Estimation and Applications of OECD Inter-Country Input-Output (ICIO) Tables in Previous Year Prices (PYP)

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Abstract

While trade in value added (TiVA) indicators have been widely used to analyse global value chains (GVCs), they are usually created in current prices and their evolution over time does not allow to disentangle changes in value-added trade flows related to prices from changes in volume that reflect some re-organisation in supply chains. Take for example the case of how important fluctuations in the price of raw materials can affect GVC indicators and may explain part of the 'deglobalisation' observed in 2011-2016. In such a way, to disentangle these changes related to inputs prices from structural changes and to better understand the reorganization of global value chains in the last two decades, the OECD Inter-Country Input-Output (ICIO) tables (from 1995 to 2018, for 67 economies and 45 industries) are estimated in previous year's prices (PYP) and GVC indicators created in chain-linked prices. The advantage of such methodology, as compared to constant prices, is that there is no need to create tables using a common base year. The proposed methodology is based on previous work done within the WIOD project (Timmer et al., 2015). These tables can also have further applications as they will allow to measure changes related to physical indicators, like emissions, use of energy, etc. and be used in studies related to changes in capital and labour productivity. The OECD will make these tables in previous year's prices publicly available.

Keywords: Inter-Country Input-Output; Trade in Value Added, International Trade, Global Value Chains, Previous Year's Prices

JEL Code: F14, F15, R15, C67

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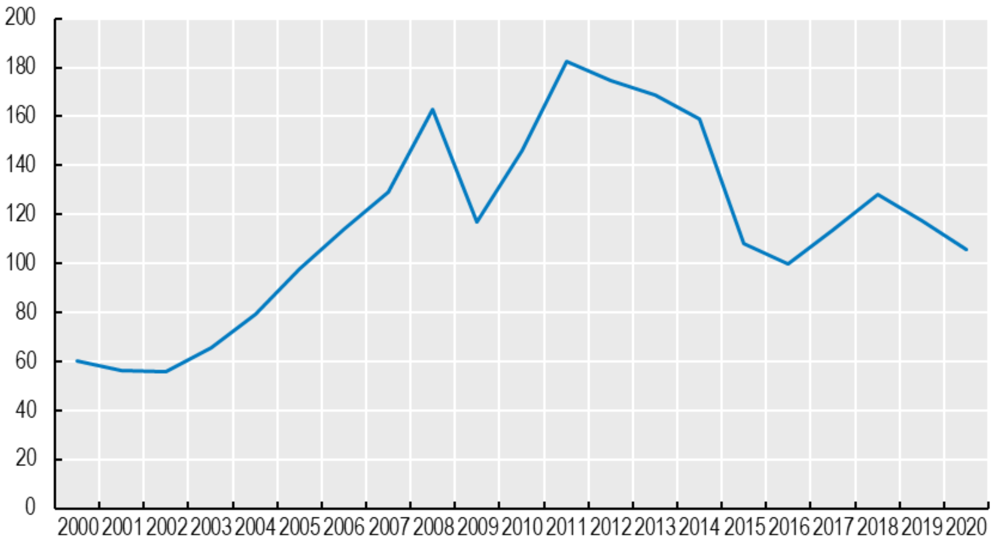
1. Introduction

To shed light on structural changes in global value chains (GVCs) and to provide answers to key questions in the current debate on international supply chains, the OECD has developed inter-country input-output (ICIO) tables in previous year's prices (pyp). These tables help to understand recent changes in the structure of GVCs and to answer questions on the slowdown in globalisation and whether there are trends towards the regionalisation of value chains or reshoring.

Figure 1. IMF All commodity price index, 2000-2020

2016 = 100



Source: IMF Primary Commodity Price System.

Trade in value added (TiVA) and GVC indicators derived from input-output tables are generally calculated in current prices. While it is not an issue when comparing data across countries and industries for a given year, the evolution of such indicators over time is influenced by changes in relative prices. For example, an increase in the price of imported inputs relative to the price of final goods increases the foreign value added in exports. It would be misleading to interpret this increase as a shift to the use of domestic inputs in the production process, when this shift only reflects a price effect. Disentangling price effects from changes in volumes is especially important in the context of the debate on a potential deglobalisation (James, 2018[1]; Livesey, 2018[2]; Antràs, 2020[3]). As pointed out by Timmer et al. (2021[4]) -one of the few papers using pyp data-, this apparent deglobalisation might be related to the use of current prices to calculate GVC indicators in the context of a high volatility in the price of raw materials. Figure 1 highlights that there was an important decrease in the price of commodities between 2011 and 2016.

Against this backdrop, this paper first presents the methodology used to estimate pyp ICIO tables and then illustrates how these tables can be used to better understand the evolution of GVCs in the past decade.

2. Methodology to estimate inter-country input-output tables in previous year's prices

This section describes the methodology used to estimate the pyp ICIO tables for the period 1995-2018. The methodology is based on the work done within the World Input-Output Database (WIOD) project and follows the main steps presented in Los et al. (2014[5]) for the construction of World Input-Output Tables (WIOTs) in previous year's prices. As such, this section draws on Los et al. (2014[5]). It first presents the data sources that were used to build a full dataset of gross output and value-added deflators for the countries included in the OECD ICIO tables and then explains the main steps in the construction and balancing of pyp tables.

2.1. Construction of U.S. dollar-denominated previous year's price deflators

Deflators were collected from a range of data sources, with the main sources of value added and gross output deflators for target countries being KLEMS projects (35%), UN National Accounts (30%), STAN (25%) and the WIOD socio-economic accounts (10%) (Table 1).

Where deflators were not available, the same sector's value added deflators were used for missing output deflators and missing sectors were substituted with the closest available aggregate. For example, a missing deflator for the chemicals industry may be substituted with the deflator of the chemicals and pharmaceuticals aggregate or the next closest available aggregate. Final demand deflators were taken from the UN National Accounts, with the exception of Chinese Taipei for which deflators were collected from the national statistics office.

Following the methodology of Los et al. (2014[5]), unavailable deflators for taxes, margins etc. related to final demand were approximated using GDP deflators and deflators for NPISH and changes in inventory were implicitly derived from output deflators. Expenditure of non-residents deflators are not available and were instead approximated using the deflators of household final consumption expenditure.

Deflators in national currency were converted using fiscal year adjusted exchange rates and constant price deflators were unchained using ICIO values to arrive at dollar-denominated previous year's price deflators.

Lastly, the deflators for the Rest of the World (RoW) were constructed as weighted averages of the ten largest economies in terms of production output per sector using data from the UN National Accounts.

Table 1 List of pyp value added and output deflator sources

ISO-3	Economy	Data sources
ARG	Argentina	UN National Accounts
AUS	Australia	STAN, UN National Accounts, WIOD
AUT	Austria	KLEMS, STAN, UN National Accounts
BEL	Belgium	KLEMS, STAN, UN National Accounts
BGR	Bulgaria	KLEMS, UN National Accounts, WIOD
BRA	Brazil	UN National Accounts, WIOD

BRN	Brunei Darussalam	UN National Accounts
CAN	Canada	KLEMS, STAN, UN National Accounts, WIOD
CHE	Switzerland	STAN, UN National Accounts
CHL	Chile	STAN, UN National Accounts
CHN	China (People's Republic of)	KLEMS, UN National Accounts, WIOD
COL	Colombia	STAN, UN National Accounts
CRI	Costa Rica	UN National Accounts
CYP	Cyprus	KLEMS, UN National Accounts, WIOD
CZE	Czech Republic	KLEMS, STAN, UN National Accounts
DEU	Germany	KLEMS, STAN, UN National Accounts
DNK	Denmark	KLEMS, STAN, UN National Accounts
ESP	Spain	KLEMS, STAN, UN National Accounts, WIOD
EST	Estonia	KLEMS, STAN, UN National Accounts
FIN	Finland	KLEMS, STAN, UN National Accounts
FRA	France	KLEMS, STAN, UN National Accounts
GBR	United Kingdom	KLEMS, STAN, UN National Accounts, WIOD
GRC	Greece	KLEMS, STAN, UN National Accounts
HKG	Hong Kong (China)	UN National Accounts
HRV	Croatia	KLEMS, UN National Accounts, WIOD
HUN	Hungary	KLEMS, STAN, UN National Accounts
IDN	Indonesia	UN National Accounts, WIOD
IND	India	KLEMS, UN National Accounts, WIOD
IRL	Ireland	KLEMS, STAN, UN National Accounts, WIOD
ISL	Iceland	Eurostat, STAN, UN National Accounts
ISR	Israel	STAN, UN National Accounts
ITA	Italy	KLEMS, STAN, UN National Accounts
JPN	Japan	KLEMS, STAN, UN National Accounts
KAZ	Kazakhstan	UN National Accounts
KHM	Cambodia	UN National Accounts
KOR	Korea	KLEMS, STAN, UN National Accounts, WIOD
LAO	Lao PDR	UN National Accounts
LTU	Lithuania	KLEMS, STAN, UN National Accounts, WIOD
LUX	Luxembourg	KLEMS, STAN, UN National Accounts
LVA	Latvia	KLEMS, STAN, UN National Accounts
MAR	Morocco	UN National Accounts
MEX	Mexico	STAN, UN National Accounts
MLT	Malta	Eurostat, UN National Accounts, WIOD
MMR	Myanmar	UN National Accounts
MYS	Malaysia	UN National Accounts
NLD	Netherlands	KLEMS, STAN, UN National Accounts
NOR	Norway	STAN, UN National Accounts
NZL	New Zealand	STAN, UN National Accounts
PER	Peru	UN National Accounts
PHL	Philippines	UN National Accounts
POL	Poland	KLEMS, STAN, UN National Accounts
PRT	Portugal	KLEMS, STAN, UN National Accounts
ROU	Romania	KLEMS, UN National Accounts
RUS	Russia	KLEMS, UN National Accounts, WIOD
SAU	Saudi Arabia	UN National Accounts

SGP	Singapore	UN National Accounts
SVK	Slovak Republic	KLEMS, STAN, UN National Accounts
SVN	Slovenia	KLEMS, STAN, UN National Accounts
SWE	Sweden	KLEMS, STAN, UN National Accounts
THA	Thailand	UN National Accounts
TUN	Tunisia	UN National Accounts
TUR	Turkey	STAN, UN National Accounts, WIOD
TWN	Chinese Taipei	KLEMS, National Statistics Office, WIOD
USA	United States	KLEMS, STAN, UN National Accounts
VNM	Viet Nam	UN National Accounts
ZAF	South Africa	UN National Accounts

2.2. Main steps in the estimation of pyp ICIO tables

Table 2 presents an overview of the ICIO in pyp. Symbols with asterisks indicate values expressed in previous year's prices. Corresponding symbols without asterisks denote values in current prices. Price indices deflators of various sorts are indicated by the symbol p. The economy described by this Figure consists of two countries, which both provide a single output. This output can be used as an intermediate input (in either of the two countries), or be used for final demand purposes (also in either of the two countries). Six final demand purposes are discerned: 1) consumption by households (*c*); 2) non-residents expenditure (*nr*); 3) consumption expenditure by non-profit organisations serving the households, NPISH (*n*); 4) government consumption (*g*); 5) gross fixed capital formation (*f*); and 6) changes in inventories (*i*).

The methodology described in Los et al. (2014[5]) is based on Dietzenbacher and Hoen (1998[6]) who proposed an approach to estimate IO tables in pyp based on the RAS algorithm.[1] The approach advocated by Dietzenbacher and Hoen (1998[6]) assumes that data on gross output by industry in pyp (*q**.), value added by industry in pyp (*v**) and total final demand by supplying industry (the sum over all cells in a row in "Final demand in Country 1" and "Final demand in Country 2") are given. This implies that the row totals and column totals for the block of intermediate inputs transactions in pyp are known. Hence, the well-known iterative RAS-procedure can be used to derive each value of intermediate inputs transactions in pyp. The RAS-procedure is completed if the sums over cells in each row are very close to the exogenously given row totals and the same applies to cells in columns. This implies that both rows and columns have been scaled up or down by row- and column-specific factors upon completion of the procedure. Since cells are in both a row and a column, each cell value originally expressed in current prices has been scaled up or down by a cell-specific factor. If RAS is used to deflate cell values in current prices, these cell-specific factors can be considered as cell-specific deflators.

In the case of ICIO, and WIOT, the data availability is a bit different from Dietzenbacher and Hoen (1998). Deflating the intermediate inputs block is not sufficient to arrive at fully deflated ICIOs, since estimates of cell-specific values of final demand by supplying industry, use category and country of destination are also part of an ICIO. These values in pyp are not known and should also be estimated. Table 2 summarises the data situation. The values (in pyp) in the shaded cells should be estimated using RAS. This requires that the sums over cells in columns and the sums over cells in rows are known.

[1] See Bacharch (1970[19]) and Miller and Blair (2022[20]).

For the variables included in Table 2, exogenous information is indicated in colours: a) information from current price ICIO in orange; b) production and value added deflators by industry in green; and c) national accounts deflators in blue. p is price, and volumes are indicated with asterisks *. The values in pyp in the shaded cells are estimated using RAS.

The price indices deflators that were described in the previous section are key to obtain a consistent and balanced ICIO in pyp. At this stage, a preliminary overall consistency of the price indices deflators was conducted, assuring that the weighted average of the industry value added price deflators match the GDP deflator and that a given industry gross output price deflator stays in a range between -10% or +10% of the same industry value added price deflator.

For the variables in the rows related to net taxes, the industry-level value added deflators have been assumed to apply ($p_{1rz}= p_{1v}$ and $p_{2rz} = p_{2v}$). To deflate gross output levels, gross output levels in current prices (q_1 an q_2) were divided by industry-specific gross output deflators (p_1 and p_2). The initial constraints on the columns sums in pyp of the intermediate input block are now given by $z_{*11} + z_{*21} = q_{*1} - rz_{*1} - v_{*1}$ and $z_{*12} + z_{*22} = q_{*2} - rz_{*2} - v_{*2}$. The initial constraints on the entire rows sums in pyp have also been derived: $z_{*11} + z_{*12} + c_{*11} + n_{*11} + g_{*11} + f_{*11} + i_{*11} + c_{*12} + n_{*12} + g_{*12} + f_{*12} + i_{*12} = q_{*1}$ and $z_{*21} + z_{*22} + c_{*21} + n_{*21} + g_{*21} + f_{*21} + i_{*21} + c_{*22} + n_{*22} + g_{*22} + f_{*22} + i_{*22} = q_{*2}$.

At this stage, the column constraints for the final demand blocks have still to be determined. Aggregate deflators for household consumption (*p1c* and *p2c*), for government consumption (*p1g* and *p2g*) and for gross fixed capital formation (*p1f* and *p2f*) were estimated based on UN National Accounts. Deflators for taxes, subsidies, international transport margins etc. related to final demand are not available. As an admittedly rough approximation, we assume that $p1rc = p1rn = p1rg = p1rf = p1ri = p1GDP$ *and* $p2rc = p2rn = p2rg = p2rf = p2ri = p2GDP$, i.e. all deflators are assumed to equal the GDP deflator of the country to where the respective final products are sold. This fixes the initial constraint on the columns of a number of final demand columns: for country 1 we have $c{*}11 + c{*}21 = c{*}1- rc{*}1, g{*}11 + g{*}21 = g{*}1-rg{*}1, f{*}11 + f{*}21 = f{*}1- rf{*}1$ and analogous expressions apply to the columns for household consumption, government expenditures and gross fixed capital formation in country 2.

The consumption of non-residents is added to household consumption to estimate the values in pyp. After the system is balanced, the split is done by using the shares of non-residents expenditure on the above sum, i.e., household consumption plus consumptions of non-residents in current prices.

Available deflators for consumption expenditures by NPISH (p_{1n} and p_{2n}) and changes in inventories (p_{1i} and p_{2i}) appeared highly unreliable. As so, we assume that cell-specific deflators in the columns for consumption by NPISH and changes in inventories are equal to the known gross output deflators (e.g., for the cells in the first row, $p_{11n} = p_{11i} = p_{12n} =p_{12i} = p_1$). This yields initial values for n_{*11}, n_{*21}, n_{*12}, n_{*22} and i_{*11}, i_{*21}, i_{*12}, and i_{*22}. We use these initial values (indicated by an underlined symbol) to generate Laspeyres aggregates of the elements in the final demand columns related to consumption by NPISH and changes in inventories: $n_{*1} = n_{*11} + n_{*21} + rn_{*1}$ and $i_{*1} = i_{*11} + i_{*21} + ri_{*1}$ (and analogous expressions for these final demand categories in country 2). This approach thus basically determines implicit deflators. The initial constraints on the sum of the values in the relevant columns of the final demand block are now given by equations like $n_{*11} + n_{*21} = n_{*1} - rn_{*1}$.

The Dietzenbacher and Hoen (1998) approach cannot be applied at this stage yet, despite having obtained the initial constraints on row and column sums according to the methods described so far. This is caused by two issues. First, the RAS algorithm cannot deal with negatives, while the columns with changes in inventories frequently contain negative values. In order to address this issue, a possible approach is to use a Generalised RAS (GRAS) algorithm as it was done by Los et al. (2014). However, the option here was to use the traditional RAS approach and to treat the negative values in changes in inventories in the following way: a) the negative values are stored for later use and are transformed in positive values to be used in RAS; b) the row and columns constraints are adjusted to reflect this transformation; c) after the balancing procedure, the negative values are added to the balanced system, obtained from RAS, and the rows and columns totals adjusted according. This procedure provides consistent results with the advantage to be simpler to use and faster than GRAS in terms of computing time.

The methodology described above yields data-driven distinctions between export price indices and price indices for domestically traded products, since generally each cell will have its own deflator (p_{11z} and p_{12z}, for example, will be different).

Table 2 Stylised pyp ICIO

	Using Countries / Industries		Final demand in Country 1						Final demand in Country 2						GO
			Households	Non-residents	NPISH	Government	GFCF	Changes in Inventories	Households	Non-residents	NPISH	Government	GFCF	Changes in Inventories	
Supplying Countries / Industries	$z^*_{11} = z_{11}/p_{11z}$	$z^*_{12} = z_{12}/p_{12z}$	$c^*_{11} = c_{11}/p_{11c}$	$nr^*_{11} = nr_{11}/p_{11nr}$	$n^*_{11} = n_{11}/p_{11n}$	$g^*_{11} = g_{11}/p_{11g}$	$f^*_{11} = f_{11}/p_{11f}$	$i^*_{11} = i_{11}/p_{11i}$	$c^*_{12} = c_{12}/p_{12c}$	$nr^*_{12} = nr_{12}/p_{12nr}$	$n^*_{12} = n_{12}/p_{12n}$	$g^*_{12} = g_{12}/p_{12g}$	$f^*_{12} = f_{12}/p_{12f}$	$i^*_{21} = i_{12}/p_{12i}$	$q^*_1 = q_1/p_1$
	$z^*_{21} = z_{21}/p_{21z}$	$z^*_{22} = z_{22}/p_{22z}$	$c^*_{21} = c_{21}/p_{21c}$	$nr^*_{21} = nr_{21}/p_{21nr}$	$n^*_{21} = n_{21}/p_{21n}$	$g^*_{21} = g_{21}/p_{21g}$	$f^*_{21} = f_{21}/p_{21f}$	$i^*_{21} = i_{21}/p_{21i}$	$c^*_{22} = c_{22}/p_{22c}$	$nr^*_{22} = nr_{22}/p_{22nr}$	$n^*_{22} = n_{22}/p_{22n}$	$g^*_{22} = g_{22}/p_{22g}$	$f^*_{22} = f_{22}/p_{22f}$	$i^*_{22} = i_{22}/p_{22i}$	$q^*_2 = q_2/p_2$
Net Taxes	$rz^*_1 = rz_1/p_{1rz}$	$rz^*_2 = rz_2/p_{2rz}$	$rc^*_1 = rc_1/p_{1rc}$	$rnr^*_1 = rnr_1/p_{1rnr}$	$rn^*_1 = rn_1/p_{1rn}$	$rg^*_1 = rg_1/p_{1rg}$	$rf^*_1 = rf_1/p_{1rf}$	$ri^*_1 = ri_1/p_{1ri}$	$rc^*_2 = rc_2/p_{2rc}$	$rnr^*_2 = rnr_2/p_{2rnr}$	$rn^*_2 = rn_2/p_{2rn}$	$rg^*_2 = rg_2/p_{2rg}$	$rf^*_2 = rf_2/p_{2rf}$	$ri^*_2 = ri_2/p_{12ri}$	
Value Added	$v^*_1 = v_1/p_{1v}$	$v^*_2 = v_2/p_{2v}$	0	0	0	0	0	0	0	0	0	0	0	0	
Gross Output	$q^*_1 = q_1/p_1$	$q^*_2 = q_2/p_2$	$c^*_1 = c_1/p_{1c}$	$nr^*_1 = nr_1/p_{1nr}$	$n^*_1 = n_1/p_{1n}$	$g^*_1 = n_1/p_{1g}$	$f^*_1 = f_1/p_{1f}$	$i^*_1 = i_1/p_{1i}$	$c^*_2 = c_2/p_{2c}$	$nr^*_2 = nr_2/p_{2nr}$	$n^{*2} = n_2/p_{2n}$	$g^*_2 = n_2/p_{2g}$	$f^*_2 = f_2/p_{2f}$	$i^*_2 = i_2/p_{2i}$	

Note: Stylised ICIO for two countries, one industry and six final demand categories: 1) consumption by households (c); 2) non-residents expenditure (nr); 3) consumption expenditure by non-profit organizations serving the households, NPISH (n); 4) government consumption (g); 5) gross fixed capital formation (f); and 6) changes in inventories (i).
Exogenous information is indicated in colours: a) information from current price ICIO in orange; b) production and value added deflators by industry in green; and c) national accounts deflators in blue. p is price, and volumes are indicated with asterix *. The values in pyp in the shaded cells are estimated using RAS.
Source: Based on Los et al. (2014).

3. Recent trends in the evolution of GVCs when using pyp ICIO tables

The discussion of a potential 'deglobalisation' comes from the decrease in the elasticity of trade to GDP after the Great Financial Crisis and signs that GVCs may be shortening (Haugh et al., 2016[7]; James, 2018[1]; Livesey, 2018[2]; Antràs, 2020[3]). Since the 1980s, vertical specialisation and the international fragmentation of production have driven the growth of world trade and led to the rise of GVCs (Hummels, Ishii and Yi, 2001[8]; OECD, 2013[9]; Baldwin, 2016[10]; Johnson and Noguera, 2017[11]; Pahl and Timmer, 2019[12]). However, there has been a slowdown in the fragmentation of production after the financial crisis (Miroudot and Nordström, 2020[13]; Timmer et al., 2021[4]). More recently, COVID-19 has triggered a new debate on vulnerabilities in GVCs and whether uncertainties in the supply of foreign inputs could lead to the regionalisation of value chains or the reshoring of some industries (Miroudot, 2020[14]).

Using the OECD pyp ICIO tables, this section illustrates how indicators in 'constant' prices (chain-linked indicators derived from current and pyp tables) can shed a different light on these issues.

3.1. No deglobalisation but a slowdown in the expansion of GVCs

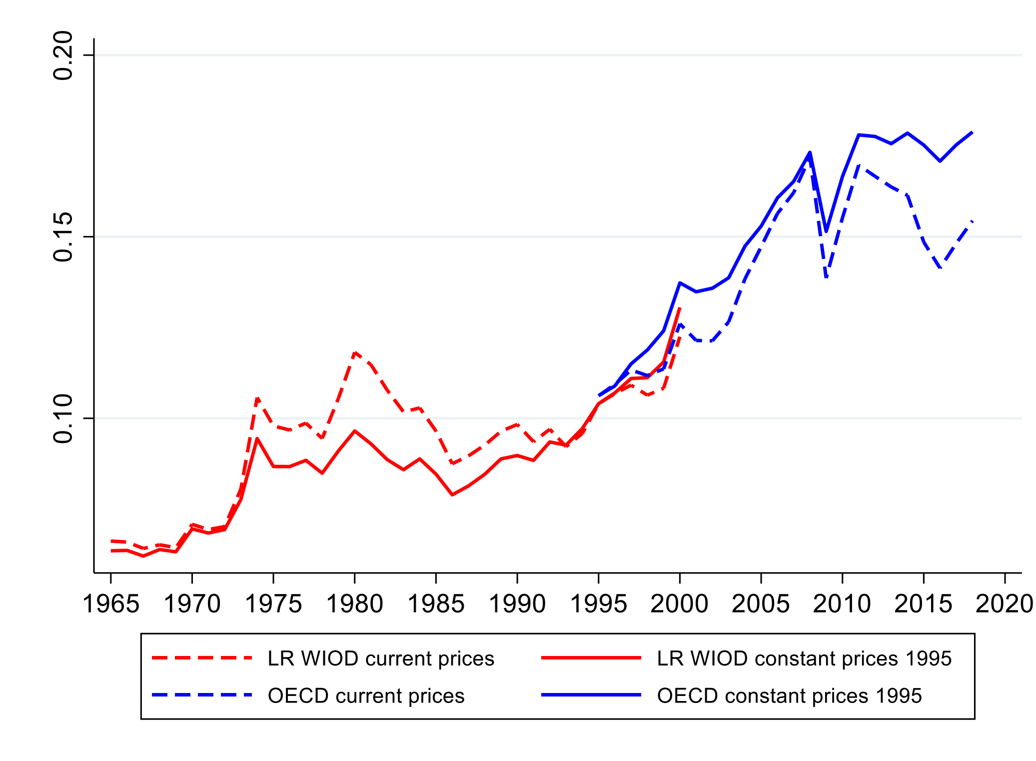
The import intensity of production is a good indicator to assess the level of fragmentation of production as it is not a value-added indicator but adds gross imports of intermediate inputs all along the value chain and measures their contribution as a share of gross output (Timmer et al., 2021[4]). As can be observed on Figure 2, the decrease in the fragmentation of production between 2011 and 2016 is more pronounced in current prices than in constant prices. Timmer et al. (2021[4]) were already highlighting that the apparent deglobalisation during this period was mostly a price effect because of the decrease in the price of intermediate inputs and particularly some raw materials. The OECD pyp ICIO tables confirm this fact, although we still see a slight decrease in the fragmentation of production based on the more recent national accounts and wider country coverage in the OECD data.

However, it is important to point out that even if the fragmentation of production has slightly decreased, it remained at a high level, especially when taking a longer time perspective. Figure 2 also includes data from the long-run WIOD (Woltjer, Gouma and Timmer, 2021[15]) with data going back to 1965.[2] In 1965, for each dollar of output in the world, the cumulated trade in intermediate inputs was only about 6 cents. Trade in intermediate inputs increased as a share of world output first in the 1970s following the end of the Bretton Woods system and the realignment of major currencies with floating exchange rates. There was then a steep increase in the fragmentation of production starting in the middle of the 1980s when MNEs engaged in vertical specialisation and offshoring strategies. The rise of GVCs was then facilitated in the 1990s by the collapse of the Soviet Union, the conclusion of the Uruguay Round and creation of the WTO, a new wave of deep regional trade agreements and market-oriented reforms in China (and its subsequent accession to WTO in 2001). This period, sometimes described as 'hyper globalisation' (Brakman and van Marrewijk, 2022[16]), saw an increase in the cumulative value of trade

[2] We use the same reference year (1995) to chain-link the import intensity of production calculated with the long-run WIOD data and OECD data. The data are not fully comparable due to differences between the two datasets. In particular, the long-run WIOD data are based on SNA 1993 while OECD data follow the SNA 2008 definitions and concepts. Despite these differences, the import intensity of production at the world level is relatively similar for the period where the two datasets overlap (between 1995 and 2000).

in intermediate inputs to 17 cents for each dollar produced at the outset of the Financial Crisis in 2008.

Figure 2. Import intensity of production at the world level, 1965-2018



Source: Authors' calculations based on OECD ICIO tables and long-run WIOD tables in current and previous year's prices.

Whether there is or not a decline in the fragmentation of production after 2011, it is still clear from Figure 2 that the period that follows the Great Financial Crisis of 2008-2009 is different from the two decades before where there was a continuous expansion of GVCs. This expansion has stopped in the last decade and this is what needs to be explained.

Figure 2 illustrates why it is important, particularly in the recent period, to do the analysis in constant prices. We observe a significant divergence between the data in current and constant prices after 2011. This can be explained by changes in relative prices affecting raw materials. When using data in current prices, the value of trade in intermediate inputs becomes lower even if the quantities traded have not changed. The constant prices correct for this and a decrease in the value of trade in intermediate inputs in constant prices means that quantities traded have been reduced.

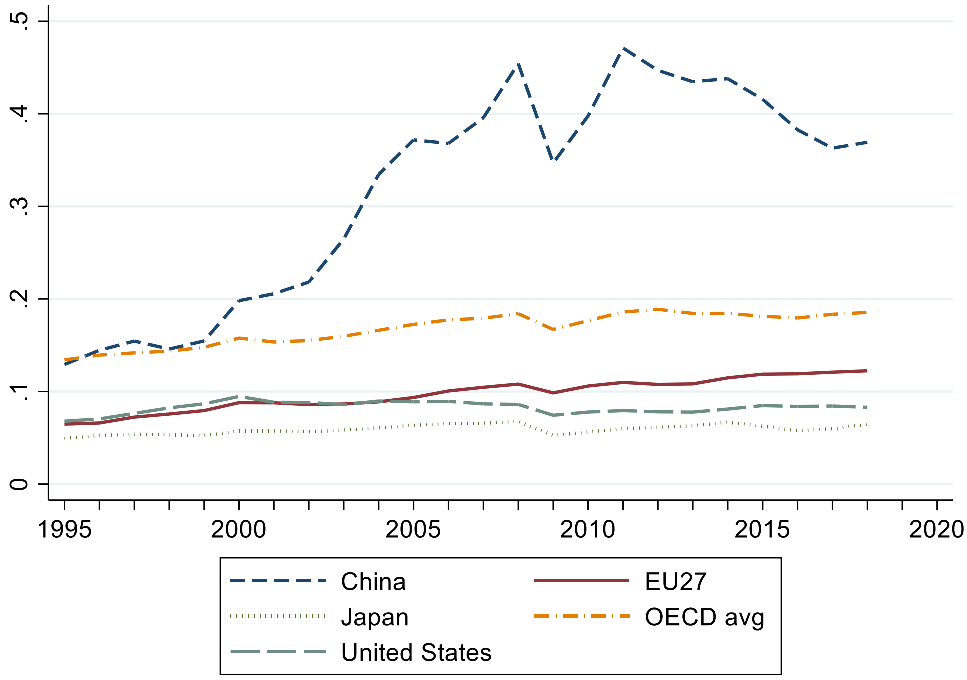
After 2016, the increase in the import intensity of production is also concomitant to higher prices for commodities. However, the constant prices suggest that there is still an increase when controlling for the price effect. What is interesting in Figure 2 is that in constant prices, 2018 is a new peak for the fragmentation of production with a world value slightly higher than in 2011. We expect the COVID-19 crisis to have caused some temporary trade collapse with lower values for the import intensity of production when lockdowns and disruptions in international transport networks were affecting the international supply of inputs. But what the period after the recovery will look like remains a question mark, especially in light of more recent crises and the Russian aggression of Ukraine.

3.2. Some heterogeneity across countries and industries

There are differences across countries when looking at the import intensity of production in constant prices (Figure 3). The result at the world level is driven by a more pronounced slowdown and even decline in China where the indicator has continuously decreased since 2011. For the European Union (analysed as a single economy), there is no slowdown and imports of intermediate inputs (from extra-EU economies) continue to account for a growing share of production after 2011. The evolution observed for the United States is similar to the OECD average (but with lower values as the country relies less on foreign sourcing), Finally, the indicator is relatively flat for Japan with no significant increase or decrease over the whole period.

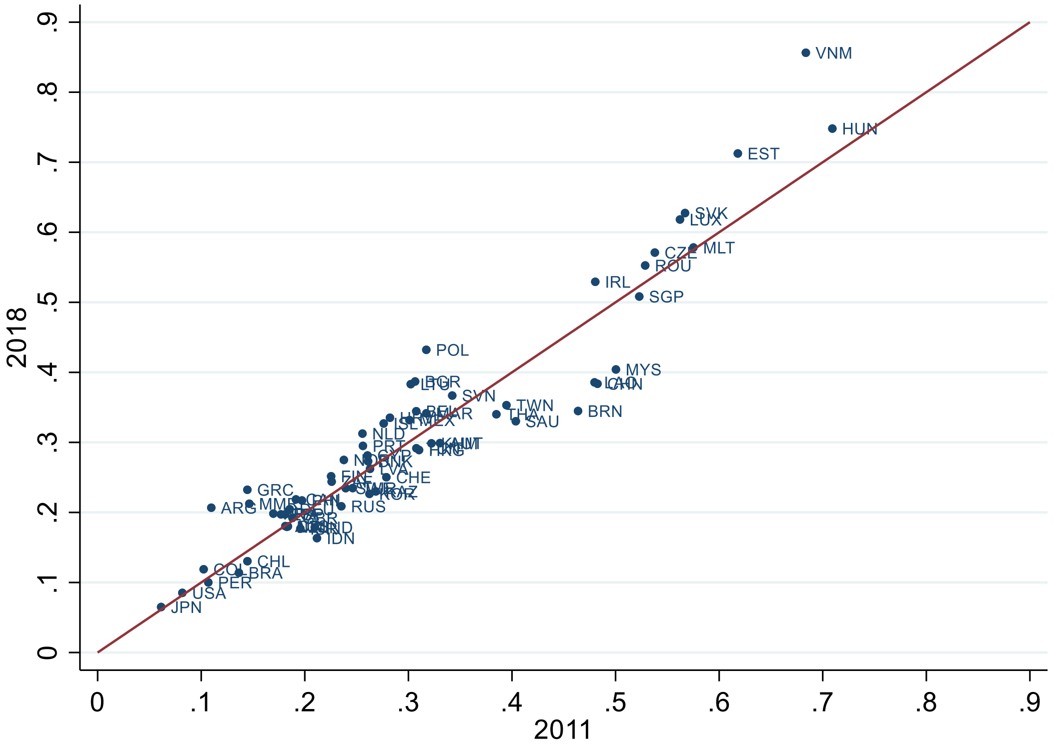
A more systematic comparison between 2011 and 2018 for all economies included in the OECD database (in constant prices) suggests that the import intensity of production has decreased in 28 countries out of 66 in the sample (Figure 4). Economies with already a high level of foreign sourcing in their value chains in 2011 (such as Viet Nam, Hungary or Estonia) tend to have an even higher import intensity in 2018. But an important increase is also observed in Poland or Greece, starting from a lower level. Consistent with the observation that the EU as a single economy did not experience a slowdown in its international fragmentation of production, EU economies are generally the ones with more foreign sourcing (from extra EU-economies as well as EU economies) in 2018. The countries where there is a noticeable decrease are mainly Asian economies such as Malaysia, Indonesia or Thailand, together with China.

Figure 3. Import intensity of production, main economies, 1995-2018



Note: Unweighted average for OECD countries.
Source: Authors’ calculations based on OECD ICIO tables in previous year’s prices.

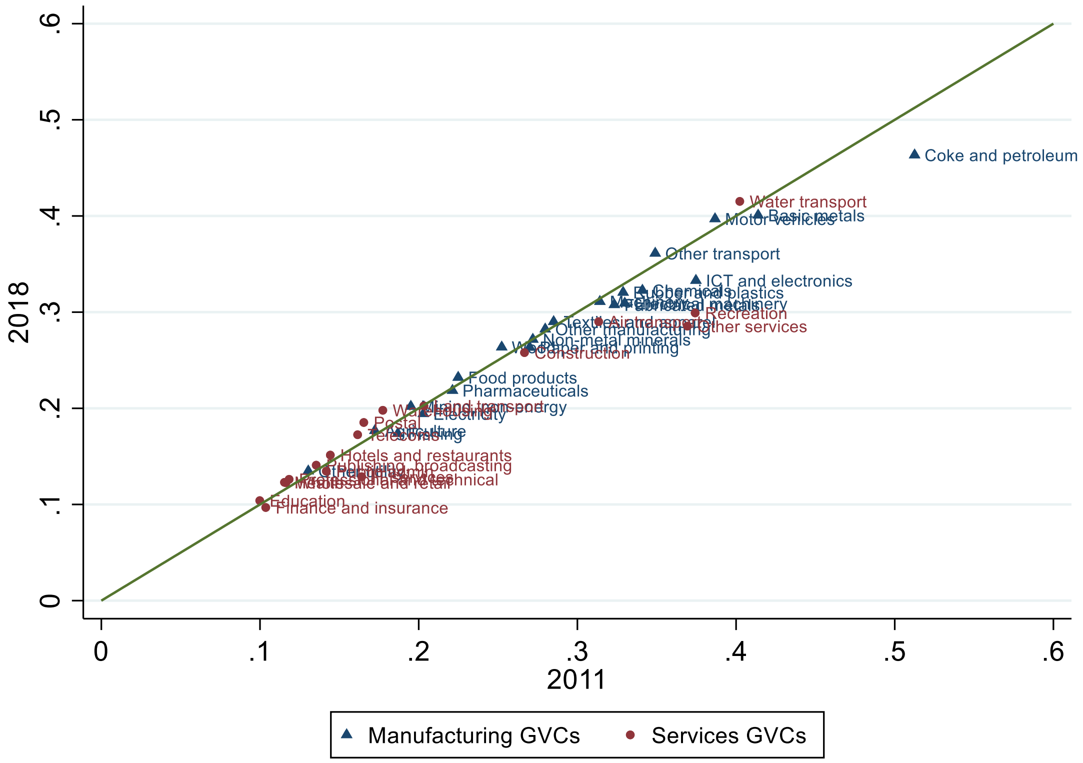
Figure 4. Import intensity of production, all economies, 2018 versus 2011



Note: Data are in constant prices, base year 1995. Industries are weighted based on their share in final demand with the same weights (2011) for both years.
Source: Authors' calculations based on OECD ICIO tables in previous year's prices.

When calculating average values across industries, a majority of sectors have more international fragmentation of production in 2018 as compared to 2011 (Figure 5). However, some industries have a significant decrease in their import intensity, such as other services, coke and petroleum and ICT & electronics. Trends across countries and industries may be related. For example, ICT and electronics is the manufacturing industry with the highest decrease while also being the sector in which China and the Asian economies identified on Figure 4 as having a decline in their fragmentation index are specialised.

Figure 5. Import intensity of production, by industry, 2018 versus 2011



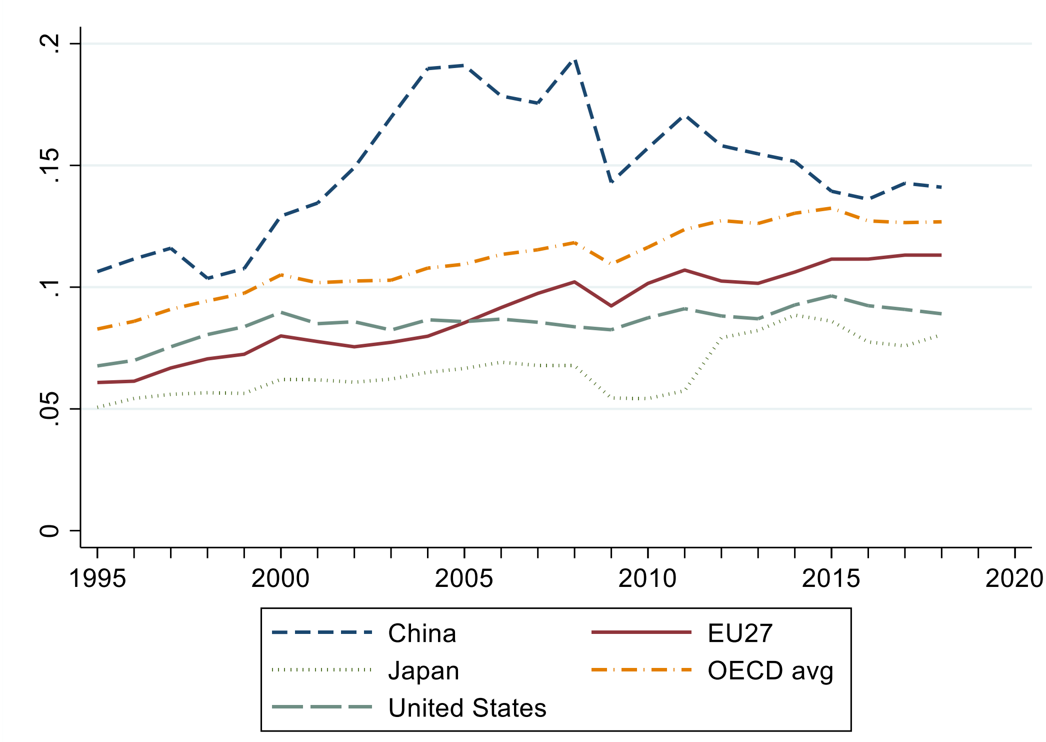
Note: Data are in constant prices, base year 1995. Countries are weighted based on their share in final demand with the same weights (2011) for both years.
Source: Authors' calculations based on OECD ICIO tables in previous year's prices.

3.3. Supply chains are becoming more domestic or more regional in some countries

The recent debate on international supply chains has suggested that vulnerabilities in international production networks may encourage firms to source more inputs domestically (reshoring) or from neighbouring countries (nearshoring). The ICIO data are available only up to 2018 and recent trends related to the COVID-19 shock are not captured. But these data suggest that, at least before the pandemic, there was no global trend towards reshoring or nearshoring. However, some of these trends are observed in some countries.

To assess whether there is reshoring in the sense of production in value chains becoming more domestic, Figure 6 shows the ratio of foreign to domestic production stages in the main economies and for OECD countries as an average. This indicator is less sensitive to changes in value added and captures the structure of value chains through an index that is proportional to the actual number of production stages (Fally, 2012[17]; Antràs et al., 2012[18]). On average in OECD countries and in the United States, there is a slight trend towards more domestic production stages after 2015. It was also the case in Japan (starting earlier in 2014) but the ratio is increasing again in 2018. The economy where there is a clear 'reshoring' of activities is actually China. As compared to the middle of the 2000s, Chinese value chains are significantly more domestic. It is not reshoring in the sense of production previously offshored going back to China, but it captures the upgrading of China in value chains and the substitution of foreign inputs by domestic inputs. EU economies show no sign of reshoring with the number of foreign production stages being at its highest level in 2017-2018.

Figure 6. Ratio of foreign to domestic production stages, 1995-2018, main economies

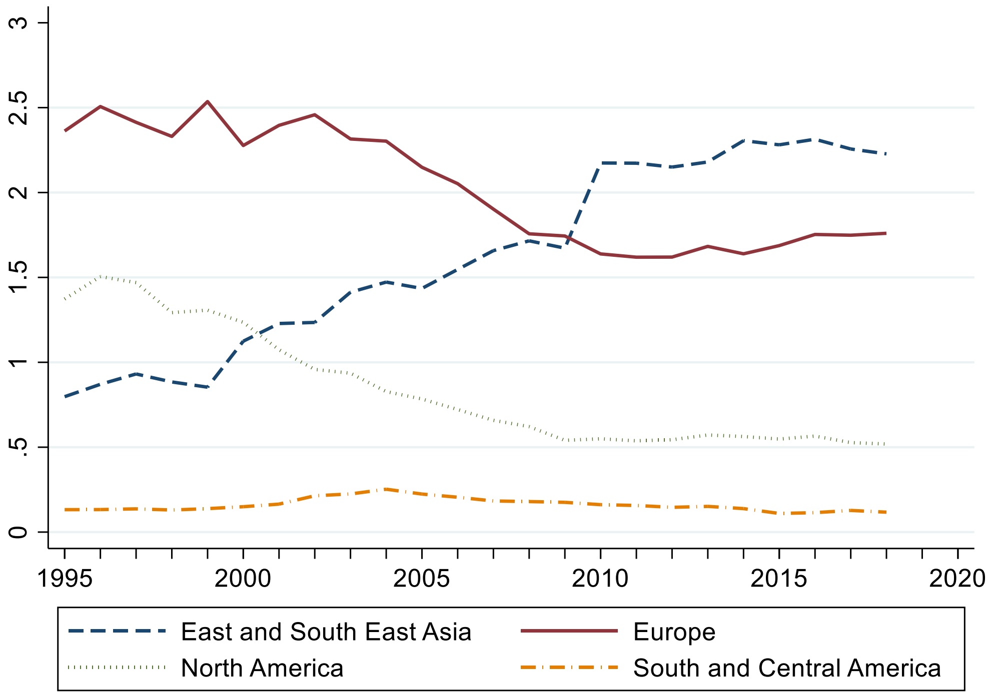


Note: Data are in constant prices, base year 1995.
Source: Authors' calculations based on OECD ICIO tables in previous year's prices.

When looking at the number of production stages, there is no evidence of a regionalisation of value chains after 2011, except for Europe where the ratio of regional to extra-regional foreign production stages has slightly increased (Figure 7). But looking at data back to 1995, there is a clear trend towards the regionalisation of value chains in East and South East Asia. However, most of the increase in the ratio of regional to extra-regional production stages took place before 2011. In Europe and North America, value chains became less regional between 1995 and 2011, the expansion of GVCs happening mostly trough trade across continents. In 2018, there are 2.2 regional production stages for each extra-regional production stage in East and South East Asia. This ratio is higher than in Europe. An analysis in value added terms (i.e. accounting for the value generated in each regional and extra-regional foreign production stage and not just their number) would show a higher share of regional value added in European GVCs.[3] Trends are however similar over time when comparing data in terms of number of foreign production stages and foreign value added.

[3] Note also that the comparison is sensitive to the definition of each region and the fact that East and South East Asia are grouped together on Figure 7.

Figure 7. Ratio of regional to extra-regional foreign production stages, 1995-2018, by region



Note: Data are in constant prices, base year 1995.
Source: Authors' calculations based on OECD ICIO tables in previous year's prices.

3.4. The concentration of supply has slightly decreased and is lower in value chains that are highly fragmented

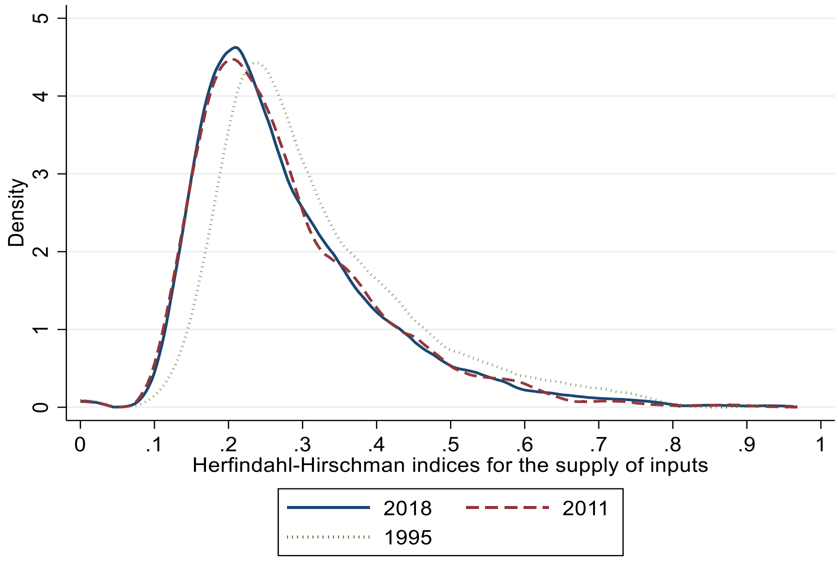
Another issue discussed in the context of the debate on the vulnerabilities of supply chains is the geographic concentration of supply. Such concentration should be assessed at a more disaggregated level than allowed by the ICIO data. Supply can look diversified for broad industries but with each firm relying on different types of inputs sourced from a limited number of countries. However, an analysis at the aggregate level is still useful to provide insights on the evolution of concentration and to compare industries and countries.

Figure 8 shows the distribution of normalised Herfindahl-Hirschman indices for the supply of inputs in all countries and industries included in the ICIO tables. This index takes the value of 1 when there is full concentration (i.e. a single country and industry provides all inputs) and a value of zero when the supply is fully diversified (i.e. all countries and industries participates equally in the supply chain, providing the same quantity of inputs). Over the years, the supply of inputs has become more diversified (distribution curves are shifting to the left).

We can also plot these distributions for two groups of industries and countries: those highly involved in GVCs (based on their fragmentation index) and those that are more focused on domestic supply (Figure 9). As expected, the concentration of supply is much higher (distribution skewed towards higher indices) when firms are relying less on international sourcing. Participation in GVCs is a source of diversification of supply and companies that have foreign suppliers tend to source their inputs from a broader range of countries and industries.

Figure 8. Concentration of supply in all countries and industries: 1995, 2011 and 2018

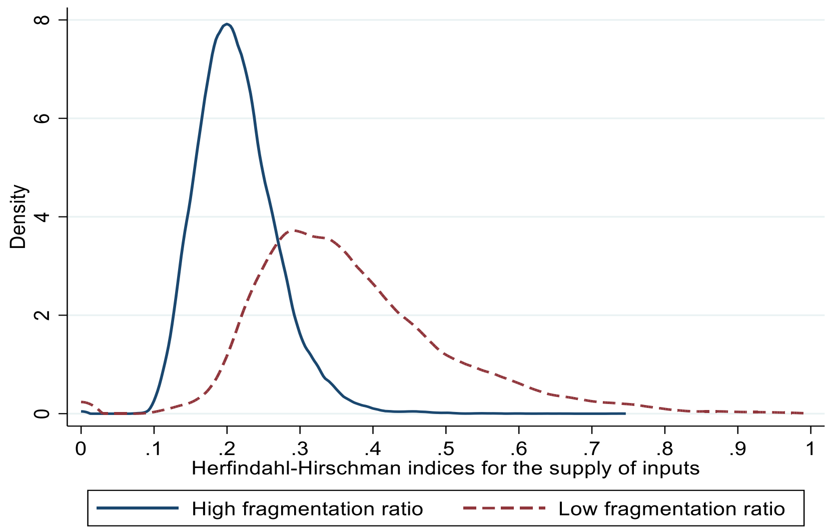
Distribution of normalised Herfindahl-Hirschman indices



Note: A value of 1 indicates full concentration (i.e. a single country and industry supplying all inputs) while zero means that all countries and industries supply the same quantity of inputs (full diversification).
Source: Authors' calculations based on OECD ICIO tables in current and previous year's prices.

Figure 9. Concentration of supply: high fragmentation versus low fragmentation industries

Distribution of normalised Herfindahl-Hirschman indices



Note: A value of 1 indicates full concentration (i.e. a single country and industry supplying all inputs) while zero means that all countries and industries supply the same quantity of inputs (full diversification).
Source: Authors' calculations based on OECD ICIO tables in previous year's prices.

Source: Authors' calculations.

4. Concluding remarks

The results of this paper have highlighted the importance of using constant prices to look at the evolution of GVCs over time and to address the debate on the slowdown in globalisation. When using pyp ICIO tables, there is no evidence of a deglobalisation following the 2008-2009 Financial Crisis. The level of the international fragmentation of production remains high and 2018 (last year available in the data) is a new peak for this indicator.

However, there is clearly a slowdown in the expansion of GVCs since 2011. Understanding the reasons why the expansion of GVCs has stopped is an important analytical question that was not answered in this paper but that can be addressed with the new data presented. In particular, a legitimate question is whether the fragmentation of production has not reached some threshold where the extra costs of further fragmenting value chains are no longer compensated by the economic gains related to trade, specialisation and economies of scale. Since the world has also entered a new period with more uncertainties and fundamental shifts in production related to climate change and the digital transformation, another explanation could be that trade costs and frictions in value chains are higher and have diminished the economic gains of the fragmentation of production. Further work is needed to understand the determinants of the changes observed in the data introduced in this paper.

The period covered by OECD ICIO pyp tables will be extended to 2020 following the forthcoming update of the OECD TiVA database and its underlying ICIO tables. These data will include the last year before COVID-19 (2019) and the first year of the pandemic. Better estimates will also be included for 2017 and 2018 based on more recent input-output information released by national statistical offices. As structural changes in value chains are very slow, it is not expected that these new data will significantly change the analysis and conclusions. But 2020 will also give an indication of the impact on GVCs of the trade collapse related to COVID-19.

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