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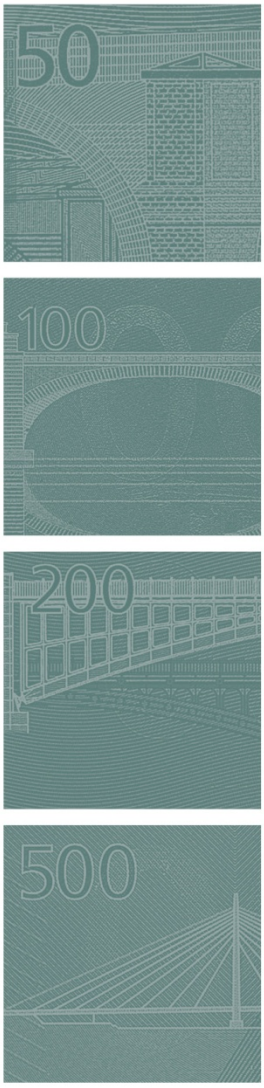

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GLOBAL VALUE CHAINS: A CASE FOR EUROPE TO CHEER UP

Filippo di Mauro, Hedwig Plamper and Robert Stehrer

COMPNET POLICY BRIEF 03/2013
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This policy brief presents research conducted within the Competitiveness Research Network (CompNet). The network is composed of economists from the European System of Central Banks (ESCB) - i.e. the 28 national central banks of the European Union (EU) and the European Central Bank – a number of international organisations (World Bank, OECD, EU Commission) universities and think-tanks, as well as a number of non-European Central Banks (Argentina and Peru) and organisations (US International Trade Commission).

The objective of CompNet is to develop a more consistent analytical framework for assessing competitiveness, one which allows for a better correspondence between determinants and outcomes.

The research is carried out in three workstreams: 1) Aggregate Measures of Competitiveness; 2) Firm Level; 3) Global Value Chains. CompNet is chaired by Filippo di Mauro (ECB). The three workstreams are headed respectively by Chiara Osbat (ECB), Antoine Berthou (Banque de France) and João Amador (Banco de Portugal). Julia Fritz (ECB) is responsible for the CompNet Secretariat.

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ABSTRACT

A higher integration of firms in global value chains is – in the public debate - often seen with suspicion and frequently made the culprit of adverse economic developments, most notably competitiveness losses, import penetration, export compression, and job shedding. New indicators based on a decomposition of value added into its domestic and foreign components are better able to assess the challenges, but also the opportunities of higher fragmentation of production, arising for instance from economies being able to serve emerging export markets, and 'climbing up the value chain', via increasing international division of labour. In the last few years there has been a strong effort to construct databases, which allow us to proxy – admittedly, still only partially - the complex interactions that are increasingly taking place in global production and supply chains. Such statistics, aimed at measuring trade in value-added terms, show in many cases a different picture than the traditional trade indicators based on gross terms.

If we apply such new indicators to Europe, the picture that emerges in terms of trade performance and competitiveness is more nuanced than standard statistics would suggest.

The European economies have by and large been able to deepen their internal integration as well as to re-orient themselves towards higher skilled and higher value-added service activities. As a corollary, substantial job opportunities by exporting are also being created in service activities (when appropriately measured), which at times more than compensate for job losses experienced in the shrinking traditional manufacturing activities. This policy brief provides few examples of such developments and offers an overview of existing new value-added based databases, which provide a basis for the improvement of our assessment on global value chains in Europe and beyond.

INTRODUCTION

The widespread internationalisation of production processes has often a negative connotation in the public discussion. Economic "hollowing out", job shedding, risk of closure of once successful iconic firms tend to be seen as the most disturbing results, while the positive effects of higher global competition and the ensuing healthy restructuring of the "affected" economies are largely overlooked.

One major reason for that is inaccurate measurement. Standard trade indicators do not take at all into consideration that economies are increasingly interconnected at all stages of the production chain. How can we continue solely utilising aggregate trade performance indicators, such as gross exports, when we know that domestic firms are increasingly outsourcing part of their production activities? Obviously, at the very least, we would need to disentangle the domestic from the foreign value-added component of such gross export, and further adjust for (value-added adjusted) market-share developments, when assessing competitiveness. And even if domestic value-added as a share of exports might be lower in such circumstances, the increasing integration in global value chains (GVCs) is a plus for the firms involved, as it allows a flexible adjustment to changes in the pattern of competitive advantages.

But if international comparisons based on gross trade indicators have become less meaningful, how can we distil its value-added (VA) component in order to measure the exact benefits and disadvantages of GVC integration? One way to handle this question is to make use of global input-output tables, which allow for a more accurate representation of the extent and the nature in which firms participate in GVCs, as well as of the related impact on value-added and other economic indicators at the individual country and even industry level.

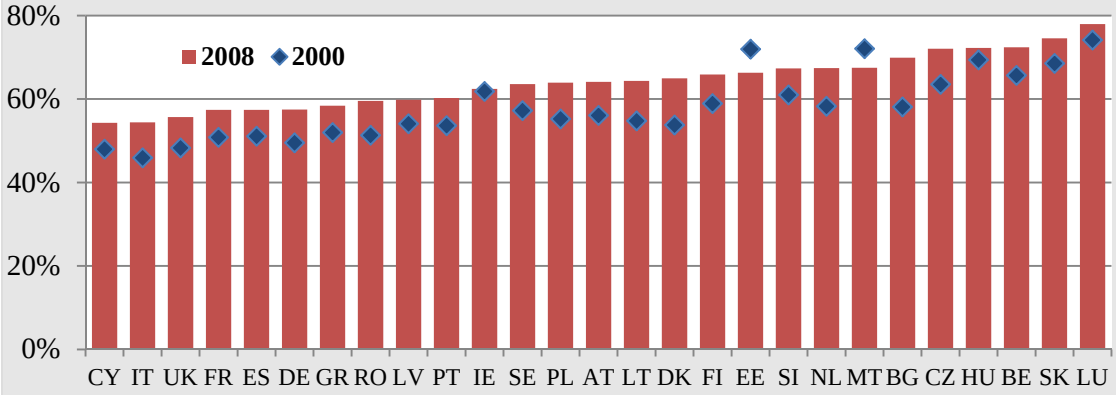
In using these new methods it has been shown, for instance, that in value-added terms the bilateral trade surplus of China vis-à-vis the EU or the US is actually a fraction of what it would appear to be in standard statistics. What is however less known is that Europe as a whole tends to emerge as a much more resilient and potentially competitive economy than traditionally portrayed, once standard economic activity and trade measures have been purged of distortions. One example shown in this policy brief is that higher integration in global supply chains by EU firms has implied, for certain countries in particular, an overall increase in employment, as the losses in manufacturing activities have been more than compensated by gains in services.

A technical appendix provides an overview of the available global input-output tables and databases on value-added trade, which form the basis of the analysis here presented.

EUROPEAN GLOBAL VALUE CHAINS ARE THRIVING

Global trade linkages have been steadily gaining in depth and importance over the last few years. This has taken the form of production processes that are much more finely fragmented across borders in order to better exploit the comparative advantages of the participating countries, both in terms of resource cost and efficiency and proximity to final destination markets. A commonly used indicator to measure this phenomenon is the so-called "GVC participation index" developed by Koopman et al. (2011), which takes into account two factors: (i) the extent in which exporters depend on foreign suppliers for intermediate inputs (i.e. the share of foreign VA in exports), and (ii) the share of domestic VA contained in foreign exports to third countries. Looking at Europe, the vast majority of countries records an increase of the index between 2000 and 2008 (Figure 1), which points to an increase in the vertical specialisation of production.[1]

Figure 1: EU countries' participation in GVCs, 2000 vs. 2008



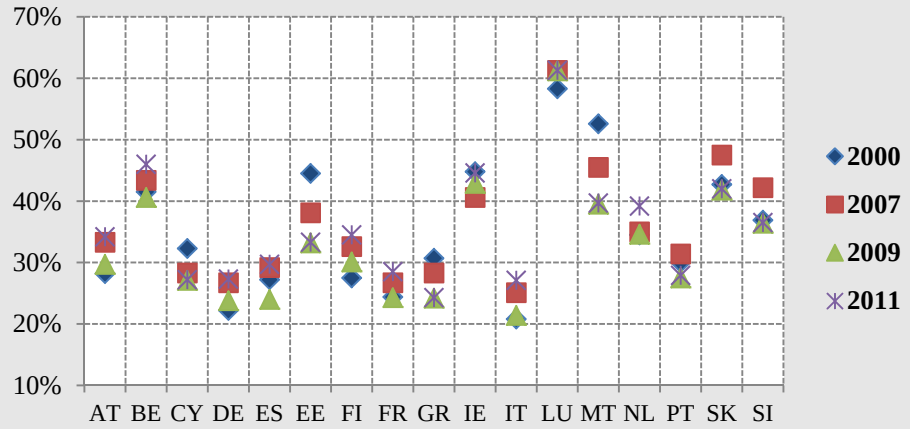
Source: ECB calculations using WIOD, based on Koopman et al. (2011)

Also, the financial crisis appears to have stopped the global integration of euro area economies only temporarily: CompNet research indeed confirms a rebound of foreign value added in exports in 2011 after a sharp contraction in 2009 (Figure 2; Amador et al., 2013). Notwithstanding this increase in global integration, the average share of foreign VA in euro area exports (e.g. broadly, the import content of exports) equalled still just over 30% in 2011.[2] This is a far cry from the fears that Europe would fail to generate continued growth in value-added while integrating into global value chains.

[1] A similar GVC participation index is calculated by Miroudot and De Backer (2013) using the OECD inter-country input-output database, which overall confirms the ordering of EU countries with regards to GVC participation in 2008. Both indices are descriptive and do not per se imply any changes in welfare arising from GVC participation.

[2] Smaller countries generally exhibit higher shares of foreign VA (e.g. over 60% in Luxembourg in 2011, a country strongly affected by financial services).

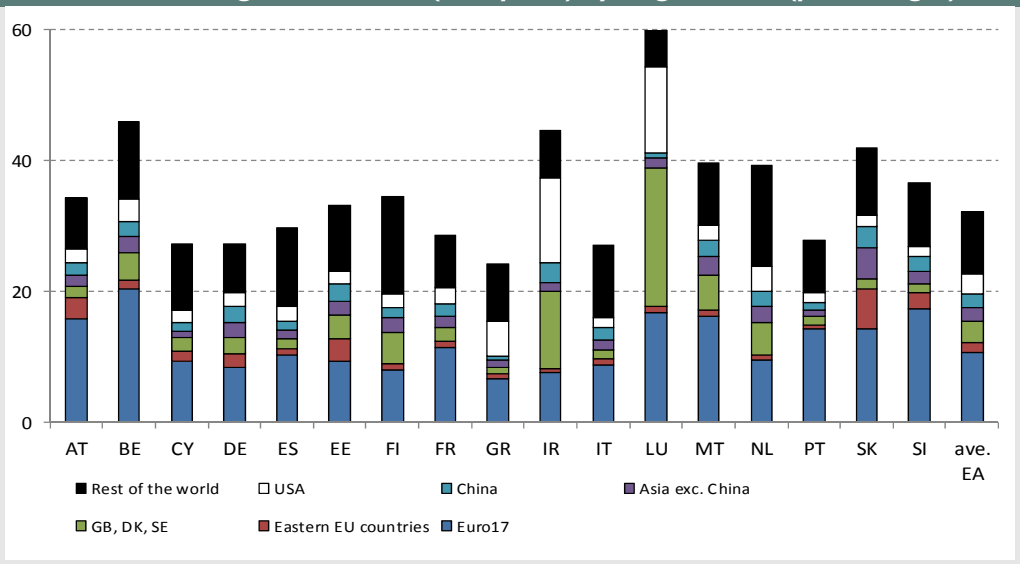
Figure 2: Foreign value added in exports, 2000-2011



Source: Amador et al. (2013) using WIOD

Another positive outcome for Europe of the higher GVC integration is that the reorganisation of production was taking place amid higher integration within the continent. Using 2001 data for the euro area, Amador et al. (2013) show for instance that the foreign value-added - while increasing as a share of exports - was to a major extent sourced from other euro area countries (Figure 3).

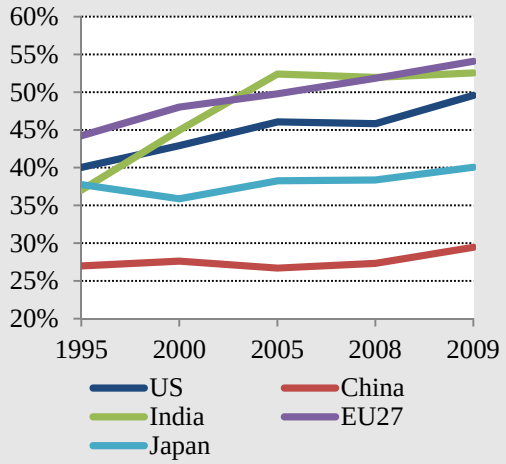
Figure 3: Share of foreign value added (in exports) by origin – 2011 (percentages)



Source: Amador et al. (2013) using WIOD

Another critical development associated with an increasing integration into GVCs is the growing importance of services. In particular, it is increasingly recognised that production of final manufacturing goods "embodies" also a larger share of service activities (Figure 4; Timmer et al., 2013). This implies that trade in services is more important – and by the above mentioned estimates more than double - than the current trade statistics would report.

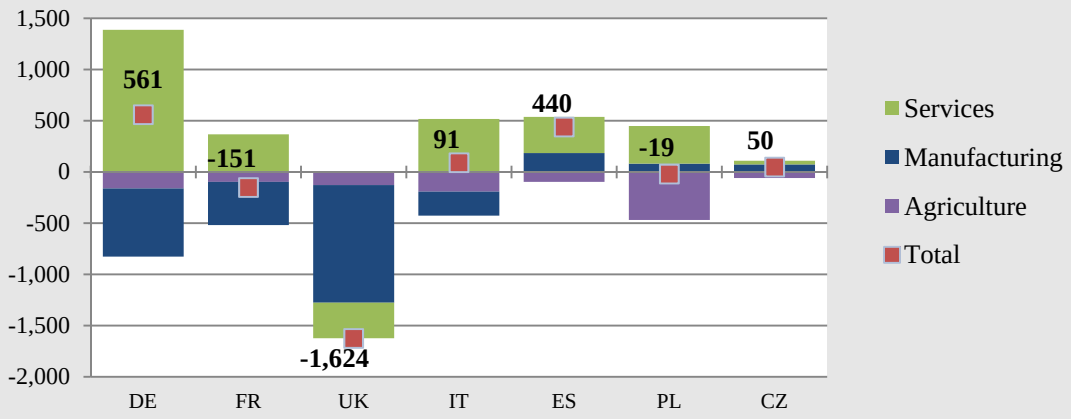
Figure 4: Services VA embodied in gross exports, 1995-2009



Source: WTO-OECD TiVA (2013)

Services also are an increasingly important contributor to job creation. Similar to their indicator "manufacturers GVC income"[3], Timmer et al. (2013) build another indicator, "manufactures GVC jobs", which computes the number of jobs associated with all activities that are directly and indirectly involved in the production of final manufacturing goods. Results are even in this case rather positive for Europe (Figure 5). While manufacturing jobs cuts were rather high over the 1995-2008 period, service activities embodied in final manufacturing goods were associated with substantial job creation (with the notable exception of the UK). For instance, for Germany and Spain service jobs creation more than compensated the losses in manufacturing (net creation between 1995 and 2008 equalled 561,000 GVC jobs in Germany and 440,000 in Spain), providing a good argument in favour of policies supporting high-skilled services and improving domestic services infrastructure.

Figure 5: GVC jobs creation (in 1000s), 1995 vs. 2008



Source: Timmer et al. (2013) using WIOD

[3] "Manufactures GVC income" according to Timmer et al. (2013) is defined as the sum of all value added by all labour and capital that is directly and indirectly used for the production of final manufacturing goods.

CONCLUSIONS

While frequently controversial, the internationalisation of production and, more specifically, a higher degree of vertical integration into global value chains provided in recent years critical stimulus to the European economy. First, it fostered an industrial restructuring both across the European economies and between Europe and the rest of the world, which allowed European firms to vertically specialise in those activities in which they have a comparative advantage. Such specialisation also took the form of a deeper integration within a European value chain. That this process was not accompanied with a hollowing-out of the European economy is shown by the fact that foreign value added still represents only less than a third of the average euro area gross exports, which reduces to about a fifth when one excludes intra-euro area sourcing.

On the contrary, the generation of domestic value added by European economies remains very high. Furthermore, along with the increase in GVC participation, the importance of services - both directly and as "embodied" in final manufacturing - has grown in terms of value added and job creation. For instance, from the mid-90s, job creation in service activities in Germany and Spain more than compensated job losses in declining traditional manufacturing activities.

Overall, the most critical policy message is the following: when assessing country competitiveness - both in terms of export performance and job creation - it is essential to make systematic use of the newly developed indicators, which are able to distil value added creation from traditional trade statistics in gross terms. Given their relevance, it is all the more important to ameliorate these new indicators, particularly for what concerns sector disaggregation. The latter remains limited, as it is derived from aggregated Input-Output tables, which are hard to collect. An obvious direction is to integrate such tables with firm-level data; a route which is being investigated within CompNet.

APPENDIX 1 – COMPARISON OF THE MAIN GLOBAL DATABASES

In the light of complex production lines, parts and components of an individual finished good typically cross several borders many times before reaching the final consumer. In order to eliminate this double-counting of intermediates and to extract exactly how much value added is generated at each of the different production stages, researchers rely on information coming from input-output tables. This is a very complex task, since reliable I-O tables are only available at the national level and hardly interconnected across countries. Also, the degree of sector detail, typically ranging between 25 and 100, can only broadly mimic the complexity and variety of existing products. Notwithstanding these difficulties, there are now a number of available databases, which allow for a distillation of value-added from gross trade flows (see Table 1). Typically these databases differ in a number of dimensions, such as *i)* the country, sector and time coverage, *ii)* their linked satellite datasets, *iii)* the methodology used for their construction, and *iv)* their public accessibility.

Table 1: Summary of existing global databases

		Coverage	Time Dimension	Features	Satellite Accounts or Ready-to-use Indicators
TRADE	**IDE-JETRO (Asian IIO)**	9 Asian countries and US, 76 industries	intermittent years 1975-2005	• ICIO	• employment statistics (2000, 2005)
	WIOD (World Input-Output Database)	40 countries (incl. all EU27) plus ROW, 35 sectors	1995-2009 annually, will be updated to 2011	• ICIO • based on SUTs and benchmarked to national accounts • available in this and last year's prices	• socio-economic accounts (employment statistics) • services • environmental accounts
	OECD-WTO TiVA (Trade in Value Added)	57 countries, 18 industries (37 in underlying tables)	1995, 2000, 2005, 2008, 2009	• OECD ICIO (not publicly available) • OECD-WTO Trade in Value Added indicators (TivA)	• services • GVC indicators: incl. GVC participation, distance to final demand, GVC length, GVC income
	YNU-GIO (Yokohama National University – Global IO Table)	27 endogenous and 61 exogenous countries, 35 sectors	2005-2010 annually	• ICIO	• shock transmission indicators: Simultaneous Shock Transmission Index (SSTI), industry-specific Shock Transmission Index (STI)
	GTAP[4] (Global Trade Analysis Project)	129 countries, 57 sectors, 5 factors (land, skilled/unskilled labour, natural resources, capital)	2000, 2004, 2007	• dataset of harmonised national IOTs and social accounting matrices (SAMs) • serves as a basis for a number of ICIO projects	• energy volumes, land use, CO2 emissions • international migration • processing trade accounts for China and Mexico constructed by Koopman et al. (2013) and Tsigas et al. (2013)

[4] GTAP consists of a harmonised meta-dataset of bilateral trade, together with national IOTs as well as social accounting matrices (SAMs) for 129 countries and 57 sectors (Walmsley et al., 2012). Instead of harmonising data from a wide range of sources themselves, a number of authors, including Koopman et al. (2013) and Tsigas et al. (2013), take the GTAP dataset as a basis for constructing inter-country IOTs.

		Coverage	Time Dimension	Features	Satellite Accounts or Ready-to-use Indicators
ENVIRONMENT	EXIOPOL (Externality and IO Tools for Policy Analysis)	43 countries plus ROW, 129 sectors/products	2000, currently being updated to 2007	• environmentally enhanced Supply & Use table SUT/ MRIO	• 30 emitted substances, 80 resources by industry • environmental accounts (global warming potential, acidification, total material requirement, external costs) • land use and water use
	EORA	187 countries, 25-500 sectors depending on country	1990-2011 (based on initial MRIO estimated for year 2000)	• MRIO • reliability statistics (est. standard deviations) • highly disaggregated • avoids transforming original raw data	• 35 environmental indicators (air pollution, greenhouse gas emissions, water use, ecological footprint, human appropriation of net primary etc.)

Therefore, the choice of the preferred database will depend on the nature of the policy/research questions at hand, across the four dimensions mentioned above.

i) With regards to the first dimension, for policy makers with a focus on Asia the database of Asian International IOTs (AIIOTs), produced by the Institute for Developing Economies of the Japan External Trade Organisation (IDE-JETRO) (Meng et al., 2013), is the most natural choice. However, if the recent financial crisis is the subject, one should better rely on the World Input-Output Database (WIOD) (Dietzenbacher et al., 2013), which is currently the only database providing data up to the year 2011 in both current and previous year's prices. Finally, in case of the prospect of being able to count on periodical updates was a priority, the WTO-OECD Trade in Value Added (TiVA) database (De Backer and Miroudot, 2013) would be the only option.

ii) Value-added databases are used for different purposes, and this is reflected in the satellite datasets they are connected to. For instance, on account of providing a set of socio-economic satellite accounts, WIOD is well suited to exploring the interaction between GVCs and employment creation for 40 countries (incl. EU27). On the other hand, the most prominent environmentally extended (EE) input-output tables EORA (Lenzen et al., 2013) and EXIOPOL (Tukker et al., 2013) are linked to environmental accounts and emission datasets.

iii) With respect to the methodology used to extract the value-added, there is a clear trade-off between accuracy and data availability. In particular, a first group of researchers uses a simplifying proportionality assumption[5] to break down imports into intermediate and final uses (e.g. EORA, EXIOPOL, Johnson and Noguera (2012), Andrew and Peters (2013)). A second

[5] The product-level breakdown into intermediate and final uses is assumed to be proportional to the aggregate breakdown in the destination country.

group instead assigns each import flow to one of the three end-use categories (intermediate inputs, final consumption and gross fixed capital formation) individually, with help of additional data. In particular, detailed trade data and correspondences to broad end-use categories (BEC) are used, increasing the accuracy of the resulting inter-country IOTs (e.g. WIOD, Koopman et al. (2013), Tsigas et al. (2012)). The problem is that, while the second methodology improves accuracy in comparison to the simple proportionality assumption, some proportionality assumptions still have to be applied within certain use categories.[6]

iv) Finally, with respect to accessibility, at the moment only WIOD (up to the year 2009) and parts of EORA are freely available, while GTAP and IDE-JETRO can be accessed against payment of a fee. EXIOPOL and the OECD do not publish their global input-output tables, although the OECD-WTO Trade in Value Added (TiVA) database can be accessed freely online.

[6] Interested readers can also refer to Appendix II of this policy brief, to the Economic Systems Research special issue (Vol. 25, Nr. 1), as well as to Miller and Blair's textbook on input-output analysis (2009) for more technical explanations.

APPENDIX II – INPUT-OUTPUT ANALYSYS APPLIED TO THE STUDY OF GLOBAL VALUE CHAINS

Although input-output analysis has a long tradition in economics since the 17th century, in its modern form was first developed by Leontief in the 1930s as a tool for inter-industry analysis (Miller & Blair, 2009). This framework accounts for the fact that each industry produces products (output) that may be used by other industries, and also by the industry itself, as inputs, giving rise to the name input-output analysis. Part of the output will also be attributed to final consumption, as well as exports. Therefore, input-output tables (IOTs), as the one shown in Figure 1, allow one to track the distribution of each industry's product throughout the economy.

Figure 1: Single-region input-output table

	Industry 1	Industry 2	Industry 3	Final Consumption	Gross Capital Formation	Exports	Total
Industry 1	use of intermediate inputs			final uses			total use of output
Industry 2							
Industry 3							
Imports	use of imported inputs			imported final uses			
Value Added	use of primary inputs						
Gross Output	total supply of output						

Source: The authors, adapted from EUROSTAT (2008)

The emergence of global value chains has extended the use of IOTs, allowing for addressing the impact of interdependencies of industries across different countries (or regions). The elements of these multi-regional input-output (MRIO) (also called inter-country input-output (ICIO)) tables[7] now represent flows between country-industry pairs (see Figure 2).

Figure 2: Interregional input-output table

		Inter-industry Transactions/Intermediate Demand				Final Demand			Total
		Country 1		Country 2	...	Country 1	Country 2	...	
		Ind 1	Ind 2 ...	Ind 1	Ind 2 ...	...				
Country 1	Industry 1 Industry 2 ...	use of domestic inputs		use of foreign inputs					
Country 2	Industry 1 Industry 2 ...	use of foreign inputs		use of domestic inputs					
...	...	use of foreign inputs		use of foreign inputs					
Value Added		use of primary inputs		use of primary inputs					
Gross output									

Source: The authors, adapted from De Backer and Miroudot (2013)

[7] For the sake of brevity the terms MRIO and ICIO are used interchangeably in this policy brief. However, there are some differences with regards to the underlying methodology, which are discussed in more detail in the appendix.

In principle, an inter-country input-output table is, therefore, a device that makes it possible to track the flows of products between sectors and countries as well as to final uses, like household and government consumption and gross fixed capital formation. Furthermore, it provides information on the use of and payment to primary factors. In doing so it follows the national accounting principle in the sense that the value-added (GDP) is recorded at a regional basis and not according to the ownership principle (GNP). Thus, an IOT allows one to track domestic rather than national value-added. Whereas most countries provide information on domestic - and in fewer cases imported - inter-industry flows in the form of supply and use tables (SUT) and national input-output tables (IOTs), there is generally a lack of data on imports from specific country-industry pairs.

An input-output table is basically a system of linear equations of the following form:

total output = intermediate demand + final demand

or, following (Miller & Blair, 2009), in matrix notation:

$$\mathbf{x} = \mathbf{Zi} + \mathbf{f},$$

where **Z** is the matrix of inter- and intra-industry transactions with element $\boldsymbol{z_{ij}^{RS}}$ denoting the input from industry $\boldsymbol{i}$ in country $\boldsymbol{R}$ to industry $\boldsymbol{j}$ in country $\boldsymbol{S}$. One can then define the input-output ratios or input coefficients as

$$\boldsymbol{a_{ij}^{RS}} = \frac{\boldsymbol{z_{ij}^{RS}}}{\boldsymbol{x_j^S}},$$

and under the assumption that they are fixed, we can also write

$$\mathbf{x} = \mathbf{Ax} + \mathbf{f} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f},$$

where **A** is the matrix of input coefficients $\boldsymbol{a_{ij}^{RS}}$. In a true interregional IOT the production structure of each industry in each region is perfectly known, but in reality the input coefficients $\boldsymbol{a_{ij}^{RS}}$ and particularly the international dimension of the **A** matrix always have to be estimated on account of a major shortcoming in the available data. Generally, data on imports in national SUTs or IOTs are provided only by industry aggregate without a breakdown by source country.

In order to derive flows between specific country-industry pairs, additional information from detailed trade data has to be used, allowing researchers i) to determine the breakdown into intermediate (**Z** or **Ax**) and final uses (**f**) of these imports, and ii) to distinguish intermediate imports in each destination country-industry pair according to the source country.

One important method of constructing the final global IOT rests on the application of the proportionality assumption to separate imports into intermediate and final uses; here it has been

assumed that for each product the breakdown into intermediate and final uses is proportional to the aggregate breakdown into intermediate and final uses in the destination country. An IOT resulting from the use of the proportionality method is commonly called a multiregional input-output (MRIO) table.

A second way to separate intermediate from final imports is to sort bilateral trade flows with help of the UN Broad Economic Categories (BEC) or refinements of these, which makes it possible to assign each imported product to one of the three end-use categories (intermediate inputs, final consumption and gross fixed capital formation) at the 6-digit HS level. This results in an individual split into intermediate and final uses for each origin industry increasing the accuracy of estimated input coefficients.

Lastly, it has to be mentioned that for both MRIOs and ICIOs an assumption of proportionality is applied within the three end-use categories, particularly to split imported intermediates across industries. A more sophisticated approach would be to use additional information to provide a more differentiated breakdown of use patterns of imported intermediates across industries, but this data is generally unavailable.[8]

[8] This holds with the exception of IDE-JETRO (Tukker and Dietzenbacher, 2013).

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