

Performing supply chain analysis using different sources: differences between TiVA and GTAP trade in value added indicators

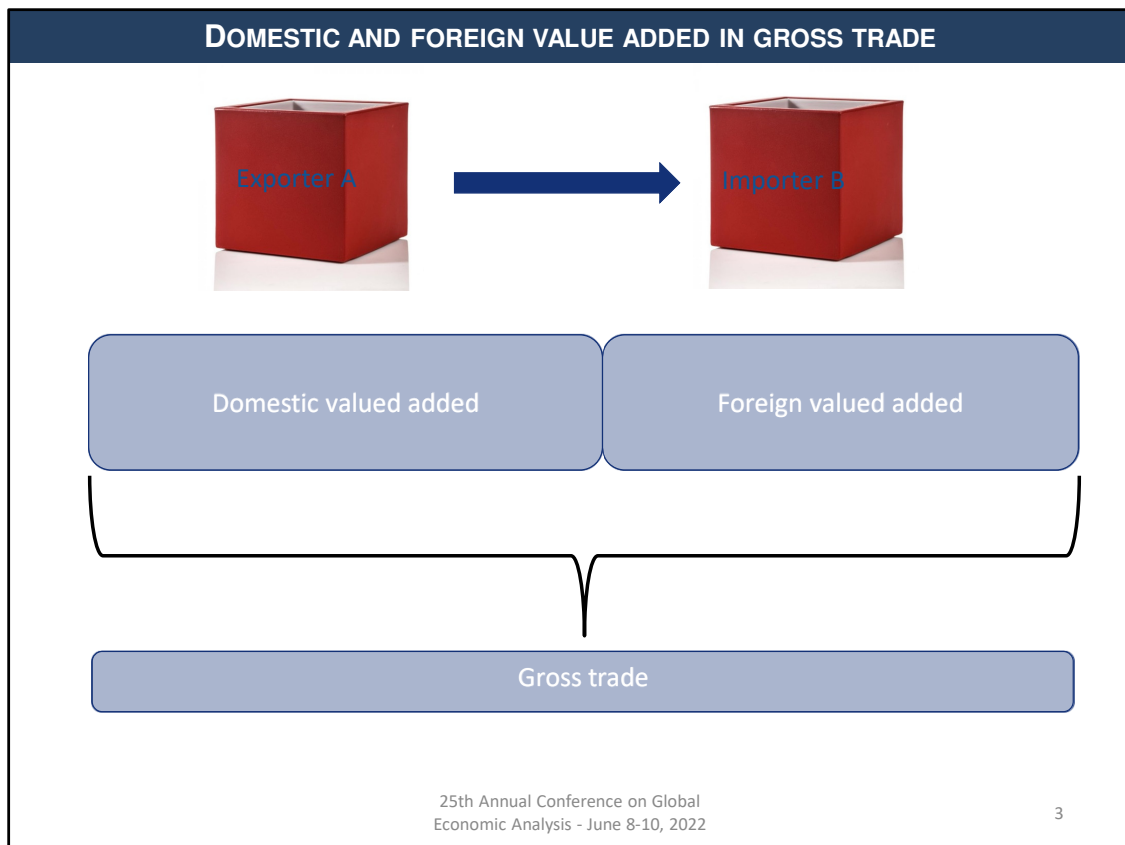


Ilaria Fusacchia, Luca Salvatici, Beatriz Velazquez

25th Annual Conference on Global Economic Analysis: **Accelerating Economic Transformation, Diversification and Job Creation**
Session: **Trade policy modelling and data issues**

OUTLINE

- Introduction
 - Trade in value added (TVA): concepts and data
 - GVCs and measurement challenges
- Comparison between indicators estimated using two of the main global databases used for macroeconomic analysis of GVCs and trade in VA patterns:
 - GTAP Data Base in its MRIO version
 - the OECD-WTO TiVA database
- Objective: assess and discuss the deviations in the estimates of GVC-related trade based on the two databases
- Methodology: inclusion of TiVA-like indicators within the module introducing the VA decomposition of gross trade flows within a general equilibrium model (GTAP-VA module - Antimiani et al., JGEA 2018).



Trade statistics on gross exports *alone* no longer informative for a full evaluation of production patterns beyond global trade.

Do not allow to measure the domestic content of imports, or to assess triangular trade.

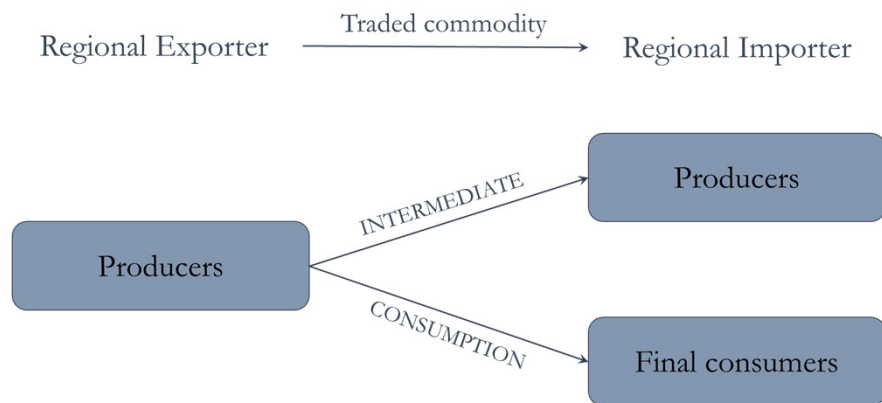
Much of the work on developing measures of trade on a value-added basis (TVA) has focused on the use of global inter-country, input-output (ICIO) tables.

ICIOs are constructed by harmonizing input-output tables for multiple regions and linking trade flows directly from producers in each region to importing firms and consumers in all other regions.

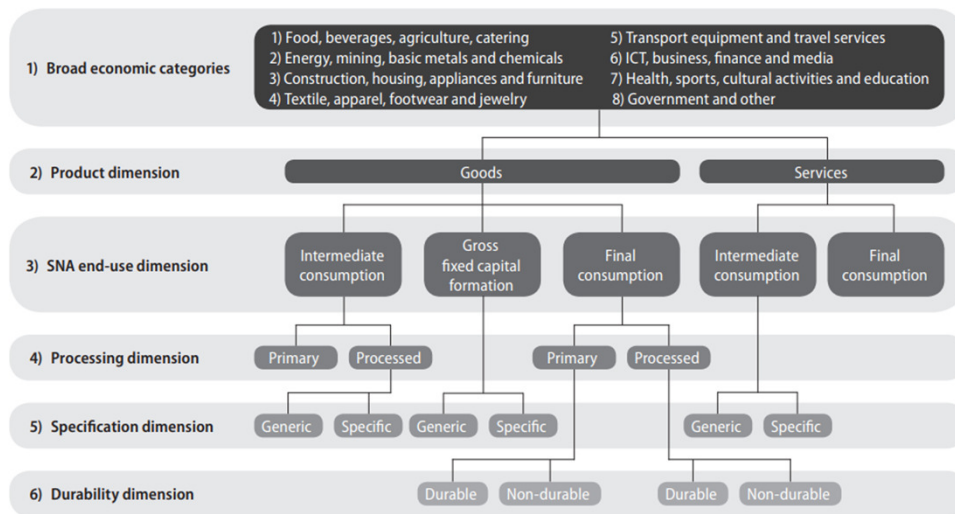
OVERVIEW OF THE MAIN FEATURES OF THE DATABASES

	Geographical coverage	Sector breakdown	Time span	Methodological reference
GTAP Data Base Ver. 10A https://www.gtap.agecon.purdue.edu/databases/v10/index.aspx	121 countries and 20 regions	65 sectors	2004, 2007, 2011, and 2014	Aguiar A., Chepeliev M., Corong E., McDougall R., van der Mensbrughe D. (2019) "The GTAP Data Base: Version 10", Journal of Global Economic Analysis, 4(1): 1-27.

. THE ICIO FRAMEWORK



An inherent assumption in (8) is that the breakdown of flows by country of origin is identical regardless of the intended end-uses of the imports in question. In practice though, the composition of products in say the automobile industry that are imported as an input (e.g., car parts) could well differ from that which is imported for final use (e.g., assembled cars).



More recent WIOT initiatives have taken steps to relax this feature of the proportionality assumptions, by bringing in the UN Broad Economic Categories (BEC) classification system to distinguish between products by end-use categories, namely as intermediate inputs versus final (consumption or investment) goods.

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GTAP-MRIO Ver. 10A https://www.gtap.agecon.purdue.edu/databases/Utilities/v10.aspx	121 countries and 20 regions	65 sectors	2014	Carrico C., Erwin C. and van der Mensbrugghe D. (2020) "The GTAP version 10A Multi-Region Input Output (MRIO) Data Base", Research Memorandum, 34.
OECD/WTO TiVA Database [Ed. 2018] https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm	64 countries	36 sectors	2005 to 2015 (preliminary projections to 2016 for some indicators)	OECD-WTO (2012) "Trade in Value Added: Concepts, Methodologies and Challenges", Joint OECD-WTO concept note.

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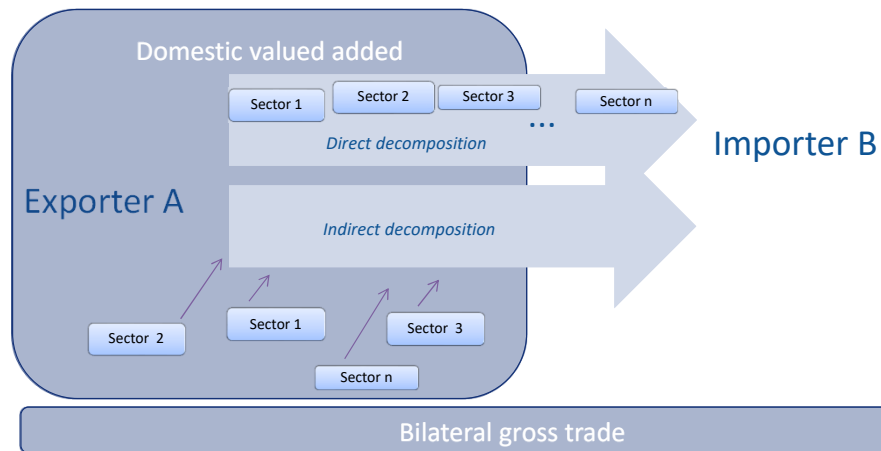
Tuttavia, c'è una più recente release, la "2021 edition" che copre 66 economie e 45 settori per il periodo 1995-2018 ([Trade in Value Added – OECD](#))

SECTORS AND COUNTRIES AGGREGATION

1. To enable the juxtaposition, the sectors in GTAP and TiVA databases are first mapped to the ISIC (<https://unstats.un.org/unsd/classifications/Econ/isic>), the reference point for sectoral classification in most input-output statistics: this means that both GTAP sectors (GSC3) and TiVA industry codes (Ed. 2018) are defined by reference to the ISIC Rev. 4 codes.
2. Next, the databases are aggregated at the highest possible detail, depending on the common ISIC codes.
3. In terms of geographical coverage, the correspondence tables discussed here include all European Union countries plus the major players in the trading world system, namely, the United Kingdom, China, Japan, and the United States. The Rest of the World aggregate includes all the other countries in the databases.

Structural Indicators - based on the values presented in ICIO	
PROD	Production (gross output), USD million
VALU	Value added, USD million
PROD_VASH	Value added as a share of Gross Output, by industry, percentage
EXGR EXGR_INT	Gross/Interm exports, by industry and by partner country, USD million (f.o.b.)
IMGR IMGR_INT	Gross/Interm imports, by industry and by partner country, USD million (f.o.b.)
Domestic value added content of gross exports	
EXGR_DVA	Domestic value added content of gross exports
EXGR_DVASH	Domestic value added share of gross exports
EXGR_TDVAIND	Industry domestic value added contribution to gross exports
Decomposition of domestic value added content of gross exports	
EXGR_DDC	Direct domestic value added content of gross exports
EXGR_IDC	Indirect domestic value added content of gross exports
EXGR_RIM	Re-imported domestic value added content of gross exports

(1) domestic value added

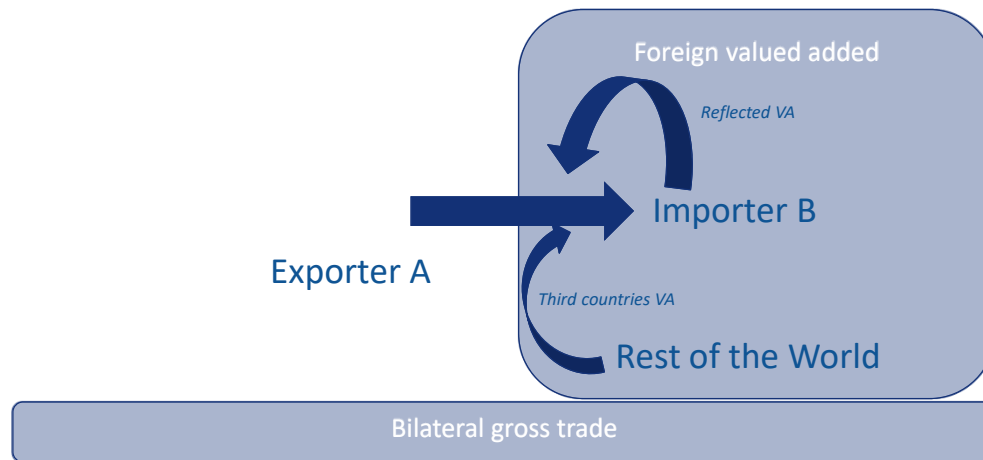


Domestic value added exported by country A to country B can be decomposed in:

- 1) Direct VA: value added generated in the exporting sector.
- 2) Indirect VA: value added generated in upstream sectors (i.e., sectors providing inputs to the exporting sectors)

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Foreign value added content of gross exports (backward participation in GVCs)	
EXGR_FVA	Foreign value added content of gross exports
EXGR_FVASH	Foreign value added share of gross exports
EXGR_TFVAIND	Industry foreign value added contribution to gross exports
DEXFVApSH	Foreign value added share of gross exports, by value added origin country

(2) foreign value added



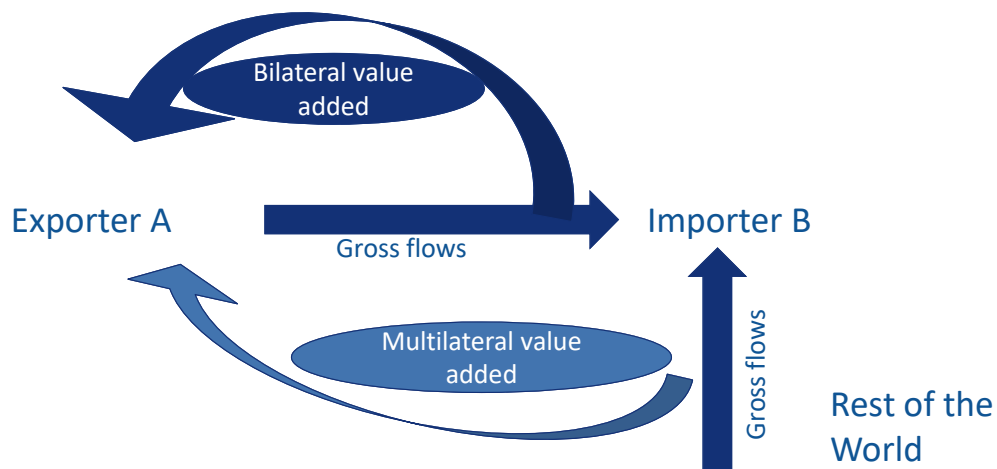
Country A exports to country B include foreign value added that can be decomposed as follows:

- 1) Reflected VA: value added generated in the importing country itself.
- 2) Third countries VA: value added generated by countries different from A and B (backward linkages).

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EXGR_TFVAIND	Industry foreign value added contribution to gross exports
DEXFVApSH	Foreign value added share of gross exports, by value added origin country
Domestic value added content of foreign gross exports (forward participation in GVCs)	
EXGR_DVAFXSH	Domestic value added embodied in foreign exports as share of gross exports
FEXDVApSH	Domestic value added in foreign exports as a share of gross exports, by foreign export origin country
Origins of value added By Source Country and Industry (BSCI)	
EXGR_BSCI	Origin of value added in gross exports
IMGR_BSCI	Origin of value added in gross imports
FDVA_BSCI	Origin of value added in final demand

In order to assess the trade relevance of partner countries, gross bilateral exports are:

- a) too much because they include foreign value added;
- b) too little because they do not take into account the whole international trade network.

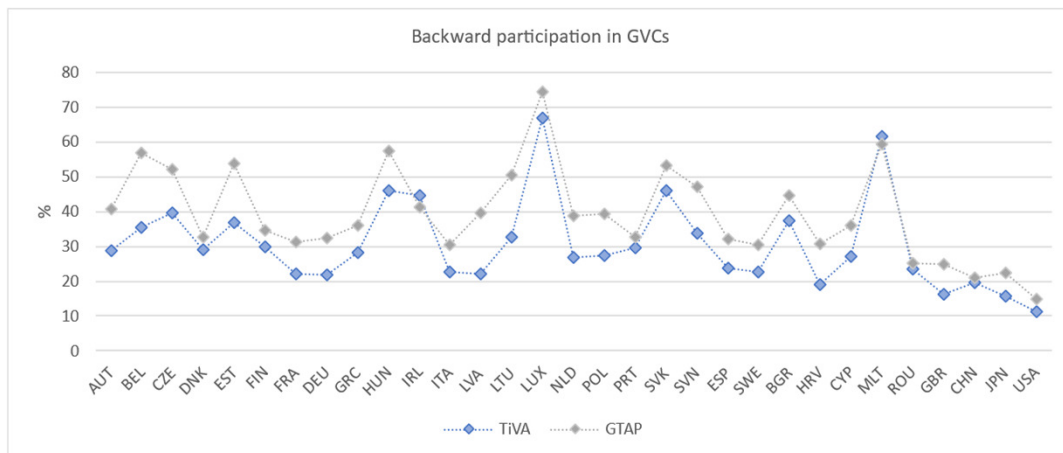


Value added relationship between two countries is driven not only by bilateral trade but also by the whole international trade network:

- 1) DVA reaches the importer through the bilateral exports from country A to country B, and
- 2) through the DVA embedded in the exports of third countries to B (forward linkages).

The total value added exported to a given destination may be larger or smaller than bilateral gross values, depending on the magnitude of backward and forward linkages.

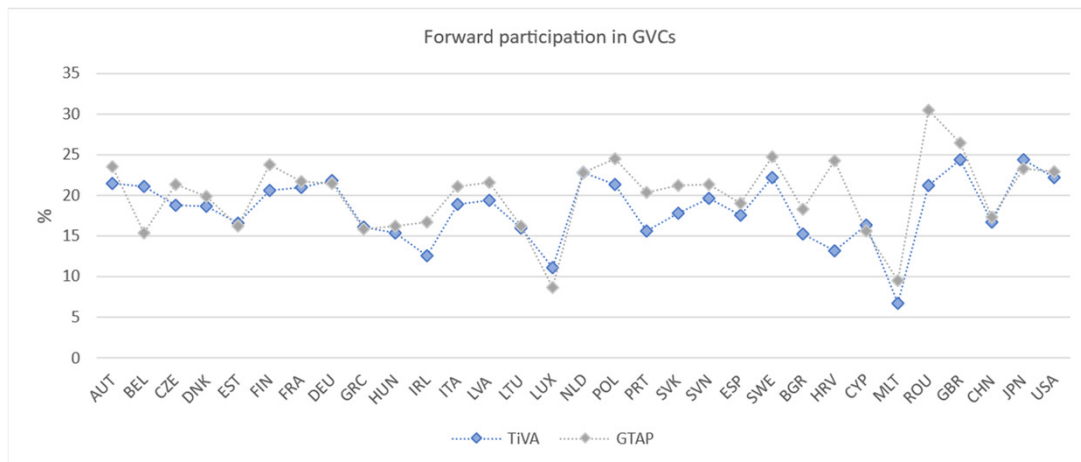
GVC PARTICIPATION



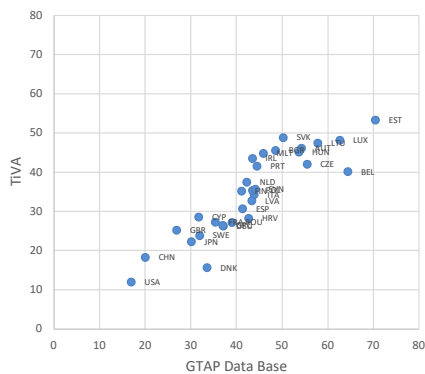
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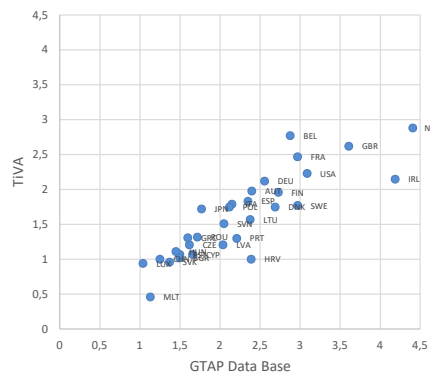
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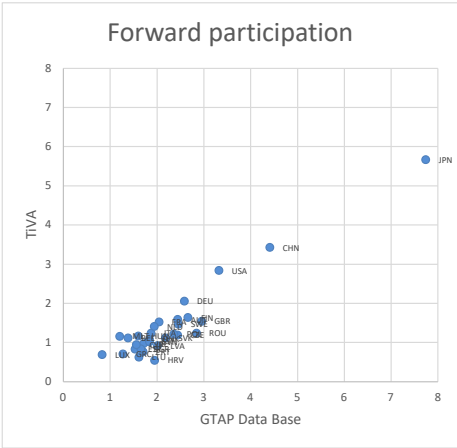
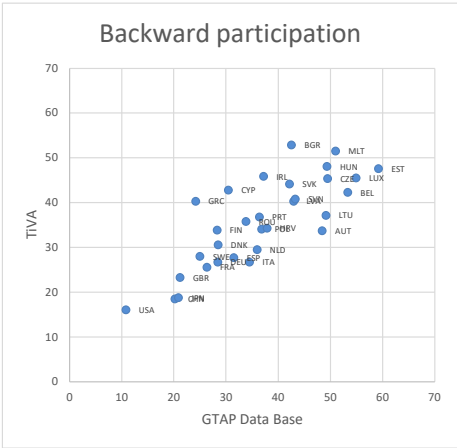


Backward participation



Forward participation





STRUCTURAL INDICATORS

GTAP and TiVA databases are based on distinct sources and harmonization choices: the GTAP database is benchmarked to adjusted trade statistics instead of national accounts statistics as is preferred in TiVA:

- TiVA starts from the SUTs or IO tables and then benchmark them to national accounts statistics using trade data.
 - GTAP and GTAP-MRIO use trade data as a benchmark for adjusting the IO tables.
-
- a) Production: $GTAP > TiVA$
 - b) Value added: $GTAP < TiVA$
 - c) Value added shares of gross output
 - d) Exports: $GTAP >> TiVA$
 - e) Imports: $GTAP >> TiVA$
 - f) Intermediate total trade: $GTAP >> TiVA$
-
- The biggest deviations mainly concern EU member countries; a plausible explanation is that the OECD table excludes the re-exports and transit trade taking place within the EU.
 - Large differences at the sector level: Computer, electronic and optical products show the highest difference between the databases, both for exports and imports.

MAIN DIFFERENCES IN THE DATA SOURCES AND METHODOLOGIES UNDERLYING GTAP-MRIO AND TiVA

BASE DATA	
Variable	Data source
Output, value added	- TiVA: OECD STAN Database (2008 SNA/ISIC Rev.4), OECD annual National Accounts database, SUTs, IO tables, and structural business statistics (UNIDO's INDSTAT) - GTAP: IO tables provided by GTAP network members, WB mainly from the World Development Indicators (WDI) by the World Bank.

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Structural Analysis database
System of National Account
International Standard Industrial Classification

MAIN DIFFERENCES IN THE DATA SOURCES AND METHODOLOGIES UNDERLYING GTAP-MRIO AND TiVA

BASE DATA		
Variable	Data source	Methodological choices / Estimation techniques
Trade	United Nations International Trade Statistics Database (UN Comtrade)	Treatment of re-exports Evaluation adjustments to move between basic, producer and world prices
Intermediate trade	TiVA: The Bilateral Trade Database by Industry and End-use category (BTDIxE) - Estimated Bilateral Trade in Services by Industry (EBTSI) GTAP-MRIO: UNSD 6-digit HS 2012, BEC concordances rev. 4, SNA	

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Re-exports:

- In GTAP, trade data for more than 50 countries that re-export are re-estimated by deriving domestic exports and by converting total imports into retained imports.
- In the construction of OECD's ICIO, for partner shares of trade in goods, reported imports are prioritized as initial values

Evaluation adjustments:

- The OECD's ICIOs are based on the available data and therefore reflect the use table at basic prices when disseminated or estimated from existing information.
- GTAP constructs the data with the use of information on multi-country margins and taxes.

In an ideal world, GVCs would be measured directly on the universe of firm-to-firm trade flows.

Antras and Chor (2021) highlight three potential directions for improvement in measurement:

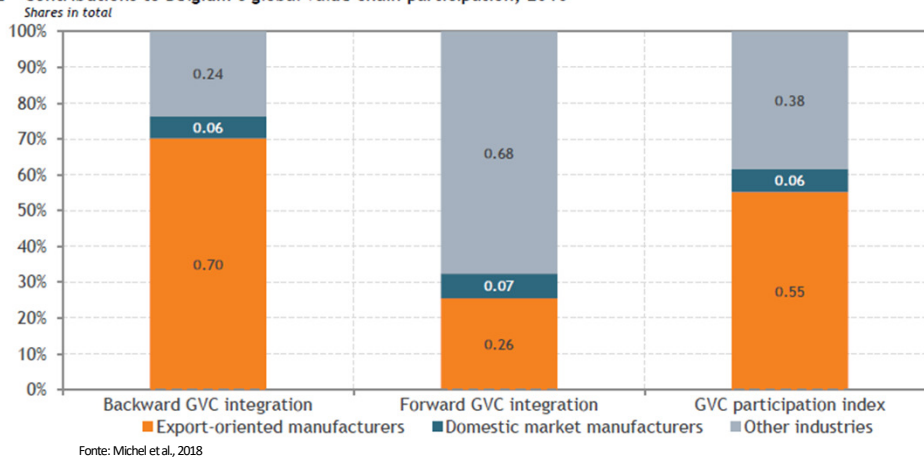
2. "A second distinct data challenge is raised by the presence of multi-product firms"
3. "A third measurement issue is raised by de Gortari (2019), who documents how observed patterns of input sourcing can differ systematically across firms even within the same industry, depending on the identity of the export markets that the firms' output is destined for."

Antras, Pol, and Davin Chor. Forthcoming. "[Global Value Chains](#)." Handbook of International Economics. Vol. 5. Elsevier.

DIFFERENTIATED FORWARD PARTICIPATION

Differentiation of the role played by export-oriented firms in shaping countries' participation in GVCs

Graph 12 Contributions to Belgium's global value chain participation, 2010



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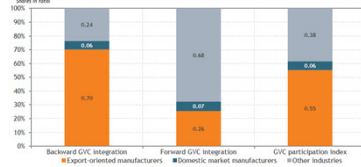
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techreport{NBERw25155, title = "The Role of Exporters and Domestic Producers in GVCs: Evidence for Belgium based on Extended National Supply-and-Use Tables Integrated into a Global Multiregional Input-Output Table", author = "Michel, Bernhard and Hambÿe, Caroline and Hertveldt, Bart", institution = "National Bureau of Economic Research", type = "Working Paper", series = "Working Paper Series", number = "25155", year = "2018",

DIFFERENTIATED FORWARD PARTICIPATION

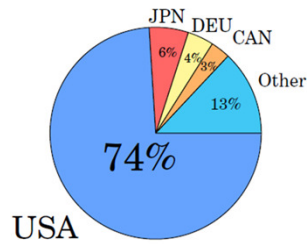
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Graph 12 Contributions to Belgium's global value chain participation, 2010



Fonte: Michel et al., 2018

Foreign Inputs in Exports to the U.S.



Foreign Inputs in Exports to Germany

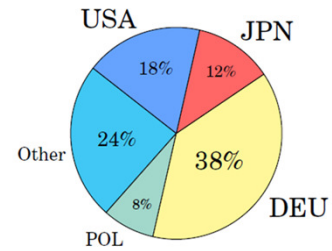


Figure 1: Distribution of Foreign Inputs Used in Mexican Final Good Motor Vehicle Exports

Fonte: De Gortari, 2019

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@techreport{NBERw25868, title = "Disentangling Global Value Chains", author = "de Gortari, Alonso", institution = "National Bureau of Economic Research", type = "Working Paper", series = "Working Paper Series", number = "25868", year = "2019",

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3. "A third measurement issue is raised by de Gortari (2019), who documents how observed patterns of input sourcing can differ systematically across firms even within the same industry, depending on the identity of the export markets that the firms' output is destined for."
1. "we anticipate and welcome more efforts to bring to bear more detailed micro data, to directly inform and refine the construction of the proportionality weights"

Antras, Pol, and Davin Chor. Forthcoming. "[Global Value Chains](#)." Handbook of International Economics. Vol. 5. Elsevier.

Differentiated backward participation: improve estimates of imported inputs across sectors ([BATmodel - Better agri-food trade modelling for policy analysis](#))

GTAP-MRIO:

- 1) Reallocates bilateral imports based on BEC
- 2) Within each use category allocation is based on proportionality assumption

The example of France's imports in dairy products

France's imports of dairy products (US\$ million, 2014)

	Total	Final use	Intermediate use
	4,655	2,907	1,748

	Total	mil	ofd	
	interm.			
bel	18,7	18,7	15,2%	18,7
deu	20,9	20,9	15,4%	20,9
ita	20,0	20,0	10,9%	20,0
nld	11,3	11,3	19,7%	11,3
esp	8,5	8,5	14,5%	8,5
...	...	...	...	...

Original data in GTAP

BEC attribution

Proportionality

Source: GTAP-MRIO Data Base V10.A

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We operate under two constraints which must be satisfied to maintain balance in the entire GTAP database:

- i) at the sector level, the value of intermediates goods imported from each provider must not exceed the total value of imports from each trade partner;
- ii) the import values aggregated across providers for each commodity/activity pair must be equal to the original data in GTAP. As for activities and commodities covered by the available microdata, we differentiate activities of importing firms operating in the domestic market only from those producing for foreign markets.