 0.053 for observations with low GVC participation, and 0.076 and 0.078 for observations with high GVC

participation. These differences in means are highly statistically significant, as shown in t-tests in table 1.

For employment, however, the relationship is not as straightforward. When plotting all countries and only developing countries, the two distributions are almost identical. Only the right tails of the distribution with high GVC participation are slightly larger. Table 1 shows the means of the two distributions, which are 0.049 for low and high participation for all countries and 0.078 (low) and 0.074 (high) for developing countries. These differences in means are not statistically distinguishable. Value chains with low GVC participation actually even experience slightly faster growth of manufacturing employment in exports.

These results suggest that higher GVC participation contributes to labour productivity growth, but they open the question whether this is also true for employment growth.

Table 1. Difference in means: average annual growth rates in long-run periods

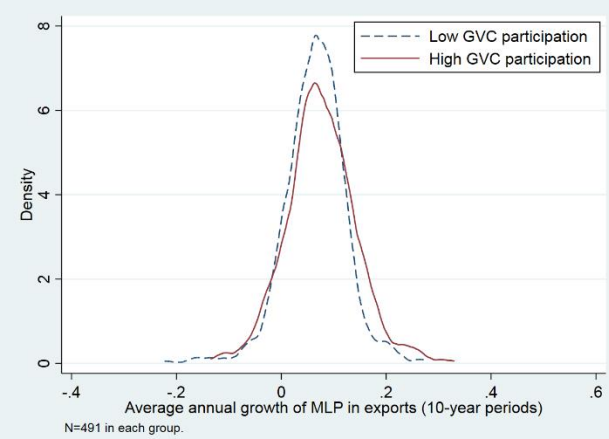
	Low GVC participation	High GVC participation		
All countries	Mean	Mean	t-value	p-value
Growth of labour productivity in exports	0.064 (N=491)	0.076 (N=491)	2.87	p<0.01
Growth of employment in exports	0.049 (N=491)	0.049 (N=491)	0.03	p=0.51
Developing countries only				
Growth of labour productivity in exports	0.053 (N=267)	0.078 (N=267)	4.10	p<0.01
Growth of employment in exports	0.078 (N=267)	0.074 (N=267)	0.28	p=0.61

Note: 'Low GVC participation' are all observations in the top quartile of the respective distribution of initial VAX-D ratios. 'High GVC participation' are all observations in the bottom quartile of the distribution.

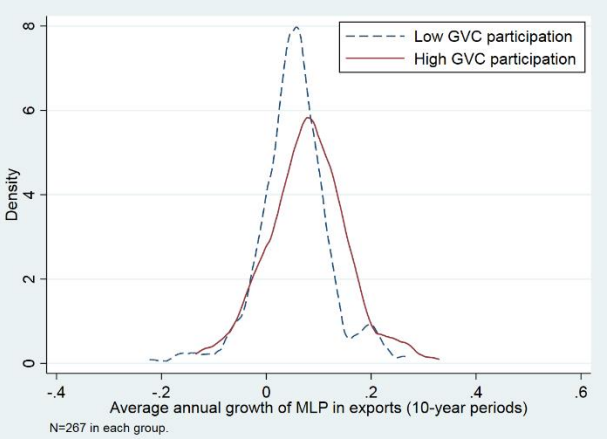
Source: Authors' calculation on described data set.

Figure 4. Labour productivity in exports growth: Kernel density plots

4(a) All countries



4(b) Developing countries

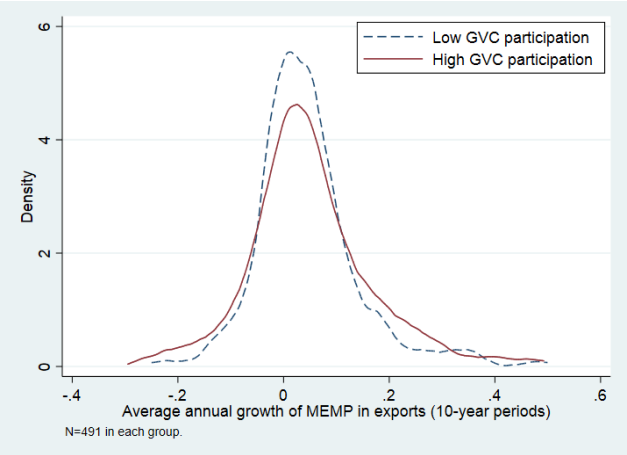


Note: 'Low GVC participation' are all observations in the top quartile of the respective distribution of initial VAX-D ratios. 'High GVC participation' are all observations in the bottom quartile of the distribution of initial VAX-D ratios. In all graphs, the tails are not displayed, and the data is cut as shown in the graphs. MLP is manufacturing labour productivity in exports; growth rates are in long-run periods (10 years).

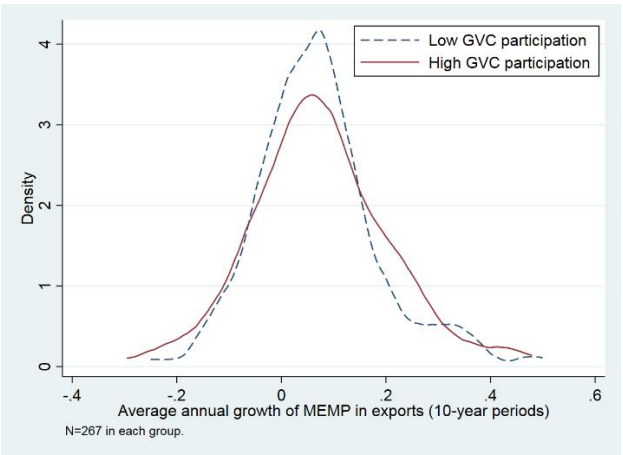
Source: Authors' calculation on described data set.

Figure 5. Employment in exports growth: Kernel density plots

5(a) All countries



5(b) Developing countries



Note: See Figure 4. MEMP is manufacturing employment in exports; growth rates are in long-run periods (10 years).

Source: Authors' calculation on described data set.

V. Econometric Results

V.1. Econometric Model

To investigate the issue in full, we will estimate the following model:

$$\widehat{mlp}_{ict} = \beta_0 + \beta_1 P_{ict} + \beta_2 mlp_{ict} + \beta_3 (mlp_{ict} * P_{ict}) + C_c + T_{it} + \varepsilon_{ict}, \quad (11)$$

where $\widehat{mlp}$ is average annual growth of nominal formal manufacturing labour productivity in exports, *i* is exporting industry, *c* is country, *t* is time period and ε is the error term. *P* is (initial) GVC participation, measured by (ln) VAX-D ratio. The scale is thus reverted and a negative coefficient of β_1 implies a positive effect of GVC participation. Following Rodrik (2013), we add time period-industry dummies T_{it} to account for price developments.[11] We also add country dummies, C_c, to control for potential cross-country differences in the measurement of value added and employment as described in section III. As the dependent variable is in growth rates, this matters only if, for example, productivity growth in larger firms is different from smaller firms (which are not covered in all countries in the industrial surveys). More importantly however, country dummies also account for VAX-D-ratio differences across countries. For example, larger countries tend to have higher VAX-D ratios because more intermediates are domestically available (e.g., Baldwin and Lopez-Gonzalez, 2015; Timmer et al., 2013). We thus might only pick up the relationship if we control for these country-specific averages.

We also add initial nominal labour productivity (mlp) and an interaction with initial GVC participation. As all our regressions include time period-industry dummies, labour productivity can be interpreted as relative productivity as the productivity frontier is country-invariant, but product specific.

[11] Value added is in nominal dollars and we assume that the inflation term is only product (and not country) specific by the law of one price for traded products.

As shown in Rodrik (2013), patterns of convergence are strong in manufacturing. As international production networks span large parts of the world and the general tradability of manufacturing products might be at the core of unconditional convergence (Rodrik, 2013), both GVC participation and relative productivity might convey similar information. The specification identifies whether there is any additional effect of participating in GVCs beyond the general trend of convergence in manufacturing. Independent of GVC participation, countries might benefit from the availability of information and codified knowledge, which helps lagging countries to learn from earlier innovations and thus catch up. Countries that engage in GVCs might additionally benefit, for example, from direct production assistance and use of sophisticated inputs embodying technology. By means of the interaction, we study whether the effect of GVC participation depends on the distance to the productivity frontier. We would expect that the productivity effects operate especially in value chains where the productivity level is further from the productivity frontier, because this might offer more scope for learning. We use cluster-robust standard errors to control for heteroscedasticity. Errors are clustered at the cross-sectional identifier, that is, the value-chain dimension (that is, the country-industry). All our variables are in log-terms. The baseline regression is for 10-year periods. We will also run these regressions in 5-year periods, following the same regression set up.

The full model for explaining employment growth is

$$\widehat{memp}_{ict} = \beta_0 + \beta_1 P_{ict} + \beta_2 mlp_{ict} + \beta_3 Reg_{ct} + \beta_3 Hum_{ct} + T_{it} + \varepsilon_{ict}, \qquad (12)$$

where $\widehat{memp}$ is average annual growth of formal manufacturing employment in exports. We add time period-industry dummies to control for fluctuations in world demand. For example, world demand for 'automotives' might develop differently from demand for 'food and beverages' and thus affect employment growth in these value chains. We add additional control variables at the country-level. We firstly add initial labour market regulations (*Reg*). There is a large literature

arguing that stricter labour market regulations have detrimental effects on employment generation (Botero et al., 2004). Labour market regulations create adjustment costs to which firms may respond by substituting capital for labour (Heckman and Pages, 2004). Furthermore, labour market regulations may increase the bargaining power of workers, which might reduce investments and thus limit the scale of the sector if investors fear that workers will extract a larger share of the profits ex-post (Besley and Buress, 2004). If true, we can expect a negative association with employment growth in exports. We measure labour market institutions by the Index of Economic Freedom (Fraser Institute, 2015). As the detailed index of labour market regulations is not available for a large set of countries before 1980, we use their aggregate index, which however also includes measures on the business environment.

We also add an indicator for the initial level of human capital (*Hum*). A highly skilled workforce may imply a comparative advantage in skill-intensive activities (Wood and Berge, 1997). For developing countries, this might imply specialisation in manufacturing activities as opposed to primary production within the manufacturing value chains and thus might have a positive effect on employment generation. However, it could also imply a shift towards capital-intensive production if skilled labour and capital are complements in the production process (Acemoglu and Pischke, 1998). We obtain human capital stock at the country level from PWT9.0 (Feenstra et al., 2015). This index is a combination based on the average years of schooling from Barro and Lee (2013) and an assumed rate of return to education from Psacharopoulos (1994).

We add our measure of initial labour productivity. We might expect that value chains closer to the productivity frontier have slower employment growth, because these value chains are likely to be substituting away from labour to capital, following the lead of more developed countries that typically specialise in more capital-intensive activities as wages rise. On the other hand, high relative labour productivity might also signal low unit labour costs and allow countries to capture

a larger share of world demand, increase the scale of production and generate employment growth. We will also investigate whether the effect of GVC participation depends on the distance to the productivity frontier. One might expect that only countries far from the productivity frontier experience employment growth from GVC participation. They might take over labour-intensive production stages, while countries close to the frontier would mainly perform capital-intensive stages. Lastly, we also present all specifications with country dummies to control for the country averages in VAX-D ratios and measurement differences. Summary statistics of our four main variables are given in Table 2.[12]

Table 2. Summary statistics: Long-run periods

Variable	Obs.	Mean	SD	Min	Max
Growth of MEMP	1,965	0.05	0.12	-0.65	1.36
Growth of MLP	1,965	0.07	0.06	-0.22	0.46
Initial MLP (ln)	1,965	9.35	1.11	5.66	12.94
Initial VAX-D ratio (ln) (GVC participation)	1,965	-0.31	0.23	-1.66	-0.03

Source: Authors' calculation based on described data set.

V.2. Econometric Results

We begin by discussing the results on labour productivity growth in exports. Table 3 shows the regression results for long-run (10-year) periods. Without any controls (except the time period-industry dummies), we find a strong relationship with an estimated coefficient different from zero. Comparing across all value chains and within value chains over time, value chains with higher

[12] We exclude ISIC Rev.3 industry 23, 'Coke, refined petroleum and nuclear fuel' because it appears to be an important outlier. Apart from statistical concerns, there are also other reasons to exclude it. Firstly, there is little information in the VAX-D ratio in this value chain. Value chains with low VAX-D ratio simply need to import oil or other resources because they are not available domestically and this will not change. Secondly, importing raw oil is unlikely to have similar productivity dynamics as when importing intermediates in other manufacturing value chains. The economic relationship that we intend to study may thus not hold in this value chain. Therefore, we exclude this value chain from our analysis. We did not find evidence for other outliers in the data.

GVC participation (lower initial VAX-D ratio) have faster productivity growth. A one percent increase in the VAX-D ratio is associated with a 0.019 percentage point lower growth rate. This implies a 0.5 percentage-point difference in the growth rate if a value chain increases its VAX-D ratio from the 25th percentile to the 75th percentile in our sample. In column (2), we add country dummies to account for differences in VAX-D ratio related to country size. The coefficient is still statistically distinguishable from zero.

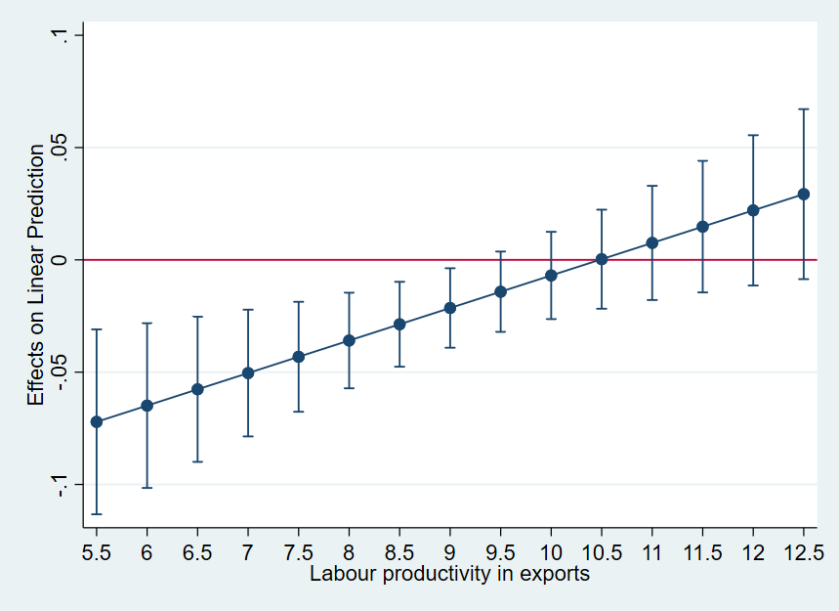
In columns (3) and (4), we add initial labour productivity in exports and the interaction with GVC participation to the model. The estimates of all three coefficients are clearly distinguishable from zero. The coefficient of the interaction is positive and the coefficient of initial VAX-D ratio is negative. This suggests that the effect of GVC participation is larger for countries further from the productivity frontier. In figure 6, we graph the marginal effects of the changes in VAX-D ratio by different levels of initial labour productivity for the result of column (4). It shows that the effect of the VAX-D ratio remains negative and significantly different from zero for all value chains with initial labour productivity (ln) lower than 9.5. The estimated effect is zero for observations with initial labour productivity of 10.5 or more. The mean of our sample is 9.4, and adding one standard deviation is about 10.5 (see table 2). For the results in column (3), we obtain a qualitatively similar result, but the effect turns significant and positive for initial labour productivity larger than 11, which corresponds to the top 5% of our distribution. Consistent with Rodrik's (2013) finding on convergence, the effect of initial labour productivity in exports is negative and statistically different from zero for all levels of GVC participation.

In table A1, we repeat columns (1) and (2) for developing countries only. Overall, the qualitative finding is the same. The association is not driven by developed countries and holds within this smaller sample, which is also suggested by the interaction with initial labour productivity. These results strongly suggest an association between GVC participation and

economic upgrading in terms of labour productivity in long-run periods. Moreover, it also strongly suggests a role for labour productivity growth especially in value chains further from the productivity frontier.

We are also in the position to investigate these effects in shorter periods. Table A2 in the appendix repeats our regressions in 5-year periods. Overall, we confirm our long-run results also in the short-run periods. This provides convincing evidence for a role of GVC participation for labour productivity growth in exports.

Figure 6. Marginal effects of GVC participation on labour productivity growth, by levels of initial labour productivity in exports



Note: Marginal effects are obtained from regression of table 3, column 4. Confidence interval for 95%.

Source: Authors' calculation.

Table 3. Explaining labour productivity (LP) growth in exports

Dependent variable: Growth of formal manufacturing labour productivity in exports				
	(1)	(2)	(3)	(4)
VARIABLES				
Initial GVC participation (reverted scale)	-0.0191***	-0.0415***	-0.178***	-0.152***
	(0.00621)	(0.0107)	(0.0441)	(0.0482)
Initial labour productivity (ln)			-0.0107***	-0.0603***
			(0.00203)	(0.00381)
Interaction: initial GVC Participation x initial LP			0.0183***	0.0145***
			(0.00470)	(0.00515)
Constant	0.0905***	0.111***	0.182***	0.606***
	(0.00658)	(0.0178)	(0.0202)	(0.0361)
Observations	1,965	1,965	1,965	1,965
Adjusted R-squared	0.172	0.416	0.238	0.570
Time period-industry Dummies	Yes	Yes	Yes	Yes
Country Dummies	No	Yes	No	Yes

Note: Robust standard errors to heteroscedasticity in parentheses. *** p<0.01, ** p<0.05, * p<0.1. GVC participation is measured by the VAX-D ratio. A negative coefficient implies a positive association of GVC participation and labour productivity growth. Variables constructed as described in the main text.

Source: Authors' calculation based on described data sets.

Employment growth in exports, however, is not associated with GVC participation as shown in Table 4. We show that there is in fact a weak positive correlation with the initial VAX-D ratio, which suggests that a higher GVC participation is associated with lower employment growth. Columns (1) and (2) show the association with and without country dummies, and all specifications include time period-industry dummies. There is only a non-significant and marginally significant positive association between initial VAX-D ratio and employment growth. This is in line with the distributions in figure 5. In columns (3) and (4), we add control variables. Again, the association between initial VAX-D ratio and employment growth is only marginally different from zero or not distinguishable. In column (3), only human capital is significantly (negatively) associated with employment growth of our control variables. This negative association might be because of a complementarity between high-skilled workers and capital. Availability of skills might yield a shift

to more capital-intensive methods of production and thus reduce employment. In column (4), we add country dummies and thus do not include the country-level control variables because they show relatively little variation over time. Initial labour productivity in exports however turns significant if we add country dummies, indicating that more productive value chains are able to extend the scale of production, such that employment is increasing.

In columns (5) and (6), we explore whether these positive associations between initial VAX-D ratio and employment growth depend on the distance to the productivity frontier. The sign of the coefficient of initial VAX-D ratio is negative, and the sign of the interaction is positive. The signs indeed suggest that the effect tends to be smaller for value chains further from the productivity frontier. However, we do not find a negative and significant association for any level of initial labour productivity in exports, but it is positive for value chains with relatively high initial labour productivity in exports. In column (5), the effect is positive and different from zero for initial labour productivity (ln) larger than about 9.5, and in column (6) larger than 10. Our sample mean is 9.4 and the standard deviation 1.1. Figure 7 shows the marginal effects based on column (6).

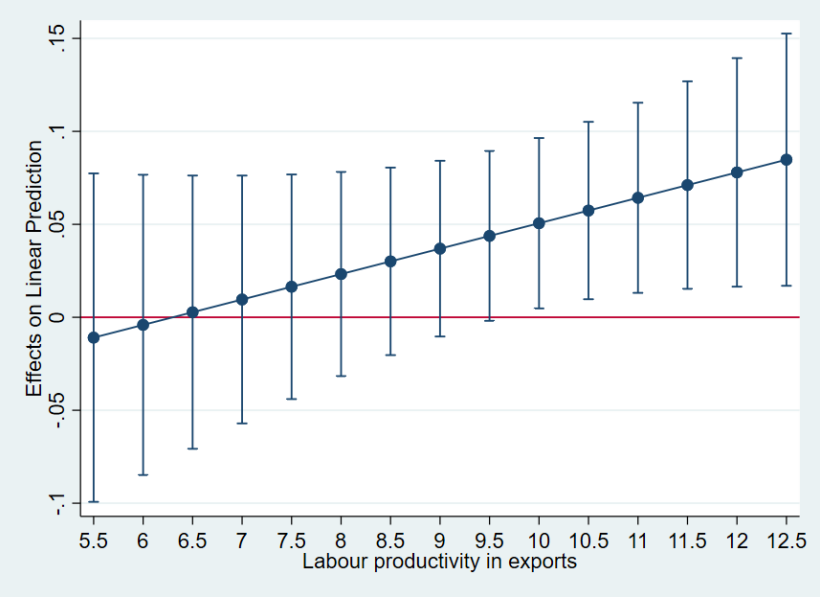
These results show that there is no positive association between GVC participation and employment growth in exports. There is no long-run effect of GVC participation for the least productive value chains, and GVC participation is even associated with slower employment growth for relatively productive value chains.

We again repeat the regressions in column (1) to (4) for developing countries in table A3 in the appendix. As suggested by the results in column (5) to (6) of table 4, we do not find a statistically significant association for developing countries. In terms of control variables, we find an additional role for regulatory institutions. The sign is positive and distinguishable from zero, suggesting that less regulation is associated with faster employment growth in formal manufacturing value chains.

In Appendix table 4, we also show the results for the short-run in 5-year periods. In the short-run, we also do not find any employment generation in association with GVC participation. The coefficient for GVC participation is not statistically different from zero in columns (1) to (4). In column (5), the effect becomes positive and distinguishable from zero for value chains with initial labour productivity larger than 10. In column (6), the association is not statistically different from zero for any level of initial labour productivity. Again, human capital shows a negative association with employment growth in exports and regulatory institutions a positive one.

Overall, these results clearly show that on average GVC participation does not contribute to employment generation. In the long run, the relatively most productive value chains even seem to experience negative effects on employment generation.

Figure 7. Marginal effects of GVC participation on employment growth, by level of initial labour productivity in exports



Note: Marginal effects are obtained from regression of table 4, column 6. Confidence interval for 95%.

Source: Authors' calculation.

Table 4. Explaining Employment growth in exports

Dependent variable: Growth of formal manufacturing employment in exports						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Initial GVC participation (reverted scale)	0.0114	0.0465*	0.0252*	0.0367	-0.137	-0.0861
	(0.0125)	(0.0239)	(0.0132)	(0.0242)	(0.0843)	(0.0920)
Initial labour productivity (ln)			0.000311	0.0322***	0.00640	0.0370***
			(0.00336)	(0.00826)	(0.00478)	(0.00907)
Initial human capital			-0.0633***		-0.0648***	
			(0.00741)		(0.00758)	
Initial regulatory institutions			0.00307		0.00253	
			(0.00213)		(0.00219)	
Interaction: initial GVC participation x initial LP					0.0175**	0.0137
					(0.00849)	(0.00918)
Constant	0.0274***	-0.00325	0.148***	-0.271***	0.0993***	-0.316***
	(0.0103)	(0.0217)	(0.0256)	(0.0721)	(0.0343)	(0.0805)
Observations	1,965	1,965	1,965	1,965	1,965	1,965
Adjusted R-squared	0.074	0.223	0.136	0.232	0.137	0.233
Time period-industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	No	Yes	No	Yes	No	Yes

Note: Robust standard errors to heteroscedasticity in parentheses. *** p<0.01, ** p<0.05, * p<0.1. GVC participation is measured by the VAX-D ratio. A negative coefficient implies a positive association of GVC participation and employment growth. Variables constructed as described in the main text.
Source: Authors' calculation based on described data sets.

VI. Conclusion

It is argued that GVCs provide a way to quickly industrialize without the need for building up a sizeable domestic manufacturing base first. Countries are supposed to simply join GVCs and benefit from specialisation, while the long-run productivity and employment generation would follow. In this study, we have investigated empirically whether GVC participation is indeed a panacea for industrialisation. The key contribution of our study is to provide long-run evidence since 1970 on a large set of developing countries.

We find robust evidence for a positive productivity effect from GVC integration. This is true in long-run (10-year) periods and in short-run (5-year) periods. Moreover, GVC participation

is of particular interest to developing countries, as we find that especially the relatively unproductive value chains can benefit most from GVC participation in terms of productivity growth.

This speaks against concerns that GVC participation will leave developing countries locked in unproductive activities (see Dalle et al., 2013). Through GVC participation, countries become more productive in performing the same activities or they might move into higher value-adding activities. Our identification does not distinguish between them, and this is an interesting avenue for further research by, for example, collecting cross-country data on business functions (as in de Vries and Reijnders, 2017). In any case, our results suggest that countries are not locked in unproductive activities when engaging in GVC production.

However, our findings on employment generation in the formal manufacturing sector provide a more pessimistic outlook. Even after conditioning the relationship between GVC participation and employment growth in exports on other factors, we do not find any sign of a positive relation. In fact, the average effect even turns negative if we limit the variation to value chains over time. However, from a development perspective, GVC participation does not seem to harm the least productive value chains, as this negative relation is only present for the most productive value chains. Nevertheless, the results suggest that GVC participation is on an average not a driver of job growth in modern activities in the economy. While we find no effect on average, it is clear that some countries have successfully relied on GVC production as a stepping stone for both productivity and employment creation. Upgrading through GVC participation is possible, but far from automatic.

The characteristics of countries and value chains constituting the outlying cases that do achieve both high productivity and employment growth are an interesting avenue for future research. In particular, case-study approaches are suited to suggest determinants for why a

particular case deviates positively or negatively from our result. More research is also needed on a more technical aspect. So far, it is not possible to distinguish exporters from non-exporters in terms of domestic and foreign backward linkages in cross-country studies. As exporters typically tend to use more foreign intermediates than firms selling to the domestic market (on China, see Koopman et al., 2012), we might tend to underestimate the foreign content in export production by aggregation. Future research on production structures by firm type is needed to better capture such particularities in a cross-country setting.

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Appendix 1. Additional tables

Table A1. Explaining labour productivity growth in exports: developing countries

Dependent variable: Growth of formal manufacturing labour productivity in exports		
	(1)	(2)
VARIABLES		
Initial GVC participation (reverted scale)	-0.0193*	-0.0454***
	(0.0106)	(0.0155)
Constant	0.0708***	0.0871***
	(0.00981)	(0.0196)
Observations	1,068	1,068
R-squared	0.175	0.448
Adjusted R-squared	0.133	0.400
Time period-industry Dummies	Yes	Yes
Country Dummies	No	Yes

Note: Robust standard errors to heteroscedasticity in parentheses. *** p<0.01, ** p<0.05, * p<0.1. GVC participation is measured by the VAX-D ratio. A negative coefficient implies a positive association of GVC participation and labour productivity growth. Variables constructed as described in the main text.
Source: Authors' calculation based on described data sets.*** p<0.01, ** p<0.05, * p<0.1

Table A2. Explaining labour productivity growth in exports: 5-year periods

Dependent variable: Growth of formal manufacturing labour productivity in exports				
	(1)	(2)	(3)	(4)
VARIABLES				
Initial GVC participation (reverted scale)	-0.0241***	-0.0807***	-0.167***	-0.200***
	(0.00564)	(0.0123)	(0.0503)	(0.0586)
Initial labour productivity (ln)			-0.0090***	-0.0707***
			(0.00228)	(0.00489)
Interaction: Initial GVC participation x initial LP			0.0165***	0.0177***
			(0.00537)	(0.00646)
Constant	0.124***	0.286***	0.201***	0.648***
	(0.00902)	(0.0243)	(0.0227)	(0.0375)
Observations	3,803	3,803	3,803	3,803
Adjusted R-squared	0.267	0.358	0.295	0.479
Time period-industry Dummies	Yes	Yes	Yes	Yes
Country Dummies	No	Yes	No	Yes

Note: Robust standard errors to heteroscedasticity in parentheses. *** p<0.01, ** p<0.05, * p<0.1. GVC participation is measured by the VAX-D ratio. A negative coefficient implies a positive association of GVC participation and labour productivity growth. Variables constructed as described in the main text.

Source: Authors' calculation based on described data sets.

Table A3. Explaining employment growth in exports: developing countries

Dependent variable: Growth of formal manufacturing employment in exports				
	(1)	(2)	(3)	(4)
VARIABLES				
Initial GVC participation (reverted scale)	0.00585	0.0391	-0.00442	0.0278
	(0.0228)	(0.0364)	(0.0260)	(0.0371)
Initial labour productivity (ln)			0.0228***	0.0349***
			(0.00509)	(0.0121)
Initial human capital			-0.0651***	
			(0.0109)	
Initial regulatory institutions			0.0117***	
			(0.00395)	
Constant	0.0525***	-0.0221	-0.0911*	-0.325***
	(0.0194)	(0.0298)	(0.0500)	(0.110)
Observations	1,068	1,068	1,068	1,068
Adjusted R-squared	0.092	0.186	0.148	0.195
Time period-industry Dummies	Yes	Yes	Yes	Yes
Country Dummies	No	Yes	No	Yes

Note: Robust standard errors to heteroscedasticity in parentheses. *** p<0.01, ** p<0.05, * p<0.1. GVC participation is measured by the VAX-D ratio. A negative coefficient implies a positive association of GVC participation and labour productivity growth. Variables constructed as described in the main text.

Source: Authors' calculation based on described data sets.

Table A4. Explaining employment growth in exports: 5-year periods

Dependent variable: Growth of formal manufacturing employment in exports						
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES						
Initial GVC participation (reverted scale)	-0.00533	0.00427	0.0154	-0.00715	-0.171**	-0.103
	(0.0110)	(0.0244)	(0.0121)	(0.0244)	(0.0869)	(0.102)
Initial labour productivity (ln)			-0.00550*	0.0236***	0.00187	0.0275***
			(0.00334)	(0.00733)	(0.00469)	(0.00839)
Initial human capital			-0.0524***		-0.0542***	
			(0.00626)		(0.00628)	
Initial regulatory institutions			0.00763***		0.00694***	
			(0.00226)		(0.00229)	
Interaction: initial GVC participation x initial LP					0.0201**	0.0108
					(0.00891)	(0.0110)
Constant	0.0367**	0.135***	0.157***	0.00642	0.0980**	-0.0292
	(0.0183)	(0.0454)	(0.0300)	(0.0591)	(0.0405)	(0.0706)
Observations	3,803	3,803	3,777	3,803	3,777	3,803
Adjusted R-squared	0.066	0.144	0.096	0.148	0.097	0.148
Time period-industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country Dummies	No	Yes	No	Yes	No	Yes

Note: Robust standard errors to heteroscedasticity in parentheses. *** p<0.01, ** p<0.05, * p<0.1. GVC participation is measured by the VAX-D ratio. A negative coefficient implies a positive association of GVC participation and labour productivity growth. Variables constructed as described in the main text.

Source: Authors' calculation based on described data sets.

Appendix 2. Data construction

In this section, we describe the data construction of the series of formal manufacturing employment and value added. Our dataset covers an unbalanced sample of 58 countries of which 40 are non-high-income countries.

The construction of the series of employment and value added relies mainly on the UNIDO Industrial Statistics database (UNIDO Indstat2, 2016). In some cases, these data are complemented by other sources to bridge small gaps in the data.

As described in the main text, the construction is guided to maximize intertemporal (over time), internal (between variables), and international (cross-country) consistency by applying linking procedures. We proceed as follows.

In the first step, we clean the data. We set observations to missing which we identify as erroneous entries. Firstly, we set all negative entries of value added and employment to missing. Secondly, we treat zeros and missing observations. In the raw data, zeros might appear when data is missing, that is, when the industry is not sampled in the respective year. It can, however, also indicate that the actual value is zero.[13] We therefore set zeros to missing that (i) are entered in-between recorded values. Hence, if an industry has a positive value in year 1, a zero in year 2, but a positive value in year 3, we assume that the zero in-between is a missing value. We set observations to missing if (ii) the industry records zeros at the beginning or end of the time series, but emerges from 0% to more than 5% of total manufacturing, and vice versa. Hence, we allow for the possibility that industries emerge or vanish, but restrict it to a change of 5% in total manufacturing. We assume that larger changes from or to 0 indicate that the zero indicates missing

[13] A motivating example for this treatment is Senegal. Between 1986 and 1989, no industry records any value added and employment except for recycling and food manufacturing. After this period, all remaining industries start recording again. It is very unlikely that all industries disappear in the same year and return in the same year.

data. We do not set observations to missing if only zeros are recorded in one industry, and thus allow for the possibility that some industries do not exist at all. We also set observations to missing if (iii) a positive value is recorded in the other variable. For example, if employment data is recorded, but value added is reported as zero, we treat the zero as a missing value.

Having obtained the cleaned value added and employment data, we aggregate into the 14 ISIC Rev.3 categories: 15t16, 17t18, 19, 20, 21t22, 23, 24, 25, 26, 27t28, 29, 30t33, 34t35, 36t37. We additionally construct aggregate categories for 17t19 and 29t33, because almost all countries report the categories 18t19 and 29t30 together in years before the 1990s, such that we cannot aggregate into our classification. This provides aggregated series of 14 industries plus the two higher aggregates of value added and employment in three and two different classifications, respectively. Value added is reported in basic prices, in market prices and in unreported classification; employment as persons engaged and employees. To bridge gaps within these five series, we linearly interpolate the series. If the two more aggregated categories are available but not the disaggregated ones, we use the closest available split to obtain the disaggregated categories. Per country we obtain up to five series for the two variables, aggregated to the 14 manufacturing industries.

We use these aggregated data to obtain initial cross-sections for both variables. To assure international consistency, we take the latest available value added cross-section in basic prices and employment cross-section as employees. If these classifications are not available, we prefer value added in basic prices over market prices over unreported classification, and employment as employees over persons engaged. Both cross-sections come from the same year to assure internal consistency.

We extrapolate these cross-sections backward and forward by growth-rate series, which we construct as follows. Firstly, starting from the aggregated data, we calculate the growth rates within

each of the variable-classification series, that is, of up to five series per country. Secondly, we combine these series into one single series of growth rates for each of the two variables. We thus assume that the growth rates are consistent across different classifications. When combining these growth rates into one single series, we prefer growth rates in basic prices over market prices over unreported classification. For employment, we prefer the series in employees over the series in persons engaged.[14] These constructed growth rates account for almost all derived data points in our data.

Next, we complement these series with additional sources and assumptions to bridge small gaps, for example, if there is no overlap between series in different classifications. Firstly, we add data from the OECD (OECD, 2017). This database provides total (formal and informal) manufacturing employment for up to 17 manufacturing industries. We use this data source to backdate and extrapolate, and to bridge gaps in our series of formal manufacturing employment and value added. By using this data source, we assume that the growth rates of total manufacturing are consistent with the growth rate of formal manufacturing. For France and South Korea, we also add data from KLEMS (Jäger, 2017; ASIA KLEMS, 2017), and proxy the growth rates following the same assumption. We further bridge the remaining small gaps of mostly single years, but of up to four years, by assuming a common trend of labour productivity growth across manufacturing industries. This is only done if there is no overlap between two classifications of value added, which could not be repaired by the additional data sources. It occurs in 14 countries. Table A2 provides an overview of the data sources and time period coverage for each of the individual countries.

Legend for Table A5.

[14] This procedure assures that we always start the extrapolation with growth rates of the same classification as the initial cross-section.

	Meaning
1	Growth rates are based on raw data
a	Growth rates are based on raw data, but use of higher aggregates 17t19 and/or 29t33 for respective industries
i	Growth rates for one or more industries are obtained from linear interpolation between raw data points
o	Growth rates for one or more industries are obtained from OECD (2017)
k	Growth rates for one or more industries are obtained from KLEMS
m	Growth rates of VA are based on common manufacturing trend of value added per worker
E	Employment classified as employees
PE	Employment classified as persons engaged
B	Value added classified in basic prices
M	Value added classified in market prices
NR	Value added classification is not reported

Note that the classification is not indicated in table A5 if the cross-section for extrapolation is after 2008. All of those countries report employment as employees, except Uruguay (reporting persons engaged). All countries report value added in basic prices, except Cyprus, India, Jordan, Kuwait, Mexico and Peru (in market prices), and Japan, Russia and Uruguay (in unreported classification).

Table A5. Overview of sources by country

		70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
ARG	EMP															1a	1a	1a	1a	1a	1a	1a	ia	ia	1	1	1	1	1	1	1	1	1	**E**	o	o	o	o	o	o
	VA															1a	1a	1a	1a	1a	1a	m	m	m	1	1	1	1	1	1	1	1	1	**M**	o	o	o	o	o	o
AUS	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**E**																		
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**B**																		
AUT	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	1	1	1	1	1i	1i	1i	1i	1i	1	1i	1i	1i	1i	1	1i	1i	1i
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	m	1	1	1	1	1	1i	o	1	1	1	1	1i	1i	1i	1i	1	1i	1i	1i
AZE	EMP																																1	1	1	1	1	1	1	1
	VA																																1	1	1	1	1	1	1	1
BEL	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1iao	iao	iao	1	1	1	1	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1	1	1	1	1	1	1	1	1	1	1	1	1
BGD	EMP							1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	1	i	i	1	i	i	i	i	i	i	i	1i	i	
	VA							1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	m	m	m	1m	i	i	1	i	i	i	i	i	i	i	1i	i	
BGR	EMP																										ia	1i	1	1	1	1	1	1	1	1	1	1	1	1
	VA																										iao	1a	1	1	1	1	1	1	1	1	1	1	o	1
BRA	EMP																										1ia	1ia	1ia	1a	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	iao	1
	VA																										1ao	1	1	1	1	1	1	1	1	1	1	1	1	1
CAN	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**E**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**M**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CHL	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**E**	1i	1i	1i	1i	1i	1i	1i	1i	1i	1i	1i	1i	1i	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**M**	1i	1ao	1ao	1ao	1ao	1iao	1iao	1iao	1iao	1iao	1iao	1iao	1iao	1ao
CHN	EMP											1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	**E**	1
	VA											1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	o	1	1	1	1	**M**	o
COL	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	o	1	1	1	1	1	1	1	1	1
CYP	EMP			1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1					
	VA			1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1					
CZE	EMP																										1	1	1	1	1	1i	1	1	1	1	1	1	1i	1
	VA																										1	1	1	1	o	1	1	1	1	1	1	1	1i	1
DEU	EMP																						1	1	1	1	1	o	1	1	1	1	1	1	1	1	1	1	1	1
	VA																						m	m	m	m	o	o	o	1	1	1	1	1	1	1	1	1	1	1
DNK	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	i	1	**E**									
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	ia	1	1	1	1	**B**									
ECU	EMP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1i	1	1	1	1	**E**
	VA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1i	1	1	1i	1	1	1	1	**M**
EGY	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**E**	ia	ia	ia	ia	ia	ia	ia	1	1	i	i	i	1	i	1	1i	1	i	i
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	1a	1a	1a	1a	1a	1a	**B**	1a	1a	1a	1a	1a	1	1	i	i	i	1i	i	1i	1i	1	ia	ia		
ESP	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EST	EMP																								1	1	1	1	1	1	1	1i	1i	1	1	1	1	1	1i	1
	VA																								1	1	1	1i	1	1	o	1	1	1	1	1	1	1	1i	1
FIN	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**E**	
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	ia	ia	ia	ia	ia	1	1	1	1	1	1i	1	1	1	1	1	1	**B**	
FRA	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1i	1i	1i	1i	1i	1i	1	1	1	1i	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	m	1a	1a	1a	1a	1a	1a	1a	1a	1a	m	1k	1k	1k	1ik	1k	1k	1	1	1	1i	1	1	1	1	1	1	1	1	1
GRC	EMP																								1	1	1	1	1	1	i	i	i	i	1	1	1	1	1	1
	VA																								1	1	1	1	1	1	i	i	i	i	1	1	1	1	1	1
HUN	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	1i	1i	1i	1i	1	1	1i	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	1a	1ia	1a	1ao	o	1	1	1i	1	1	1	1	1	1	1

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Table A5. Overview of sources by country

		70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
IND	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	ia	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	o	1	1	1	1	1	1	1	1	1	1	1
IRL	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	1ia	1ia	1ia	**E**	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1a	1ia	1ia
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1i	1i	1i	1i	**B**	1i	1i	1i	1i	1i	1i	1i	1i	1i	1i	1i	1i	1i
ISR	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	1ia	1ia	1ia	1ia	1ia	1ia	**E**	1ia	1ia	1ia	1ia	1ia	1ia	ia	ia	ia	ia	ia
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**M**	o	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a
JOR	EMP											1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	1	1i	1i	1i	i	1i	1	1	1	1	1	1	1	1
	VA											1ia	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1i	1i	1i	1	1i	1i	1	1	1	1	1	1	1
JPN	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	ia	ia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
KEN	EMP			1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	**PE**										
	VA			1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	1ia	1ia	1a	1a	**B**										
KOR	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**E**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**M**	k	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
KWT	EMP	1a	1a	1a	1a	1a	1a	1a	ia	ia	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	
LBN	EMP																													1	i	i	i	i	i	i	i	i	**E**	
	VA																													m	m	m	m	m	m	m	m	m	**M**	
LKA	EMP										1a	1a	**E**	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	ia	ia	1	1	1
	VA										1a	1a	**B**	ia	1a	ia	ia	ia	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	ia	ia	1	1	1
LTU	EMP																										1i	1i	1	1	1	1	1	1	1	1	1	1	1	1
	VA																										o	o	o	o	o	1	1	1	1	1	1	1	1	1i
LVA	EMP																								1i	1i	1i	**E**	1i	1i	1	1	1	1	1	1	1	1	1	1
	VA																								1	1i	1	**B**	1io	1io	1io	1io	1io	1io	1io	1io	1io	1io	1io	1io
MAR	EMP							1a	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	ia	ia	ia	ia	ia	ia	ia	ia	1	1	1	1	1	1	1	1
	VA							1a	1ia	1ia	1ia	1ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	1	1i	1i	1	1	1i	1i	1	1
MEX	EMP															1a	1a	1a	1a	1a	1	1i	1i	1i	1i	i	i	i	i	i	i	i	i	1	i	i	i	i	1i
	VA															1a	1a	1a	1a	1a	1	1i	1i	1i	1i	1	1	1	1	1	1	1	1	1i	1i	1i	1i	1i	1i
MYS	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	**E**	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	**B**	o	1	1	1	1	1	1	1	1
NLD	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1i	1i	1	1i	1	1i	1i	1i	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	1	1	1	1	1	1	1	1	1	1	1	1i	1	1i
NOR	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1i	1i	1i	1i	1	1i	1i	1i	1i	1	1	1	1i	1i
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	m	1	1	1i	1i	1i	1i	1i	1i	1i	1	1	1	1i	1i
NZL	EMP	1a	1a	1a	ia	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**E**																							
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**M**																							
PER	EMP													1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	1a	1	1	i	i	i	i	1	1	**PE**					
	VA													1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	m	1	1	i	i	i	i	1i	1i	**NR**					
PHL	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	i	1	i	1	i	1	1	i	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	i	1	i	1	i	1	1	i	1
POL	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	1	1	1i	1i	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	o	1	1	1	1i	1i	i	1i	1	1	1	1	1	1i
PRT	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	ia	ia	ia	ia	ia	1	1	1	1	1	1	1	1	1i	1i	1i	1i	1i
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1ia	1a	1a	1a	1a	1a	1a	1a	1a	o	1	1	1	1	1i	1	1	1	1i	1i	1i	1i	1i
ROU	EMP																										1	1	1	1	1	1	1	1	1	1	**E**	1	1	1
	VA																										1o	1o	1o	1o	1o	1o	1o	o	1ao	1	**B**	1ao	1ao	1iao
RUS	EMP																											1	1	1	1	1	1	1	1	1	1	1	1	1
	VA																											1	1	1	1	i	1	1	1	1	1	1	1	1

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Table A5 (continued). Overview of sources by country

		70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
SAU	EMP																										ia	ia	ia	ia	ia	ia	1ia	1ia	1ia	1ia	1ia	**E**	1	
	VA																										o	o	o	o	o	o	o	1iao	1iao	1iao	1iao	**NR**	o	
SEN	EMP																			ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	1	1	1	1	**E**						
	VA																			1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	1ia	**M**						
SGP	EMP	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	ia	1	1	1	1	**E**	1	1	1	1	1	1	1	1i	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	**B**	o	1	1	1	1	1	1	1	1i	1	1	1	1
SVK	EMP																								1	1	1	1	1	**E**										
	VA																								1	m	1	1	1	**B**										
SVN	EMP																		1a	1a	1a	1a	1a	1a	1a	1a	1i	1i	1i	1i	1i	1	1	1	1i	1	1	1	1	**E**
	VA																		1a	1a	1a	1a	1a	1a	1a	m	1o	1o	1o	1o	1o	1i	1i	1i	1i	1	1	1i	1i	**B**
SWE	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	1	1	1	1	1	1i	1	1	1	1	1	1	1
THA	EMP	1a	1a	ia	ia	1a	1a	1a	1a	ia	1ia	ia	ia	1a	ia	1a	ia	1a	ia	1a	1a	1ia	1a	ia	1a	1a	ia	1	i	**E**	i	1	i	1	i	i	i	1	i	I
	VA	1ia	ia	ia	ia	1a	1a	1a	1a	ia	1ia	ia	ia	1a	ia	1a	ia	1a	ia	1a	1a	1ia	1a	ia	1a	1a	ia	1	i	**M**	o	o	i	1	i	i	i	1	i	I
TUR	EMP	1a	1a	ia	ia	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	m	1	1	1	1	1	1	1	1	1	o	1	1	1	1	1	1	1
URY	EMP	ia	ia	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	ia	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1i	1i	1i	1i	i	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1	1	1	1	1i	1i	1i	1i	i	ia	1
USA	EMP	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**E**	ia	1	1	1	1	1	1	i	1	1	1	1	1
	VA	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**B**	o	o	1	1	1	1	1	1	1	1	1	1	1
ZAF	EMP										1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**E**	1a	ia	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	VA										1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	1a	**B**	m	ia	1i	i	i	1i	i	1i	1o	1o	1o	1o	1o	1o	1o	1o	1o	1o	1o

Note: 1 indicates that at least one industry's growth rate is based on raw data; a indicates that industries 17t18 and 19, and/or 29 and 30t33 are based on an aggregate split of the raw data; i indicates that at least one industry's growth is based on linear interpolation; o indicates that at least one industry's growth is based on data from OECD; k indicates that at least one industry's growth is based on KLEMS data; m indicates that at least one industry's value added growth is based on common trend of value added per worker.