

icio: a Stata command for the analysis of Inter-Country Input-Output tables

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International fragmentation of production

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Need new data but also new methods for a full evaluation of a country's exposure to global demand

New data: from IO to ICIO

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- **In the last five years** **Inter-Country Input-Output tables:** generalization of IO tables, describe the sale and purchase relationships between producers and consumers **within and between economies.**

In a national IO table, exports are sales to the “foreign sector”; in a ICIO table, exports are to country 1, county 2 . . .

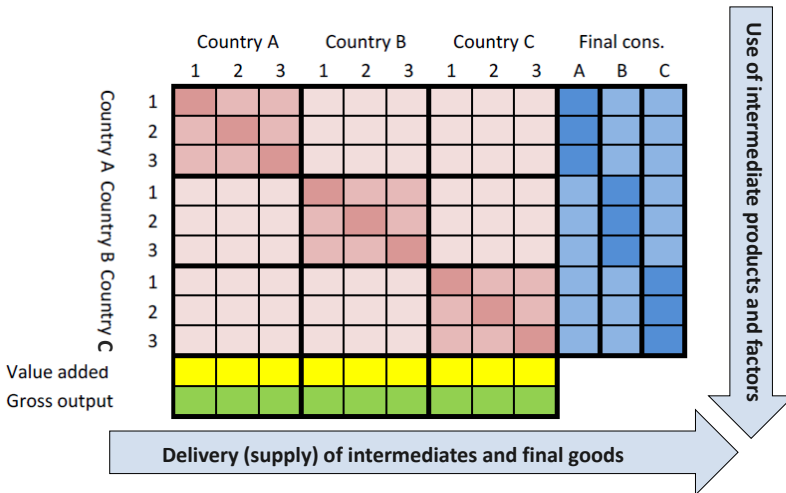
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Since 2015 more than 2000 papers exploiting ICIO.

Inter-Country Input Output table

A standard ICIO table



New data: several databases

Several databases available (GTAP, EORA, EXIOBASE, WIOD, TiVA).
Most used:

World Input-Output Database (University of Groningen and WIIW)

- 40 countries + ROW (new release 43)
- 35 sectors (new release 56)
- Full time series 1995-2011 (new release 2000-2014)
- Based on official statistics

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Trade in Value-Added (OECD)

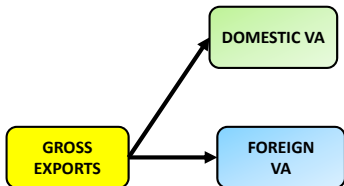
- 61 countries + ROW
- 34 sectors
- No full time series: 1995, 2000, 2005 and 2008-2011
- Incorporation of firm heterogeneity: processing trade correction for China and Mexico.

New methods: data alone are not enough

Koopman, Wang, Wei AER (2014): Comprehensive framework to classify aggregate trade flows with respect to their value added content.

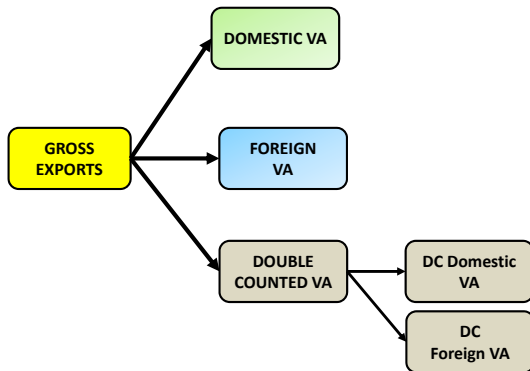
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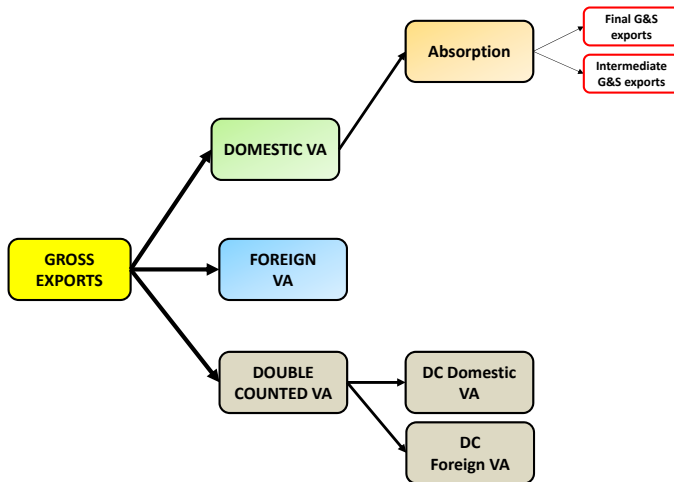
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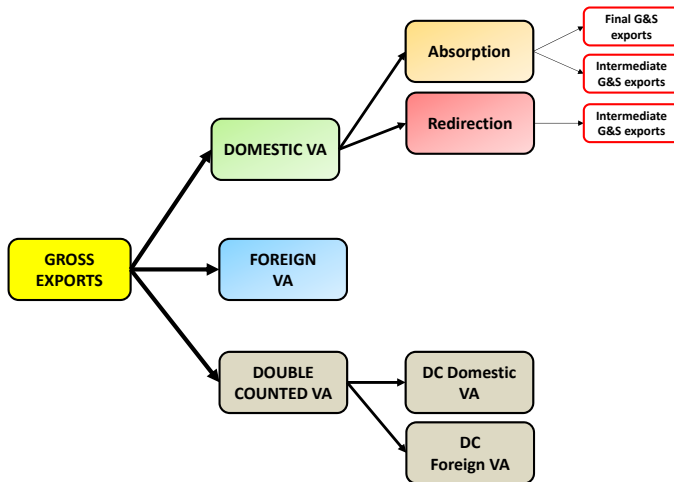
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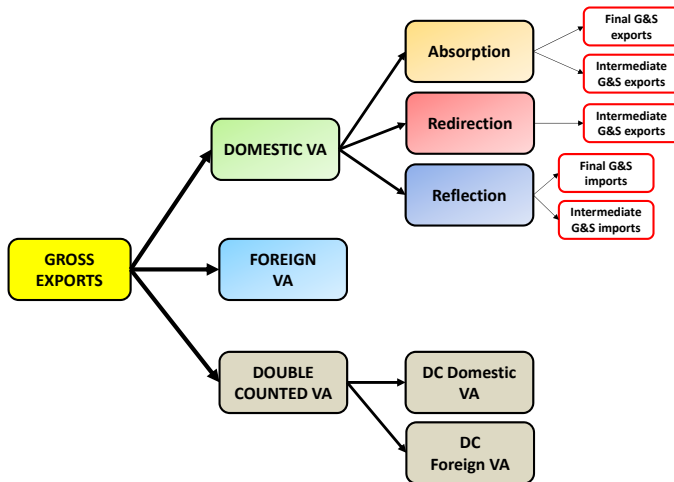
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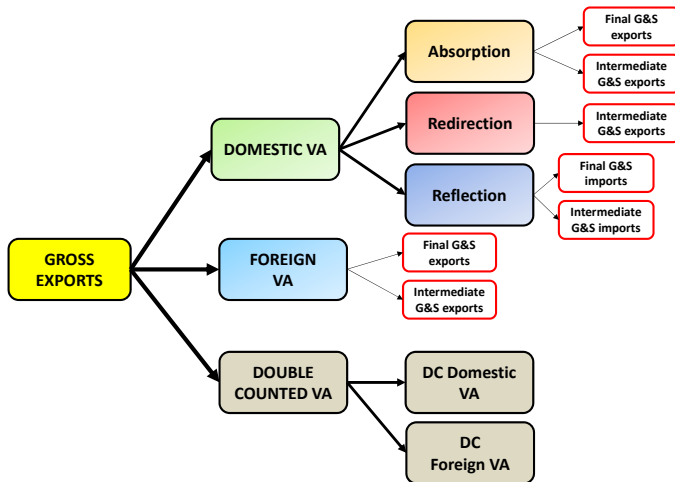
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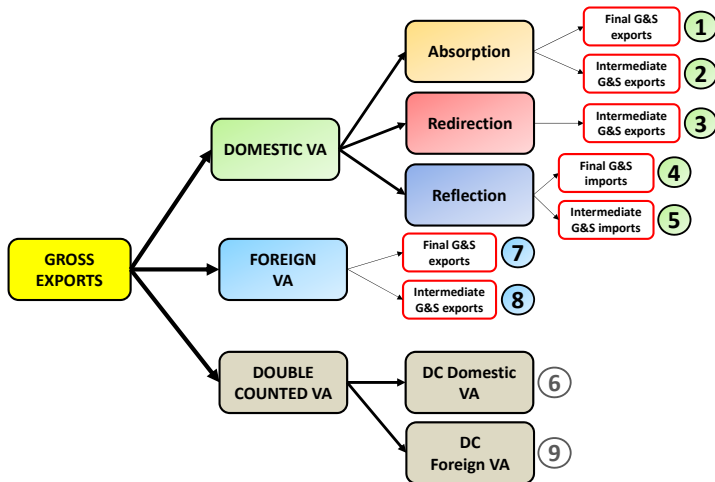
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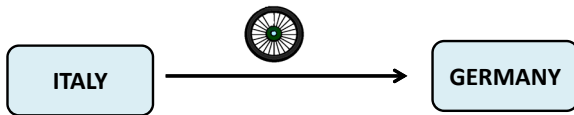
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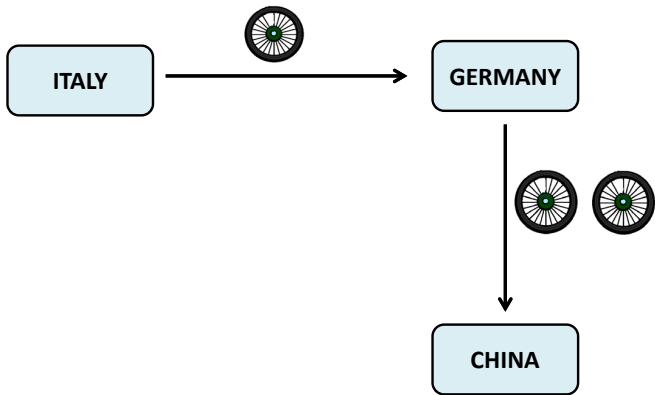
Dissecting gross exports

Fragmentation of production: a very simple example



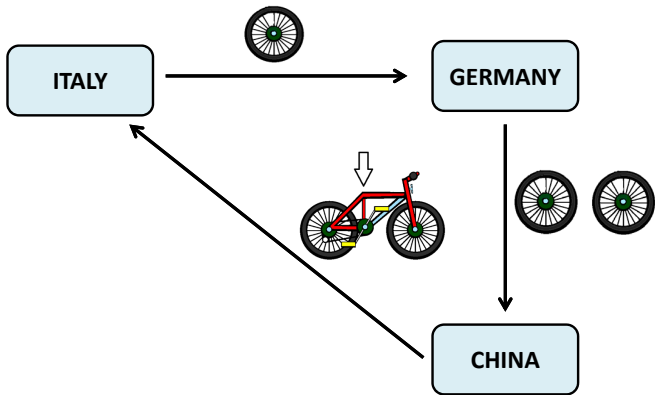
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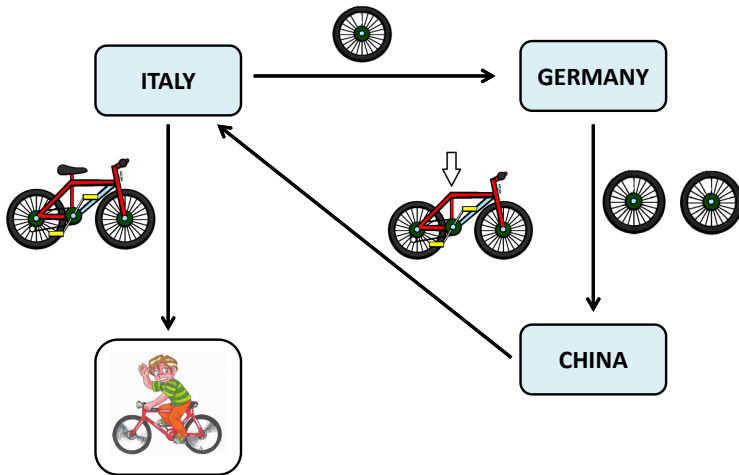
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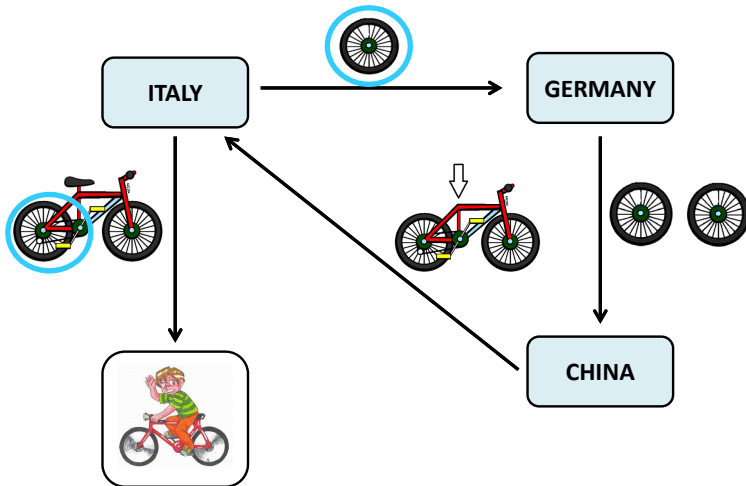
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A decomposition of Italian gross exports

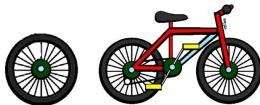
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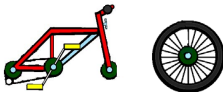
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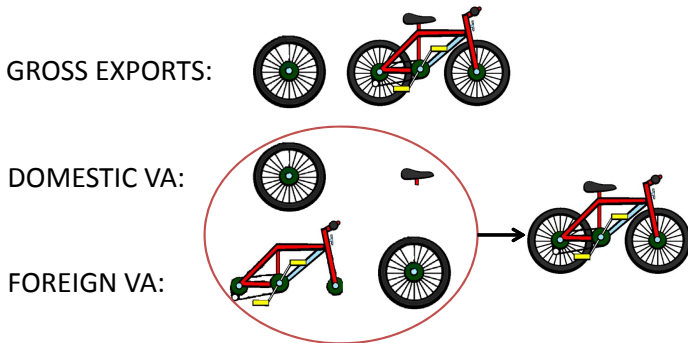


FOREIGN VA:



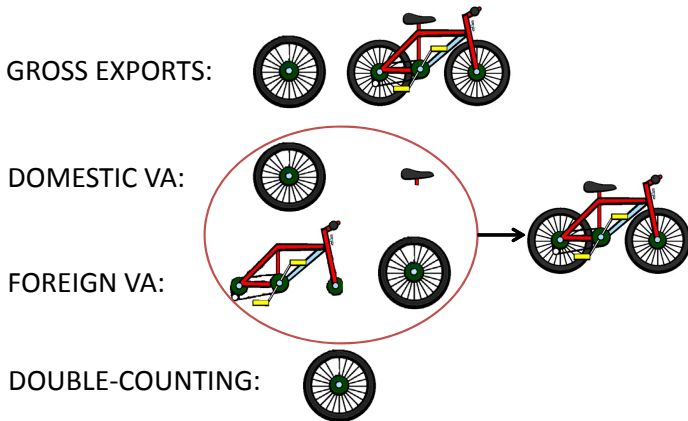
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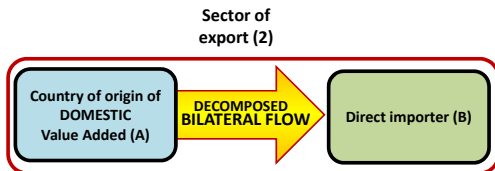
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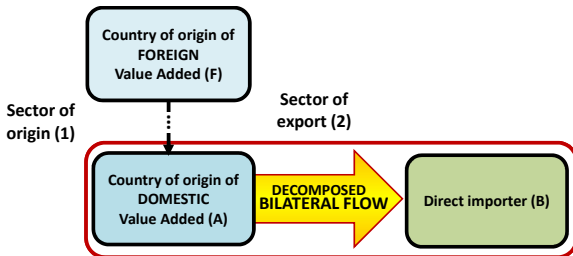
Bilateral decomposition of trade flows: intuition

Borin Mancini (2015): able to identify (up to) 6 actors and (up to) 3 sectors for each bilateral flow: require only ICIO table and a proper algebra



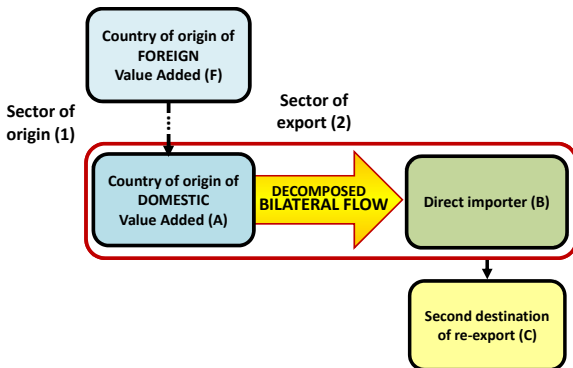
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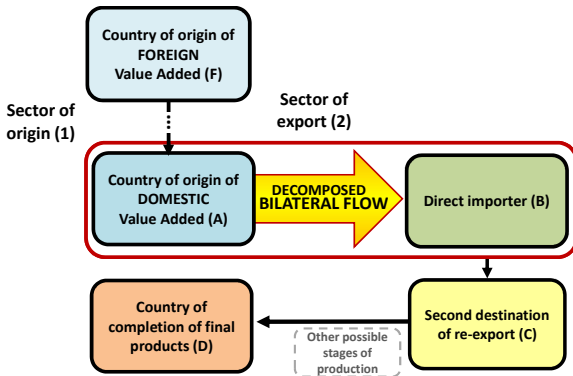
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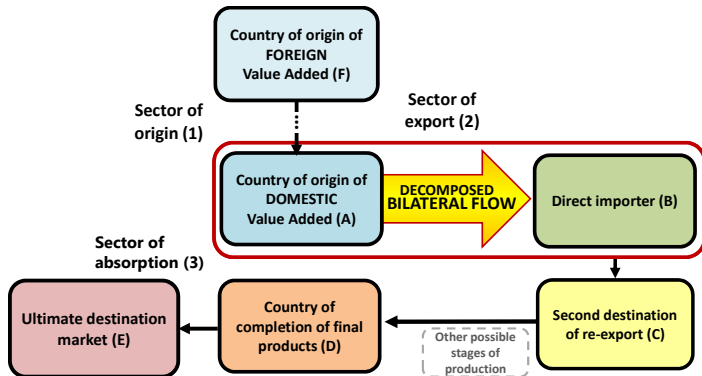
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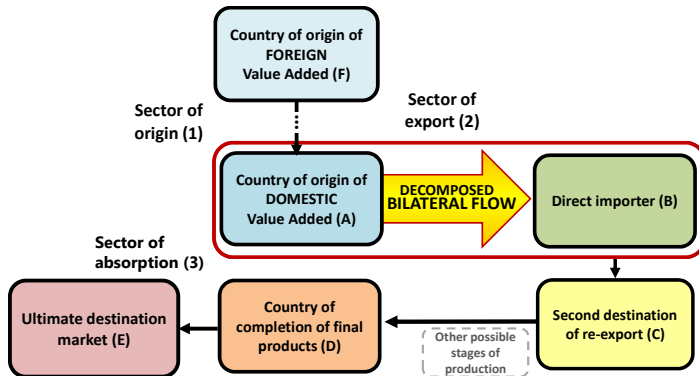
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Example: Italian (F) value added in metal products (1) in the bilateral exports of electrical components (2) from Germany (A) to Korea (B), further exported to Japan (C), embedded in Chinese (D) electronic products (3) for US (E) consumption.

Bilateral decomposition of trade flows: algebra

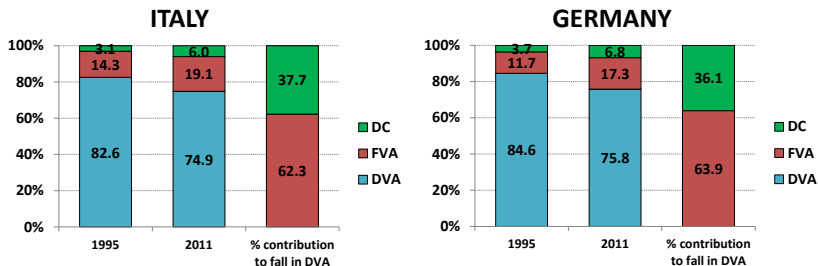
$$\begin{aligned}
 u_N E_{sr} &= \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{Y}_{sr} \\
 &+ \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[\sum_{j \neq r}^G \mathbf{A}_{rj} \mathbf{B}_{js} \mathbf{Y}_{sr} + \sum_{j \neq r}^G \mathbf{A}_{rj} \sum_{k \neq s, r}^G \mathbf{B}_{js} \mathbf{Y}_{sk} \right] \\
 &+ \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[\mathbf{Y}_{rr} + \sum_{j \neq r}^G \mathbf{A}_{rj} \mathbf{B}_{jr} \mathbf{Y}_{rr} + \sum_{j \neq r}^G \mathbf{A}_{rj} \sum_{k \neq s, r}^G \mathbf{B}_{jk} \mathbf{Y}_{kk} \right] \\
 &+ \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[\sum_{j \neq r, s}^G \mathbf{Y}_{rj} + \sum_{j \neq r}^G \mathbf{A}_{rj} \sum_{l \neq s, r}^G \mathbf{B}_{jr} \mathbf{Y}_{rl} \right. \\
 &\quad \left. + \sum_{j \neq r}^G \mathbf{A}_{rj} \sum_{k \neq s, r}^G \mathbf{B}_{jk} \mathbf{Y}_{kr} + \sum_{j \neq r}^G \mathbf{A}_{rj} \sum_{k \neq s, r, l}^G \sum_{l \neq s, r}^G \mathbf{B}_{jk} \mathbf{Y}_{kl} \right] \\
 &+ \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[\mathbf{Y}_{rs} + \sum_{j \neq r}^G \mathbf{A}_{rj} \mathbf{B}_{jr} \mathbf{Y}_{rs} + \sum_{j \neq r}^G \mathbf{A}_{rj} \sum_{k \neq s, r}^G \mathbf{B}_{jk} \mathbf{Y}_{ks} \right] \\
 &+ \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \sum_{j \neq r}^G \mathbf{A}_{rj} \mathbf{B}_{js} \mathbf{Y}_{ss} \\
 &+ \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \sum_{t \neq s}^G \mathbf{A}_{st} \mathbf{B}_{ts} E_{sr} \\
 &+ \sum_{t \neq s}^G \mathbf{V}_t \mathbf{B}_{ts} \mathbf{Y}_{sr} + \sum_{t \neq s}^G \mathbf{V}_t \mathbf{B}_{ts} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \mathbf{Y}_{rr} \\
 &+ \sum_{t \neq s}^G \mathbf{V}_t \mathbf{B}_{ts} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} E_{rs}
 \end{aligned}$$

Features of the bilateral decomposition

- **Consistent** with the original KWW framework
- Able to **trace DVA in trade flows**: exploit the bilateral dimension
- Able to **trace GVC-related trade**: intermediate and final goods crossing more than one border

Fragmentation matters

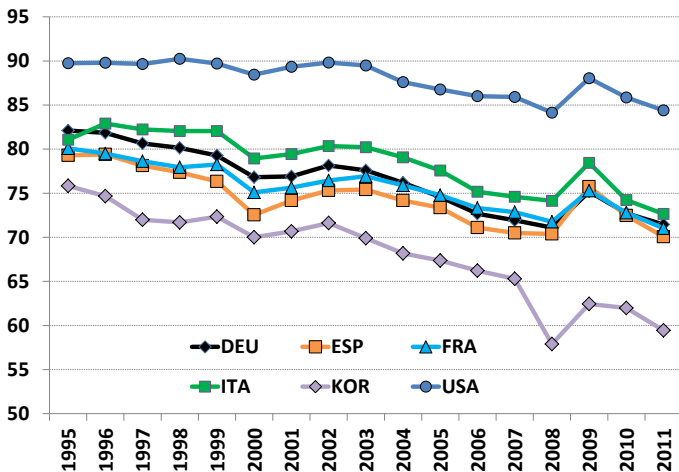
The three main components of gross exports (from TiVA)



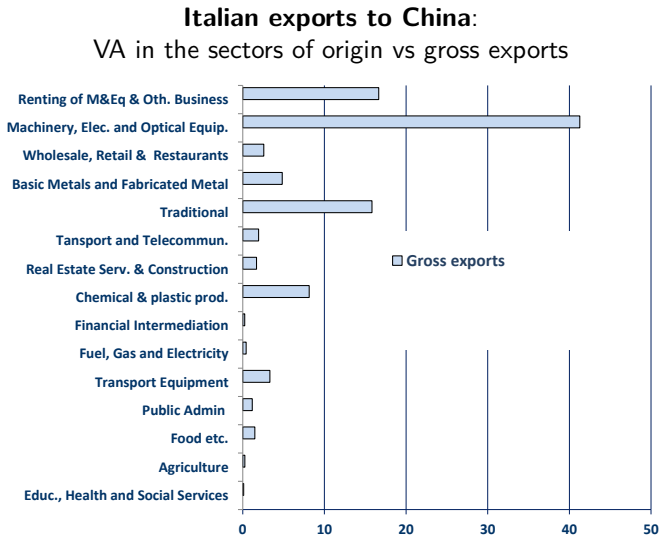
- Double-counting: small but nasty!
- ↓ in DVA content not entirely mirrored in ↑ in FVA

GDP in gross exports (DVA-content of exports)

Full time series from WIOD



A very different picture: sectoral heterogeneity



A very different picture: sectoral heterogeneity



Dissecting global value chains

How EA-3 made VA gets to China's final demand?
 Recovering information from the decomposition of bilateral exports

	France	Italy	Germany
direct to China	70.7	71.2	77.5
through other countries	29.3	28.8	22.5

share of VA exported to China through a third country

EU-27	49.4	50.7	40.2
France		7.6	6.9
Italy	4.9		4.0
Germany	20.4	22.1	
United States	3.7	3.5	3.9
Japan	2.2	1.3	2.0
Emerging Asia (excluding China)	8.9	6.6	10.4
Others	35.7	38.0	43.4

Why a Stata program?

- Measures of fragmentation are **not easy to calculate**: need to code a proper algebra
- **Lots of data sources**: difficult to use more than one database to compare results
- An easy way to get an **immediate snapshot**, without theory
- A useful tool for **different disciplines**: international trade, industrial organization, macroeconomics, finance, environmental science . . .

icio command

The basic `icio` syntax is the following.

```
icio, origin(country_name) options
```

Displays standard measures of international fragmentation for a certain country, if nothing else is specified.

Options:

origin(*country_name*) specifies the country of origin. It must be specified.

destination(*country_name*) specifies the country of destination.

iciotable(*iotable_type*) specifies the database to be used. It can be the World Input Output Database (`wiod`) or the OECD's Trade in Valued-Added (`tiva`). Default is `wiod`. User provided table (`.csv`) can be loaded through icioload(*file_icio file_country_list #sectors*)

year(*#*) specifies the reference year. Default is the last available observation (2014 for `wiod` or 2011 if `tiva` is specified).

`kww` specifies the Koopman, Wang and Wei (2014) aggregate trade decomposition approach.

`bilateral[(type)]` specifies the Borin and Mancini (2015) bilateral trade decomposition approach. Default is `sink`.

`sectoral` specifies to look at country-sector measures.

`participation` specifies the participation measures in global value chains.

`positioning` specifies the positioning (upstreamness and downstreamness of a country or a country-sector).

`outfile(string)` writes the command output in the specified ASCII file (if no extension is given, `.csv` is assumed), nothing is displayed in the output window.

`mata` specifies that the command output will be saved as a Mata matrix. Default is a matrix stored in `r()`.

Some examples

```
icio, iciotable(tiva) year(2011) origin(italy)
```

```
icio, iciotable(wiod) year(2014) origin(italy)  
participation mata
```

```
icio, iciotable(wiod) year(2014) origin(italy)  
dest(germany) bil out("/path/to/file")
```

```
icio, icioload(eora2012.csv listeora.csv 26) origin(italy)  
dest(iran) bil sect out("/path/to/file")
```

icio dialog

ICIO - Inter-Country Input-Output Tables

Country-decomposition Sectorial-decomposition

Select source data:
wiot

Country (origin)
Italy

Country (destination)
Germany

Decomposition approach:
☐ KWW
☒ Bilateral (BM)
sink

☒ Display output on screen

Export output to file:
 Browse ...

? R

Thank you for your attention