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Positioning in Global Value Chains: World Map and Indicators.

A new dataset available for GVC analyses

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Abstract

Recently, a strand of the international trade literature has developed measures of the positioning of countries and industries in Global Value Chains (GVCs) using the global Input-Output tables. These measures allow scholars from different research fields to conduct qualitative and quantitative analyses on GVCs, at the aggregate and sectoral level, and inform policymaking. To compute these indicators, a common approach is to consider the extent to which a country-industry pair sells its output for final use to consumers worldwide or instead sells intermediate inputs to other producing sectors in the world. Following this approach, we compute and make available to scholars a new dataset of GVC positioning indicators at the country-industry level based on the most used global Input-Output tables (WIOD, OECD, EORA, ADB). Specifically, we compute two popular measures: i) a measure of distance or *upstreamness* of a production sector from final demand, which was developed by Fally (2012), Antràs et al. (2012), and Antràs and Chor (2013, 2019); and ii) a measure of distance or *downstreamness* of a given sector from the economy's primary factors of production (or sources of value-added), originally proposed by Fally (2012). These indicators are "ready-to-use" and can be freely downloaded from here (https://www.tradeconomics.com/position/). This work illustrates the indicators included in this new open access dataset and the methodologies applied, and provides an international comparison, by sectors and countries, of GVC positioning measures and their evolution over time. Lastly, we propose an empirical exercise to test the consistency of these measures with trade theory.

Keywords: Global Value Chain, positioning indicators, upstreamness, downstreamness, international trade, country-sector analysis, data.

JEL codes: D57, F14, O50

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1. Introduction

Over the last decades, the world economy experienced a radical transformation through a significant fragmentation in the production of goods and services and a deeper international division of labour, resulting in larger returns from specialisation. This transformation, which has been called the "Age of Global Value Chains" (World Bank, 2020, Antràs and Chor, 2022), has had remarkable effects worldwide via changes in income, productivity, and poverty (World Bank, 2020).

Scholars have developed various indicators to map and measure the degree of participation of countries and sectors in GVCs, that is being involved in at least one stage in GVCs (see, among others, Hummels et al., 2001; Johnson and Noguera, 2012; Koopman, Wang and Wei, 2014; Borin et al., 2021). A parallel body of work looks instead at the country and/or sectoral positioning *within GVC*, that is whether a given country (or industry) is specialised in relatively upstream activities or activities that are more proximate to final demand (see Fally, 2012; Antràs et al., 2012; Antràs and Chor, 2013; Fally and Hillberry, 2015; Miller and Temurshoev, 2017; Wang et al., 2017; Alfaro et al., 2019).[1] Such notions of production staging are important as they can contribute to model productivity differences or geography or firm organisational decisions demonstrating that these choices are not merely a function of marginal costs (see Antràs and Chor, 2022, for details). Together with the GVCs participation indicators, these positioning measures help enrich and complete empirical analyses on GVCs and inform policymaking.

This paper aims to review and compute the most common GVC positioning indicators used in the empirical literature and provide scholars with a new global dataset of upstreamness and downstreamness measures for the largest number of countries – including most developing countries – and sectors and for the longest time span. Specifically, we provide GVC positioning indicators for all the economies and industries available in the most used Inter-Country Input Output (ICIO) tables, namely ADB MRIO (ADB mrio.adbx.online); EORA (Lenzen et al., 2013); OECD TiVA (oe.cd/tiva); WIOD (Timmer et al., 2015); WIOD Long Run (Woltjer et al., 2021). This vast and comprehensive dataset is available at the following link https://www.tradeconomics.com/position/. It complements the already available database on GVC participation measures by the World Bank WITS (Borin et al., 2021). Using these new measures, scholars can investigate the evolution of GVC positioning over time, at both the country and industry levels, and provide an international comparison. The key added value of this work is that scholars working on the topic of GVC and belonging to different research disciplines – economic sociology, international economics, economic geography, international

[1] This definition is sufficiently broad to encompass various possible structures and distinctive characteristics of different GVCs (Antràs and Chor, 2022).

political economy, supply chain management and international business – will benefit from these ready-to-use indicators, without necessarily getting into technicalities and performing matrix calculations.

Specifically, we compute two measures: 1) a measure of distance or *upstreamness* of a production sector from final demand, which was developed by Fally (2012), Antras et al. (2012), and Antras and Chor (2013, 2019). This measure captures the average number of production stages by pegging the endpoint of the sequence at final consumption, which enables us to measure the distance to the final demand of a product (or a country) along the production chains; 2) a measure of distance or *downstreamness* of a given sector (or a country) from the economy's primary factors of production (or sources of value-added), originally proposed by Fally (2012). This measure is based on a country-industry pair's use of intermediate inputs and primary factors of production. To the best of our knowledge, this is the first work that computes GVC positioning indicators for such a large set of countries and sectors and makes them freely available to scholars. This paper illustrates the indicators included in this new open access dataset and the methodologies applied, and provides an international comparison, by sectors and countries, of these indicators and their evolution over time. Lastly, we provide a validation test by establishing the correlation of our measures of GVC position with some selected core determinants derived from trade theory, namely trade costs and expenditure shares.

The structure of the paper is as follows. Section 2 illustrates the approach and data used to construct the GVC indicators, Section 3 presents some stylised facts, Section 4 explains the empirical analysis and comments on the outcomes, and Section 5 concludes.

2. Measuring GVCs positioning: the upstreamness and downstreamness indicators

To compute the upstreamness or downstreamness of specific industries and countries a common approach is to consider the extent to which a country-industry pair sells its output for final use to consumers worldwide or instead sells intermediate inputs to other producing sectors in the world. A sector that sells disproportionately to final consumers would appear to be downstream in value chains. In contrast, a sector that sells little to final consumers is more likely to be upstream in value chains.

Following this approach, in this work, we have computed two measures of GVC positioning that are the most popular in the literature. The first indicator is a measure of distance or upstreamness of a production sector from final demand, which was developed by Fally (2012), Antras et al. (2012) and Antras and Chor (2013).[2] Fally's model, as well as the variation proposed by Antràs et al. (2012), captures the average number of production stages by pegging the

[2] Though the arguments used to develop the index differ in Fally (2012) and Antràs and Chor (2013), Antràs et al. (2012) emphasize that the resulting indexes are equivalent.

endpoint of the sequence at final consumption, which enables us to measure the *distance to the final demand* of a sector along the production chains. More specifically, this measure (labelled U in Antras and Chor, 2019 and given the same name in our dataset) aggregates information on the extent to which "an industry in a given country produces goods that are sold directly to final consumers or that are sold to other sectors that themselves sell disproportionately to final consumers. A relatively upstream sector is thus one that sells a small share of its output to final consumers and instead sells disproportionately to other sectors that themselves sell relatively little to final consumers" (Antras and Chor, 2019). Building on these ideas, final goods can be considered one step away from demand, inputs directly used to produce final goods are two steps away from demand, inputs used to produce inputs are three steps away from demand, and so on. Furthermore, this count is weighted by the share of the value of output at each production stage in total output. The U indicator can assume values equal to or greater than 1: larger values are associated with relatively higher levels of upstreamness of the output originating from one sector.

The second measure, originally proposed by Fally (2012), is based on a country-industry pair's use of intermediate inputs and primary factors of production. It captures the distance or downstreamness of a given sector from the economy's primary factors of production (or sources of value-added). According to this measure (labelled D), an industry in each country is downstream if its production process embodies a larger value of intermediate inputs relative to its use of primary factors of production. Conversely, if an industry relies disproportionately on value-added from primary factors of production, then this industry is relatively upstream. The D indicator can assume values equal to or greater than 1: larger values are associated with relatively higher levels of downstreamness of an industry.[3]

We calculated the positioning indicators by using the intermediate use matrix (Z), the final demand matrix (FD) and the value-added matrix (VA). Following Antràs *et al* (2012) and Antràs and Chor (2019), we first perform a "net inventory" correction. This correction consists of imputing N_i^r changes in inventories in country i, sector r, to each Z_{ij}^{rs} intermediates sold by country *i* sector *r* to country *j* sector *s*, and FD_{ij}^r final goods in sector *r* sold by *i* to *j*, by applying a multiplicative factor equal to $Y_i^r/(Y_i^r - N_i^r)$ where Y_i^r is the gross output in sector *r* in country *i* and is computed as follows:

$$Y_i^r = \sum_{s=1}^{S} \sum_{j=1}^{J} Z_{ij}^{rs} + \sum_{j=1}^{J} FD_{ij}^r \quad [1]$$

[3] In addition, following Antras and Chor (2019), we have also calculated simpler versions of these two measures of GVC positioning. The first one (labelled F/GO) reduces the indicator in Antras et al. (2012) to the share of a country-industry's output that is sold directly to final consumers. A lower value of this ratio is associated with a higher upstreamness from final use. The second one (called VA/GO) reduces the Fally (2012) measure of distance from value-added to the share of a country-industry's payments accounted for by payments to primary factors. Large values of this measure are associated with lower downstreamness or higher upstreamness.
These simpler versions of the two measures of GVC positioning are also available upon request from the authors.

In order to measure sectoral upstreamness, we adopt the U_i^r index by Antràs and Chor (2013). Since $Y_i^r = \sum_{s=1}^{S}\sum_{j=1}^{J} a_{ij}^{rs} Y_j^s + FD_i^r$ (where $a_{ij}^{rs} = Z_{ij}^{rs}/Y_j^s$ is the dollar amount of sectors r's output from country i needed to produce one dollar worth of industry s's output in country j), by iterating such identity, we can express industry r's output in country i as an infinite sequence of terms as follows:

$$Y_i^r = FD_i^r + \sum_{s=1}^{S}\sum_{j=1}^{J} a_{ij}^{rs} FD_j^s + \sum_{s=1}^{S}\sum_{j=1}^{J}\sum_{t=1}^{S}\sum_{k=1}^{J} a_{ij}^{rs} a_{jk}^{st} FD_k^t + \cdots \qquad [2]$$

As in Antràs and Chor (2019) we compute the weighted average position of each country/sector pair by multiplying each term by its respective production-staging distance from final use plus one and dividing everything by Y_i^r. This means that the first term in equation (2), representing the production stage destinated to final consumption, is multiplied by 1, the second term in equation (2), representing the production stage one step before the completion of final good, is multiplied by 2, and so on. Building on such identity, the upstreamness index can be expressed as follow:

$$U_i^r = 1 * \frac{FD_i^r}{Y_i^r} + 2 * \frac{\sum_{s=1}^{S}\sum_{j=1}^{J} a_{ij}^{rs} FD_j^s}{Y_i^r} + 3 * \frac{\sum_{s=1}^{S}\sum_{j=1}^{J}\sum_{t=1}^{S}\sum_{k=1}^{J} a_{ij}^{rs} a_{jk}^{st} FD_k^t}{Y_i^r} + \cdots \quad (3)$$

It can be shown that in matrix notation this corresponds to:

$$U = [I - A]^{-2} FD_i^r \oslash [I - A]^{-1} FD_i^r \qquad (4)$$

Where A is J*S, J*S matrix of the a_{ij}^{rs}s whereas $\oslash$ refers to an elementwise division.

As for downstreamness, following Antràs and Chor (2013), we adopt the D_j^s measure. Since $Y_j^s = \sum_{r=1}^{S}\sum_{i=1}^{J} Z_{ij}^{rs} + VA_j^s = \sum_{r=1}^{S}\sum_{i=1}^{J} b_{ij}^{rs} Y_i^r + VA_j^s$ (where $b_{ij}^{rs} = Z_{ij}^{rs}/Y_i^r$ is the share of sectors r's output in country i that is used in industry s in country j), and $Y_j^s = VA_j^s + \sum_{r=1}^{S}\sum_{i=1}^{J} b_{ij}^{rs} VA_i^r + \sum_{r=1}^{S}\sum_{i=1}^{J}\sum_{t=1}^{S}\sum_{k=1}^{J} b_{ki}^{tr} b_{ij}^{rs} VA_k^t + \cdots$, analogously to the upstreamness case, we compute downstreamness as follows:

$$D_j^s = 1 * \frac{VA_j^s}{Y_j^s} + 2 * \frac{\sum_{r=1}^{S}\sum_{i=1}^{J} b_{ij}^{rs} VA_i^r}{Y_j^s} + 3 * \frac{\sum_{r=1}^{S}\sum_{i=1}^{J}\sum_{t=1}^{S}\sum_{k=1}^{J} b_{ki}^{tr} b_{ij}^{rs} VA_k^t}{Y_j^s} + \cdots \quad (5)$$

In equation (4) each element is multiplied by the production stage distance from primary factors plus one and divided by country s gross output in sector j. In matrix notation:

$$D = [I - B]^{-2} VA_j^s \oslash [I - B]^{-1} VA_j^s \qquad [6]$$

Where B is J*S, J*S matrix of the b_{ij}^{rs} whereas $\oslash$ refers to an elementwise division.

These measures were originally used to know where single industries are located along global value chains. Nevertheless, they can be aggregated at the country, global industry and global aggregate level. As a matter of fact, at the global aggregate level, upstreamness and downstreamness coincide and are a proxy for global production complexity *(*Antràs and Chor, 2019).

3. Data sources

ICIO tables provide a comprehensive map of international transactions of goods and services in a large dataset that combines, in one coherent accounting framework, the national input-output tables (representing financial transactions between economic sectors within a country) of various countries at any given time with trade flow tables (showing the value of exports and imports by country and economic sector). As these tables contain information on supply–use relations between industries and across countries, thanks to them we can identify the vertical structure of international production sharing and measure cross-border value flows for a country or region (Inomata, 2017).

Since the early 2000s, various research initiatives have undertaken the development of different ICIO databases. The main differences lie in data sources, country coverage, time span, level of sectoral disaggregation, and methodological choices. Despite their increasing widespread use in economic research, ICIO tables share some shortcomings. First, because they rely on aggregated input-output data, the resulting sectoral disaggregation of GVC flows is rough. As a result, data sources miss a notable amount of GVC related trade activities taking place among sectors. Second, in constructing the tables, researchers are forced to impose strong assumptions to back out some bilateral intermediate input trade flows that cannot be readily read from either customs data or national IO tables, leading to relevant aggregation biases (De Gortari, 2019; Antràs, 2020). We refer, for instance, to the "proportionality assumption" which – due to the lack of data on the destination industries of international trade flows – implies identical trade shares for all input purchasing industries (i.e., imported commodities are proportionally distributed over the target sectors) and the "production assumption", which says that because of the aggregation level, each industry grouping produces all its different outputs using a single production function.[4]

Nevertheless, ICIO tables have recently become an indispensable tool for economists studying GVCs, as they can be used to measure how countries and sectors participate in GVCs and several features of GVC linkages (Antràs, 2020; Antràs and Chor, 2022).

We provide here https://www.tradeconomics.com/position open access to positioning measures computed using the following ICIO datasets: EORA, OECD TiVA, WIOD, Long-run WIOD, and ADB.

The EORA Global Supply Chain Database (Lenzen et al, 2012; and Lenzen et al, 2013) - constructed by a team of researchers at the University of Sydney - provides a set of both national

[4] More recent ICIO tables have sought to improve on this standard methodology, with a key step being to construct different proportionality weights for flows of imported intermediates and final goods respectively. The WIOD, the OECD-ICIO, as well as the most recent GTAP editions, have each implemented this approach.

and global input-output tables covering 189 countries from 1990 to 2015. More specifically, we refer to EORA26, a simplified model where all countries have been aggregated to a common 26-sector harmonized classification (International Standard Industrial Classification of Economic Activities – ISIC - Rev. 3), and the supply-use tables from the full EORA MRIO have been converted to symmetric product-by-product IO tables. This dataset thus contains only symmetric product-by-product and industry-by-industry IO tables (see Table A1 in the Appendix) (https://www.worldmrio.com).

The OECD Trade in Value Added (TiVA) database is a collection of principal indicators that track the origins of value added in exports, imports and final demand for the years 1995-2018. The current 2021 edition covers 66 economies (including all OECD, EU and G20 countries and most East and Southeast Asian economies) as well as region aggregates. Indicators are available for 45 industries within a hierarchy based on ISIC Rev. 4.

The indicators are derived from the OECD's Inter-Country Input-Output (ICIO) Database (http://oe.cd/icio).

The World Input-Output Database (WIOD) (Timmer et al., 2015) – 2016 release - covers 43 countries for the period 2000-2014. Data for 56 sectors are classified according to the ISIC Rev. 4. These tables have been constructed on the basis of officially published input-output tables in conjunction with national accounts and international trade statistics (https://www.rug.nl/ggdc/valuechain/wiod).

The Long-run WIOD (Woltjer et al., 2021) covers the period 1965-2000. It includes World-Input-Output Tables (WIOTs) covering 25 countries and 23 sectors (according to the ISIC Rev. 3.1.) (https://www.rug.nl/ggdc/valuechain/long-run-wiod).

The ADB multi-region I-O database (ADB MRIO) has been developed by the Asian Development Bank. It is basically an extension of the WIOD to facilitate analysis work related to Asia and the Pacific Region. Nineteen Asian countries have been added into WIOD for the years 2000, 2007 to 2019. They are: Bangladesh, Bhutan, Brunei Darussalam, Cambodia, Fiji, Hong Kong, China, Kazakhstan, Kyrgyz Republic, Lao People's Democratic Republic, Malaysia, Maldives, Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, and Viet Nam. The current ADB MRIOTs cover 62 economies, including 25 Asian economies. Notably, the data provided for these countries are derived from estimations produced by researchers and do not refer to official statistics (https://mrio.adbx.online).

In what follows, given our interest in global analysis, we focus on the EORA26 data, as it is the only source that covers the entire global economy.[5]

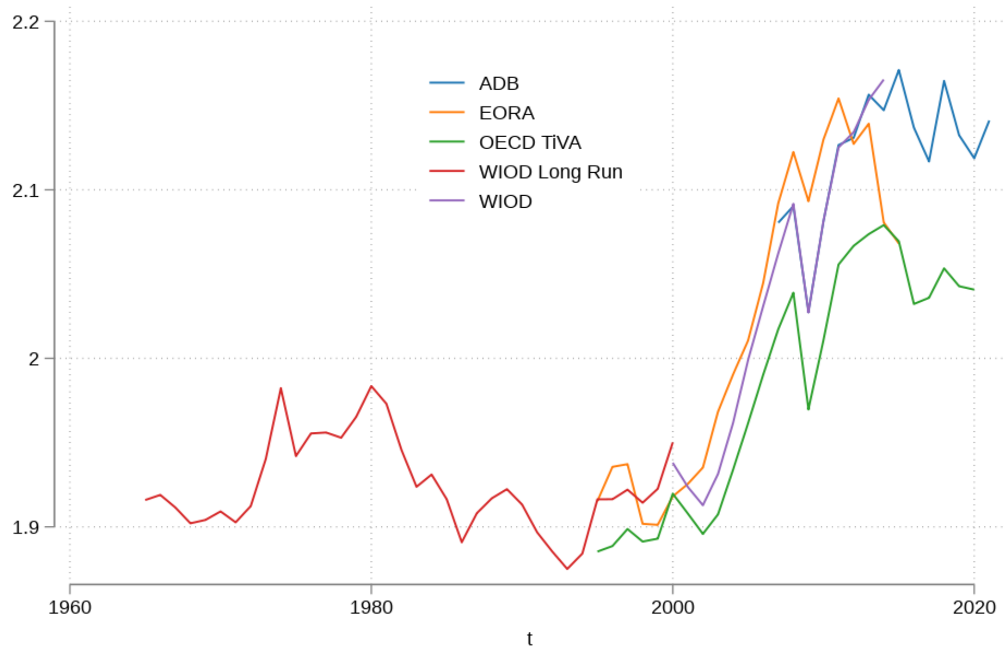
[5] Although data are available since 1990, our analysis focuses on the period 1995-2015 to exclude the period of the transition to market economies of former Eastern bloc. Furthermore, due to some inconsistencies in the Eora data, Sudan and Zimbabwe are not included in the database.

4. Descriptive statistics

In this section, we use the computed GVC positioning indicators to map the evolution of positioning of countries and sectors over time, highlighting some key descriptive patterns.

Figure 1 provides an overview of our GVC positioning indicators computed as simple world average from the various available sources. As clarified above, at the global aggregate level, upstreamness and downstreamness coincide and are a proxy for global production complexity (Antràs and Chor, 2019). Fig. 1 shows, overall, that GVC positioning is increasing over time, especially in the last two decades and that the same trend is common to all the datasets considered. This empirical evidence is consistent with the assumption that GVCs are getting longer as a result of a rise in cross-border intermediate sales and purchases caused by an increase in the inter-country network complexity effects (Miller and Temurshoev, 2017; Wang at al., 2017; Antràs and Chor, 2019). This overall picture also suggests that GVCs have become more complex since the average global production chain “length" from primary factors to a specific country and onward from that country to final demand, have both increased (reaching a peak of around two stages away from each endpoint at the global level in 2011). Following the macroeconomic dynamics, both measures rise at the turning of the century and decreased in 2009 – probably as a consequence of the 2007-08 worldwide financial crises. Conversely, thanks to the use of updated trade in value added data, Fig. 1 also shows that in the most recent years (after 2011) the phenomenon of fragmentation seems losing ground. This is important empirical evidence, likely related to the dynamics of bilateral trade costs and expenditure shares, to be better explored in subsequent empirical analyses.

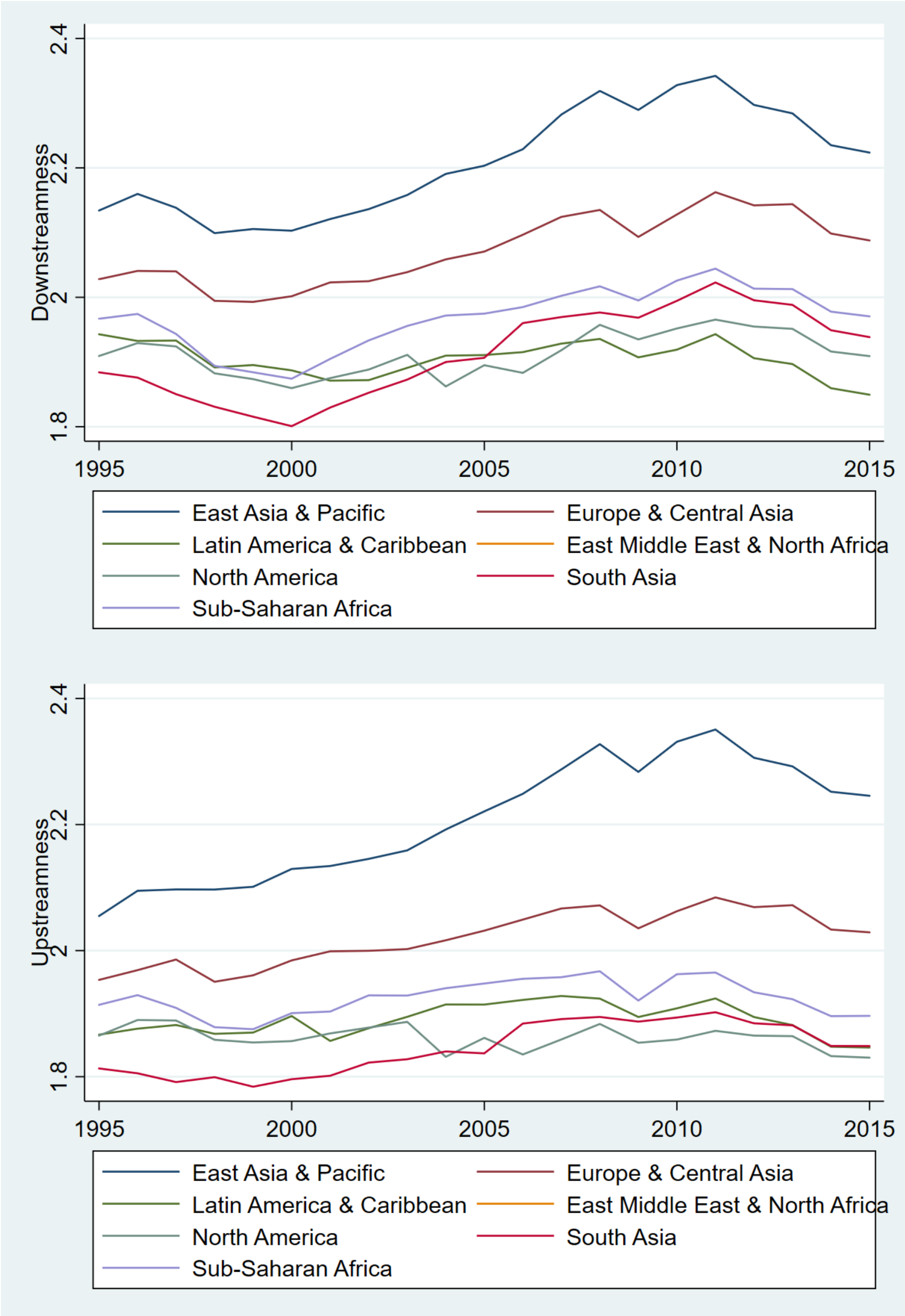
Figure 1 - GVC Positioning over time (world average)



Source: Authors' elaboration using data from all datasets.

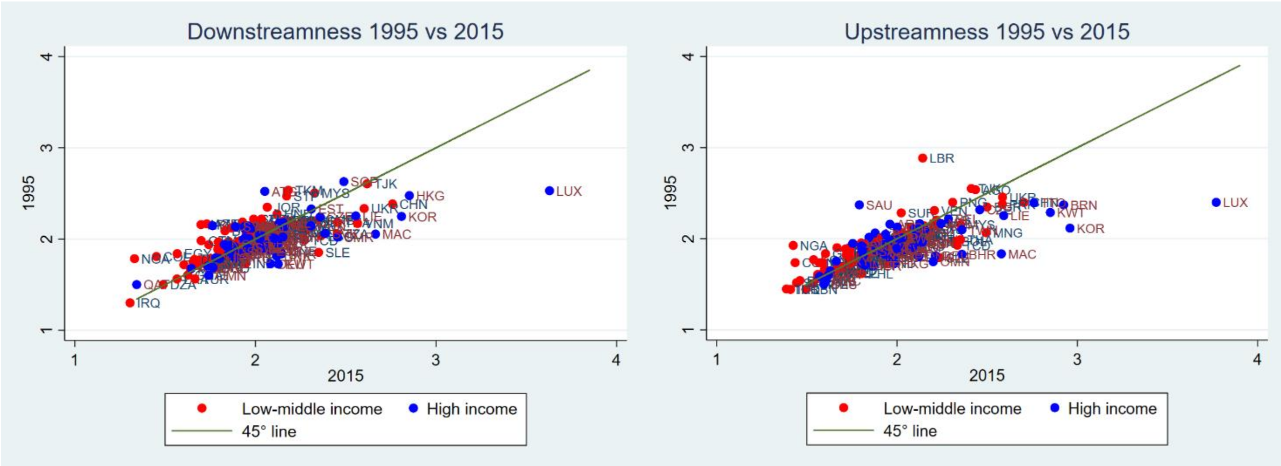
Further details are provided in *Figure 2* showing the evolution of Downstreamness and Upstreamness by world regions. The trend over time is quite similar for all the regions although with different magnitudes. East Asian and Pacific countries are those that experience the highest level of involvement in GVC, in particular for the upstreamness metrics. On the other hand, while Southern Asian countries reported in 1995 the lowest values of both downstreamness and upstreamness, they show the best performance in climbing the ladder overtaking the North American economies at the end of the period.

Figure 2- GVC Positioning by region over time



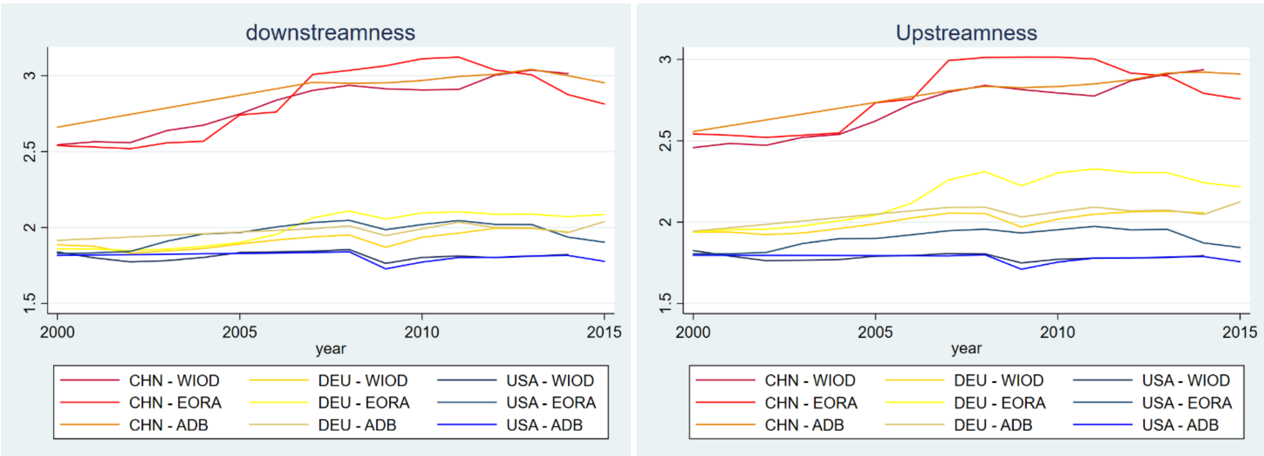
Source: authors' elaboration using EORA26 data.

Figure 3 - GVC Positioning measures by income group and their correlation over time – 1995 and 2015.



Source: authors' elaboration using EORA26 data.

Figure 4 - GVC Positioning measures for China, Germany and USA: a comparison across WIOD, EORA and ADB data



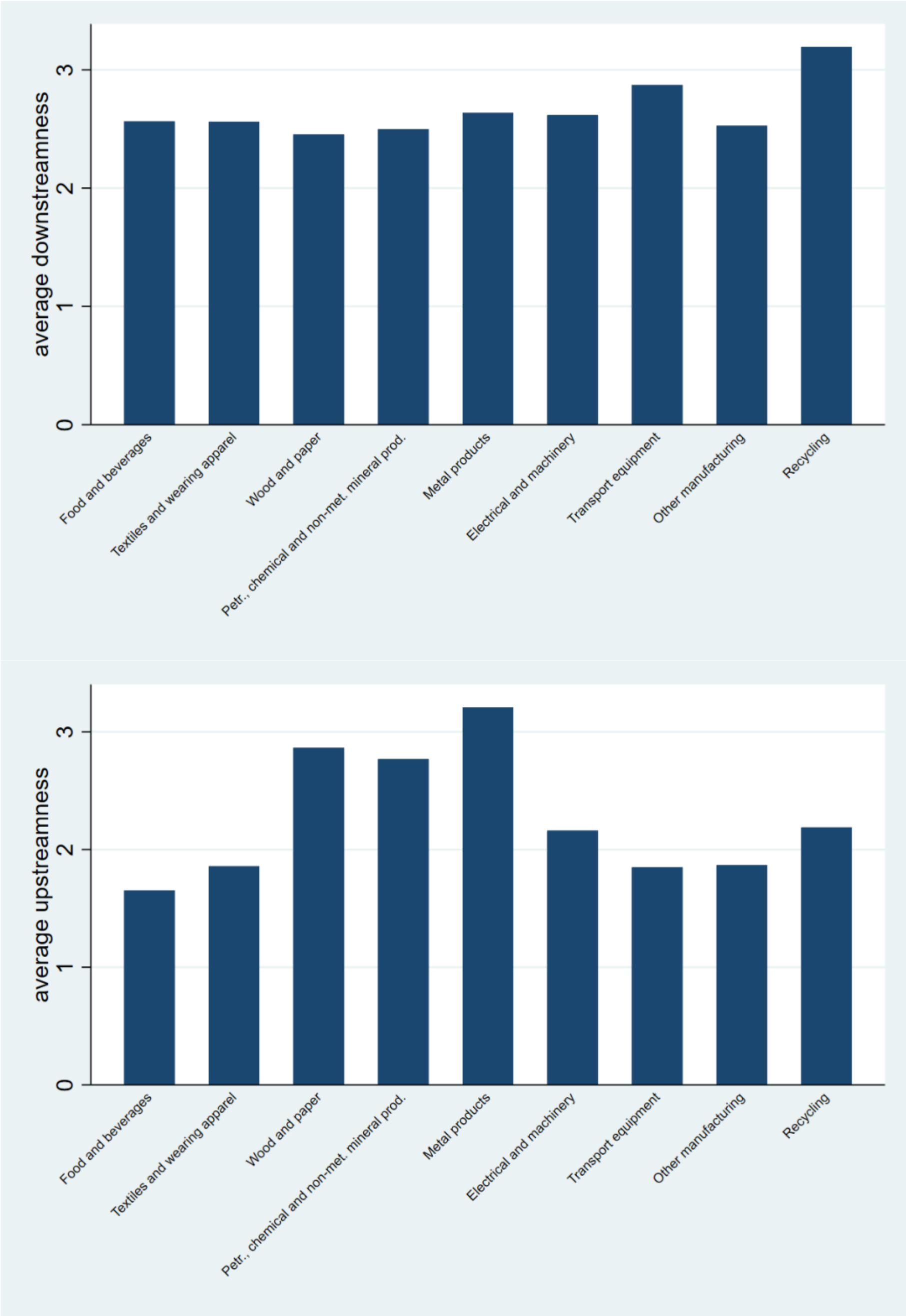
Source: Authors' elaboration.

Figure 3 shows the plot of Downstreamness and Upstreamness metrics at the beginning and at the end of the period under scrutiny. Looking at the position of countries with respect to the 45 degrees line, it is possible to identify which countries have changed their relative position in GVCs over the period. Both Downstreamness and Upstreamness plots show that, in general, more advanced economies have shifted their production towards more 'extreme' sectors: most of the countries below the 45° line – thus those countries which have experienced an increase in the positioning metrics – are high income. On the opposite, most of the countries beyond the 45° line are low-middle income economies, suggesting that such countries have shifted towards less upstream and less downstream sectors.
Figure 4 provides a comparison of the dynamics of our indicators for those countries that appear in more than one dataset for the overlapping periods. Although the figures, as expected, are different in detail, both the level gaps and the evolution of the time trends look highly consistent across the various datasets. To note that at the country level the degree of heterogeneity increases (e.g., as expected China is positioned three steps away from each endpoint whereas USA about 1.5 steps on average in all the available datasets).[6]

Figure 5 finally reports the overall levels of the two measures of positioning for each industrial sector considered in the EORA26 (see Table A2 in the Appendix for the descriptions of sectors). *Recycling*, as expected, is the most downstream sector, with a value higher than 3 while *Metal products* sector is the most upstream one. A high degree of downstreamness is found for transport equipment (D index slightly lower than 3) whereas all the other sectors have D values higher than 2.5. *Figure 5* shows high levels of upstreamness also for *Wood and paper* as well as *Petroleum, chemical and non-metal mineral products*, two sectors usually involved the first stages of global value chains. On the other hand, sectors such as *Food and beverage*, *Textile and wearing apparels* and *Transport equipment* result to be relatively upstream sectors.

[6] To be noted that in this setting the registered increase in GVC positioning can be both due to GVCs overall lengthening or countries' upgrading patterns.

Figure 5 - GVC Positioning by sector (world average, 1995-2015)



Source: authors' elaboration using EORA26 data.

5. A validation test

A key limitation of the positioning literature is the lack of a theoretical foundation within the realm of modern general equilibrium models of international trade (Antràs and Chor, 2022). Exceptions are the works of Antràs and de Gortari (2020), de Gortari (2019), Antràs and Chor (2019), who develop multi-country models that emphasize the sequential nature of trade flows in GVCs. This latter is inspired by Caliendo and Parro (2015) 's multi-industry extension of Eaton and Kortum (2002) Ricardian model of international trade. The Caliendo and Parro (2015)'s framework features input trade and inter-sectoral linkages. However, they used a "roundabout structure" assuming that goods are produced via an endless sequence of steps in an infinite loop (Antràs and Chor, 2022). Furthermore, all producers in a given sector are supposed to use the same bundle of inputs and operate the same technology, regardless of the stage of production (proportionality and production assumptions, respectively). Antràs and Chor (2019) specify the multistage production technologies featuring a discrete number of stages that add value in a pre-determined order. This way they are able to match the type of data available in ICIO tables with a small subset of primitive parameters of the model, namely, initial trade shares, demand and technological parameters, sectoral elasticities of trade flows to trade barriers.[7]

Starting from the model of Antràs and Chor (2019), we present a validation test of our positioning indicators showing that, on average, they are performing consistently with the theory. Specifically, we test whether changes in our GVC positioning indicators correlate with changes in trade costs and in final expenditure shares over time by countries and industries. As for trade costs, one could naturally argue that high cross-border trade costs would, in general, discourage GVCs. Antràs and Chor (2019) demonstrate that these effects compound along the chain and that firms will be more concerned about reducing trade costs in relatively downstream stages. This feature of the model generates a centrality-downstreamness nexus by which, *ceteris paribus*, relatively more central countries tend to specialize in relatively downstream stages. As a result, according to the Antràs and Chor (2019)'s model we should find empirical evidence of a negative relationship between changes in trade costs and our positioning measures. Concerning final expenditure shares, we take advantage of the presence of a distinct difference in the nature of GVC positioning between goods and service industries. Specifically, goods-producing industries are positioned in longer GVCs as they feature, on average, a lower share of their output going directly to final use than the service industries. At the same time, goods industries also exhibit a lower share of payments to primary value-added and, thus, are more downstream relative to primary factors than service industries. To test whether also this mechanism is at play, we correlate the dynamics of our positioning indicators with changes in final expenditure shares. Consistently to Antràs and Chor (2019), the relative "servification" of the global economy should be empirically confirmed by a negative correlation between final expenditure shares and positioning over time, on average and *ceteris paribus*. Furthermore, the empirical evidence of a positive time trend in the purchases of inputs from service industries should be confirmed by a positive correlation between changes in the share of payments to primary value-added and changes in our positioning indicators.

[7] This comes at the cost of an overfitting bias and the corresponding lack of out-of-sample validity (Antràs and Chor, 2022)

To measure cross-border trade costs from country *i* to country *j* in industry *r*, we extended the Head and Reis (2001) index of bilateral trade costs at the country/industry level. Furthermore, we disentangle it between trade costs incurred by intermediate inputs purchased by industry *s* (eq. 7) and final-use goods (eq.8) as follows:

$$\tau_{ij}^{rs} = \left(\frac{Z_{ij}^{rs} Z_{ji}^{rs}}{ZZ_{ii}^{rs} Z_{jj}^{rs}}\right)^{-\frac{1}{2\theta}} \quad [7]$$

$$\tau_{ij}^{rF} = \left(\frac{F_{ij}^{r} F_{ji}^{r}}{F_{ii}^{r} F_{jj}^{r}}\right)^{-\frac{1}{2\theta}} \quad [8]$$

where θ>1 is the constant elasticity of trade to iceberg trade costs. In this setting, we are assuming that within-country trade costs are equal to 1 ($\tau_{ii}^{rs} = 1$ and $\tau_{ii}^{rF} = 1$) and cross-border trade costs are symmetric ($\tau_{ij}^{rs} = \tau_{ji}^{rs}$ and $\tau_{ij}^{rF} = \tau_{ji}^{rF}$). Being C the number of countries in the dataset and S the number of sectors, τ_{ij}^{rs} is a C*S-by-C*S matrix while τ_{ij}^{rF} is a C*S-by-C matrix. In order to perform our validation test at the country-sector level, we considered the average values over column dimensions.
To measure the share of the industry *s* in the final-use expenditure of country *j* and the share of sector *r* inputs in the value of the gross output of industry *s* in country *j* we compute, respectively, eq. 9 and eq. 10 as follows:

$$\alpha_{j}^{s} = \left(\frac{\sum_{i=1}^{N} F_{ij}^{s}}{\sum_{i=1}^{N} \sum_{s=1}^{S} F_{ij}^{s}}\right) \quad [9]$$

$$\gamma_{j}^{rs} = \left(\frac{\sum_{i=1}^{N} Z_{ij}^{rs}}{Y_{j}^{s}}\right) \quad [10]$$

Being α_{j}^{s} is a S-by-C matrix and γ_{j}^{rs} a S-by-C*S matrix, in our validation test we consider the average values over column dimensions, thus obtaining sector-level information.

Tables 1 and 2 show the outcomes of our validation test for Upstreamness and Downstreamness, respectively. As expected, the coefficients of both trade costs and expenditure shares are significant in all the specifications and show the expected signs. Specifically, we find, on average and *ceteris paribus*, a negative association between changes in bilateral trade costs and changes in country/sector positioning (both upstreamness and downstreamness). As clarified above, this is consistent with Antràs and Chor (2019)'s model. Furthermore, although this negative association holds for both intermediate and final goods, increasing trade costs for intermediate inputs looks more relevant in making GVCs relatively shorter. This is, consistently with the theory, especially the case of Downstreamness.

Table 1: Baseline POLS estimates: Dependent Variable Upstreamness

	U	U	U	U	U	U	U
trade costs (interm.)	-0.113***				-0.114***		-0.115***
	(0.008)				(0.008)		(0.008)
trade costs (final-use)		-0.011***			-0.013***		-0.013***
		(0.003)			(0.003)		(0.003)
final use exp. (share)			-0.045***			-0.046***	-0.053***
			(0.008)			(0.008)	(0.008)
input-use (share)				-0.001***		-0.001***	-0.001***
				(0.000)		(0.000)	(0.000)
Constant	0.887***	0.735***	0.887***	0.716***	0.915***	0.894***	1.123***
	(0.012)	(0.007)	(0.030)	(0.001)	(0.014)	(0.031)	(0.034)
R^2	0.96	0.96	0.96	0.96	0.96	0.96	0.96
N	103,171	103,171	103,171	103,171	103,171	103,171	103,171
Country-sector FEs	YES	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES	YES

*** p < 0.01, ** p < 0.05, * p < 0.1 (clustered standard errors in parentheses).

As for the expenditure share, we also detected that our indicators of upstreamness/downstreamness correlate negatively with the shares of final expenditure and slightly positively with the share of payments to primary value-added in the case of downstreamness. This is also consistent with Antràs and Chor (2019)'s model as both these features are a sign of "*servification*" that is supposed to correspond to a reduction of positioning over time, on average and *ceteris paribus*.

Table 2: Baseline POLS estimates: Dependent Variable Downstreamness

	D	D	D	D	D	D	D
trade costs (interm.)	-0.458***				-0.459***		-0.460***
	(0.029)				(0.029)		(0.029)
trade costs (final-use)		0.002			-0.010*		-0.009*
		(0.005)			(0.005)		(0.005)
final use exp. (share)			-0.080***			-0.079***	-0.106***
			(0.015)			(0.015)	(0.015)
input-use (share)				0.001***		0.001***	0.001***
				(0.000)		(0.000)	(0.000)
Constant	1.476***	0.771***	1.082***	0.772***	1.496***	1.075***	1.904***
	(0.044)	(0.010)	(0.059)	(0.001)	(0.048)	(0.059)	(0.079)
R^2	0.84	0.83	0.83	0.83	0.84	0.83	0.84
N	103,184	103,184	103,184	103,184	103,184	103,184	103,184
Country-sector FEs	YES	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES	YES

*** p < 0.01, ** p < 0.05, * p < 0.1 (clustered standard errors in parentheses).

6. Conclusions

The availability of new indicators of GVCs positioning at the country and sectoral level offered by this work provides an unprecedented opportunity to carry out qualitative and quantitative analyses on different economic aspects related to GVCs. For the sake of future use by other scholars, we compute and provide access to a new dataset of GVC positioning indicators at the country-industry level, based on the most used global ICIO tables.

To the best of our knowledge, this is the first effort that computes GVC positioning indicators for such a large set of countries and sectors and makes them freely available to scholars. This work illustrates the indicators included in this new open access dataset and the methodologies applied, and provides an international comparison, by sectors and countries, of GVC positioning measures and their evolution over time. Lastly, we tested the consistency of our computation with trade theory.

We are confident that researchers will benefit from this work and use these indicators to refine their analysis of GVCs providing also more detailed information to policymakers.

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Appendix

Table A1: 182 countries included in the EORA database

Afghanistan	Chad	Hong Kong	Monaco	Singapore
Albania	Chile	Hungary	Mongolia	Slovakia
Algeria	China	Iceland	Montenegro	Slovenia
Andorra	Colombia	India	Morocco	Somalia
Angola	Congo	Indonesia	Mozambique	South Africa
Antigua and Barbuda	Congo, the D.R. of the	Iran, Islamic Republic of	Myanmar	Spain
Argentina	Costa Rica	Iraq	Namibia	Sri Lanka
Armenia	Cote D'Ivoire	Ireland	Nepal	Suriname
Aruba	Croatia	Israel	Netherlands	Swaziland
Australia	Cuba	Italy	Netherlands Antilles	Sweden
Austria	Cyprus	Jamaica	New Caledonia	Switzerland
Azerbaijan	Czech Republic	Japan	New Zealand	Syrian Arab Republic
Bahamas	Denmark	Jordan	Nicaragua	Taiwan, Province of China
Bahrain	Djibouti	Kazakhstan	Niger	Tajikistan
Bangladesh	Dominican Republic	Kenya	Nigeria	Tanzania, United Rep. of
Barbados	Ecuador	Korea, DPR of	Norway	Thailand
Belarus	Egypt	Korea, Republic of	Oman	Togo
Belgium	El Salvador	Kuwait	Pakistan	Trinidad and Tobago
Belize	Eritrea	Kyrgyzstan	Palestinian Terr., Occupied	Tunisia
Benin	Estonia	Lao P. D.R.	Panama	Turkey
Bermuda	Ethiopia	Latvia	Papua New Guinea	Turkmenistan
Bhutan	Fiji	Lebanon	Paraguay	USR
Bolivia	Finland	Lesotho	Peru	Uganda
Bosnia and Herzegovina	France	Libyan Arab Jamahiriya	Philippines	Ukraine
Botswana	French Polynesia	Liechtenstein	Poland	United Arab Emirates
Brazil	Gabon	Lithuania	Portugal	United Kingdom
British Virgin Islands	Gambia	Luxembourg	Qatar	United States
Brunei Darussalam	Georgia	Macao	Romania	Uruguay
Bulgaria	Germany	Macedonia, the FYR	Russian Federation	Uzbekistan
Burkina Faso	Ghana	Madagascar	Rwanda	Vanuatu
Burundi	Greece	Malawi	Samoa	Venezuela
Cambodia	Greenland	Malaysia	Sao Tome and Principe	Viet Nam
Cameroon	Guatemala	Maldives	Saudi Arabia	Yemen
Canada	Guinea	Mali	Senegal	Zambia
Cape Verde	Guyana	Malta	Serbia	
Cayman Islands	Haiti	Mauritania	Seychelles	
Central African Rep.	Honduras	Mexico	Sierra Leone	

Table A2: Eora sector classification

Industry Code	*Sector Description*
1	Agriculture
2	Fishing
3	Mining and Quarrying
4	Food & Beverages
5	Textiles and Wearing Apparel
6	Wood and Paper
7	Petroleum, Chemical and Non-Metallic Mineral Products
8	Metal Products
9	Electrical and Machinery
10	Transport Equipment
11	Other Manufacturing
12	Recycling
13	Electricity, Gas and Water
14	Construction
15	Maintenance and Repair
16	Wholesale Trade
17	Retail Trade
18	Hotels and Restaurants
19	Transport
20	Post and Telecommunications
21	Financial Intermediation and Business Activities
22	Public Administration
23	Education, Health and Other Services
24	Private Households
25	Others
26	Re-export & Re-import