# Implications of Global Value Chain Integration on World Trade Flows
# Concepts and Implications
# *Keeping it simple….*

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**Partially based on "Tracing value-added and double counting in gross exports" by Koopman, Wang and Wei, AER 2014 104(2): 459-94.; Extended by Wang, Wei and Zhu in NBER wp19677 "Quantifying International Production Sharing at the Bilateral and Sector Level"**

The views expressed in this presentation are solely of the presenter. It is not meant to represent in anyway the official views of the WTO.

# Objectives

- Developed to establish a precise relation between value-added measures of trade and official trade statistics, thus creating a gross trade accounting method that is fully consistent with the SNA standard;
  - We needed to transform traditional trade data into something more consistent with national income account data. Correct for intermediates, but also how and where traded goods are actually consumed. Trade in Value Added.
- Why did we do this?
  - In a world of Global Value Chains traditional trade data can be very misleading and measures like the export to GDP ratio not very informative.
  - To help policymakers and the public understand what official trade statistics really mean in terms of generating economic growth and in the linkages between firms and countries.
  - Traditional bilateral trade balances can be very misleading. US-China

# Perspectives

- We drew upon very old work - Leontief insights and thought about forward and backward linkages in modern production – increasingly those linkages were crossing borders.
- Note that the modern part of this issue relates to GVCs, but its important to think of these in the context of DVCs – how firms divvy up production – domestically and globally.
  - Fragmentation, Firm size (SMEs and MNCs), Firm size growth, FDI, etc.
- Why TiVA indicators estimated from national IO tables are not sufficient to measuring international production sharing and global value-chains
- Traditional and value-added based RCAs

# Useful information from measures and structure of double counting in a country's gross exports

- A country's exports of value-added is smaller than its gross exports due to:

  a) the use of imported inputs to produce exports;

  b) a part of its DVA in exports may return home after being processed abroad;

  c) Double counting due to two way intermediate goods trade.
- Two countries can have identical value added to gross exports ratios but very different structure of (a), (b) and (c).
- Therefore, we need to measure double counted terms and their relative importance, in addition to trade in value-added to quantify pattern of cross country production sharing and each country's position and participation in global value chain.

# Leontief insight- the basic idea underlying TiVA indicators – relying on Input Output Tables

- When $1 export is produced, a first round of value-added is generated: Direct domestic value-added induced by the $1 exports.
- To produce that export, intermediate inputs have to be used. The production of these intermediate inputs also generates value-added. This is the indirect domestic value added induced by the $1 exports.
- Such a process to generate indirect value-added can be traced throughout the economy, as intermediate inputs are used to produce other intermediate inputs.

# Production and trade in a two-country world Using Leontief and IO tables

- All output is used as intermediate or final goods at home or abroad

$$X^s = A^{ss}X^s + Y^{ss} + A^{sr}X^r + Y^{sr} \qquad (1)$$

- In block matrix notations

$$\begin{bmatrix} X^s \\ X^r \end{bmatrix} = \begin{bmatrix} A^{ss} & A^{sr} \\ A^{rs} & A^{rr} \end{bmatrix} \begin{bmatrix} X^s \\ X^r \end{bmatrix} + \begin{bmatrix} Y^{ss} + Y^{sr} \\ Y^{rs} + Y^{rr} \end{bmatrix} \qquad (2)$$

- Rearrange

$$\begin{bmatrix} X^s \\ X^r \end{bmatrix} = \begin{bmatrix} I - A^{ss} & -A^{sr} \\ -A^{rs} & I - A^{rr} \end{bmatrix}^{-1} \begin{bmatrix} Y^{ss} + Y^{sr} \\ Y^{rs} + Y^{rr} \end{bmatrix} = \begin{bmatrix} B^{ss} & B^{sr} \\ B^{rs} & B^{rr} \end{bmatrix} \begin{bmatrix} Y^s \\ Y^r \end{bmatrix} \qquad (3)$$

$$v_j^c \equiv va_j^c / x_j^c = 1 - \sum_i^N a_{ij}^{sc} - \sum_i^N a_{ij}^{rc} \quad (c = s, r \quad j = 1,2,...,N) \qquad (4)$$

= 1 – intermediate input share from both countries

$$VT_{12} = V_1 X_{12} = V_1 B_{11} Y_{12} + V_1 B_{12} Y_{22}$$

# Decomposition of value-added and final goods production based on Leontief insights (1)

When N=2

Capturing the linkages – not just Global!

$$\hat{V} B \hat{Y} = \begin{bmatrix} v_1^s & 0 & 0 & 0 \\ 0 & v_2^s & 0 & 0 \\ 0 & 0 & v_1^r & 0 \\ 0 & 0 & 0 & v_2^r \end{bmatrix} \begin{bmatrix} b_{11}^{ss} & b_{12}^{ss} & b_{11}^{sr} & b_{12}^{sr} \\ b_{21}^{ss} & b_{22}^{ss} & b_{21}^{sr} & b_{22}^{sr} \\ b_{11}^{rs} & b_{12}^{rs} & b_{11}^{rr} & b_{12}^{rr} \\ b_{21}^{rs} & b_{22}^{rs} & b_{21}^{rr} & b_{22}^{rr} \end{bmatrix} \begin{bmatrix} y_1^s & 0 & 0 & 0 \\ 0 & y_2^s & 0 & 0 \\ 0 & 0 & y_1^r & 0 \\ 0 & 0 & 0 & y_2^r \end{bmatrix} \quad (4)$$

$$= \begin{bmatrix} v_1^s b_{11}^{ss} y_1^s & v_1^s b_{12}^{ss} y_2^s & v_1^s b_{11}^{sr} y_1^r & v_1^s b_{12}^{sr} y_2^r \\ v_2^s b_{21}^{ss} y_1^s & v_2^s b_{22}^{ss} y_2^s & v_2^s b_{21}^{sr} y_1^r & v_2^s b_{22}^{sr} y_2^r \\ v_1^r b_{11}^{rs} y_1^s & v_1^r b_{12}^{rs} y_2^s & v_1^r b_{11}^{rr} y_1^r & v_1^r b_{12}^{rr} y_2^r \\ v_2^r b_{21}^{rs} y_1^s & v_2^r b_{22}^{rs} y_2^s & v_2^r b_{21}^{rr} y_1^r & v_2^r b_{22}^{rr} y_2^r \end{bmatrix}$$

Decompose GDP by sector; forward linkage

Decompose final goods by VA source; backward Linkage

# Applications of Leontief insight measuring TiVA and quantifying GVC (2)

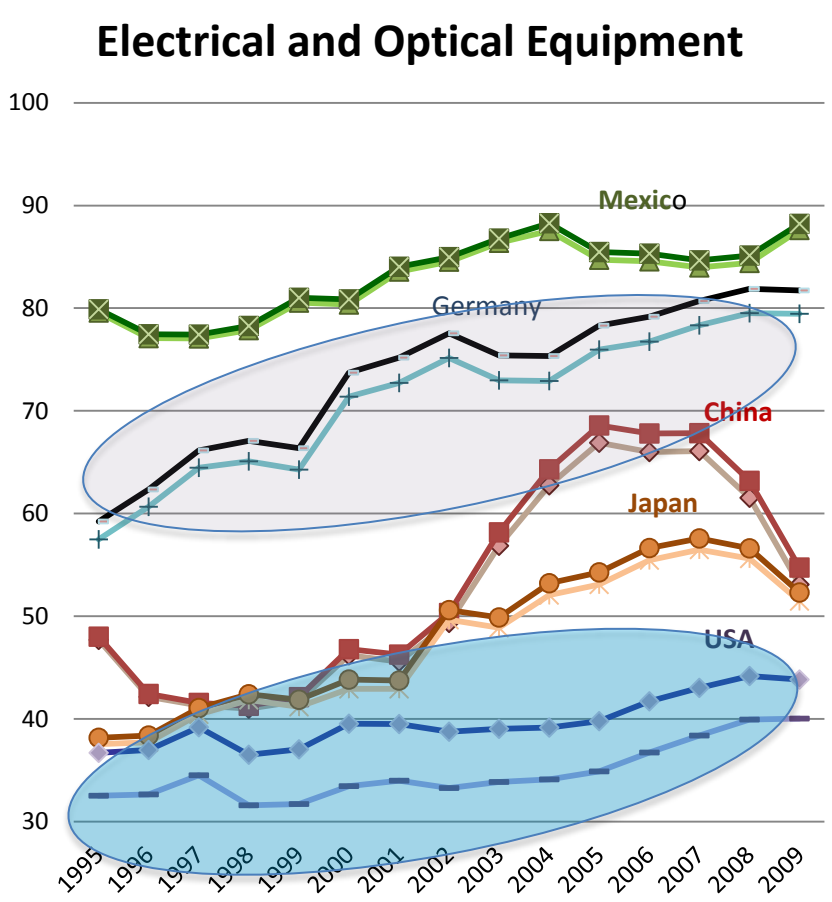
- Decompose GDP by industry to where and how it is used based on Leontief insights (forward looking linkage, sum matrix across columns).

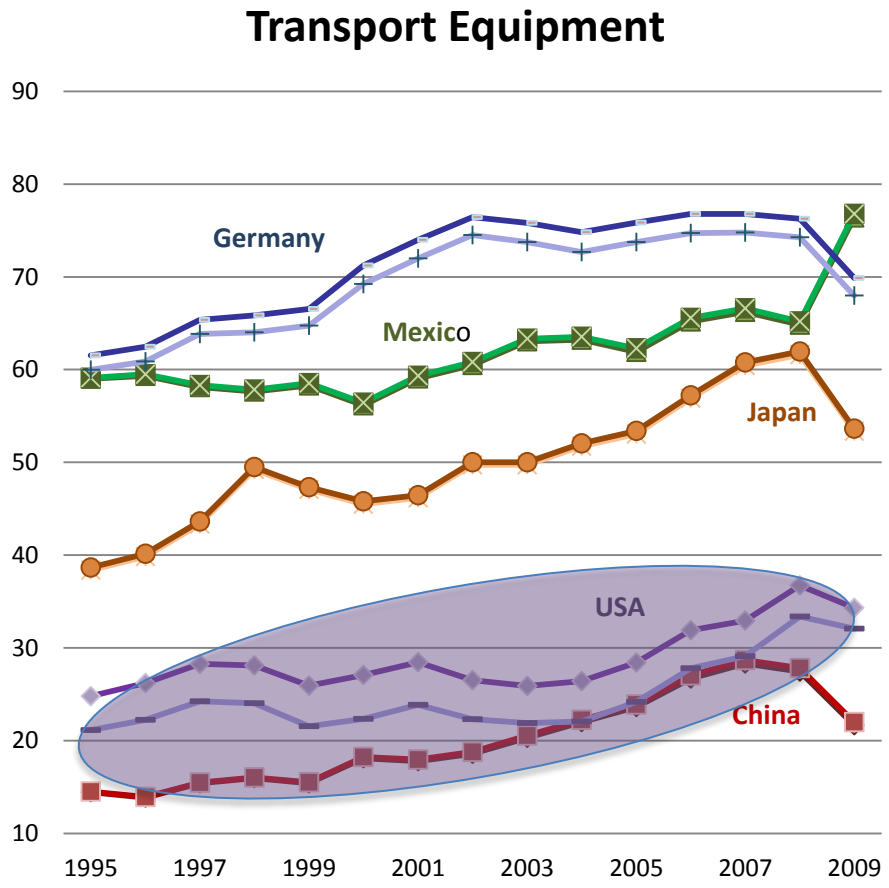
- One needs to be careful. For some countries and sectors, where a significant amount of exported domestic value-added returns home to be consumed some measures may not perform well.
- For instance the Johnson and Noguera VAX ratio computes value-added exports based on only forward linkages (the amount of domestic value-added created in the source country's production sector absorbed in the destination country)
- But in the source country's sector gross exports there is also domestic value-added from other domestic sectors (backward linkages).

# VA exports/GDP (VAX) and DVA in exports/GDP ratio

## The difference is DVA returned to the source country

## Sector and Country Differences – look at the gap between lines

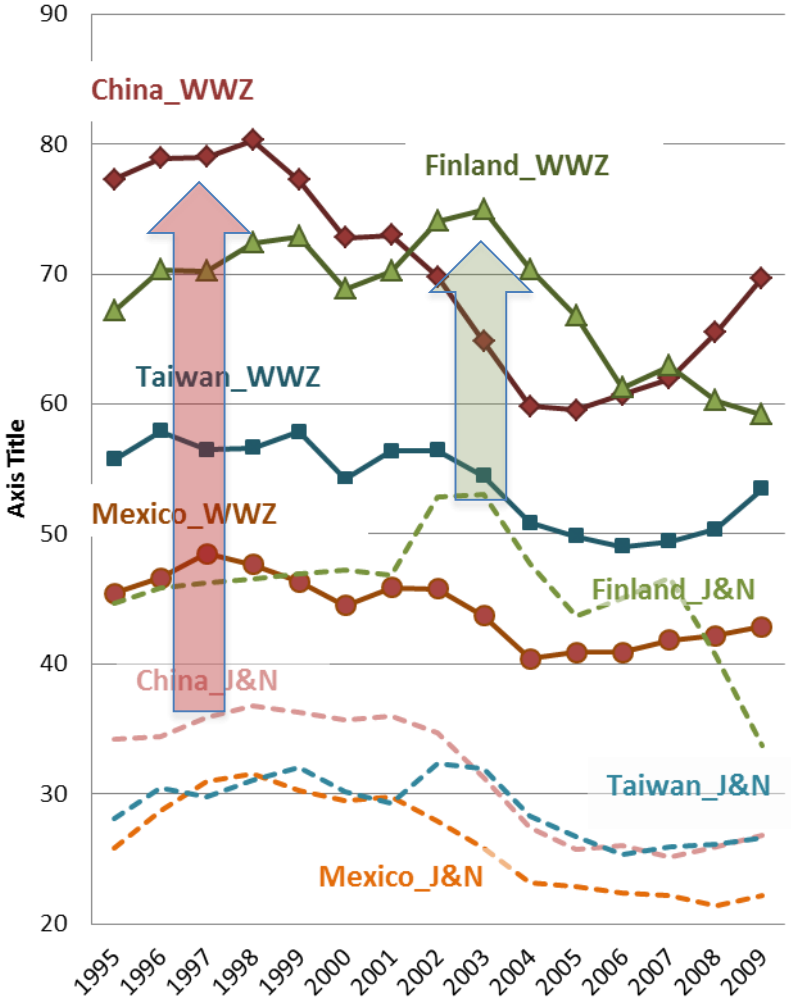


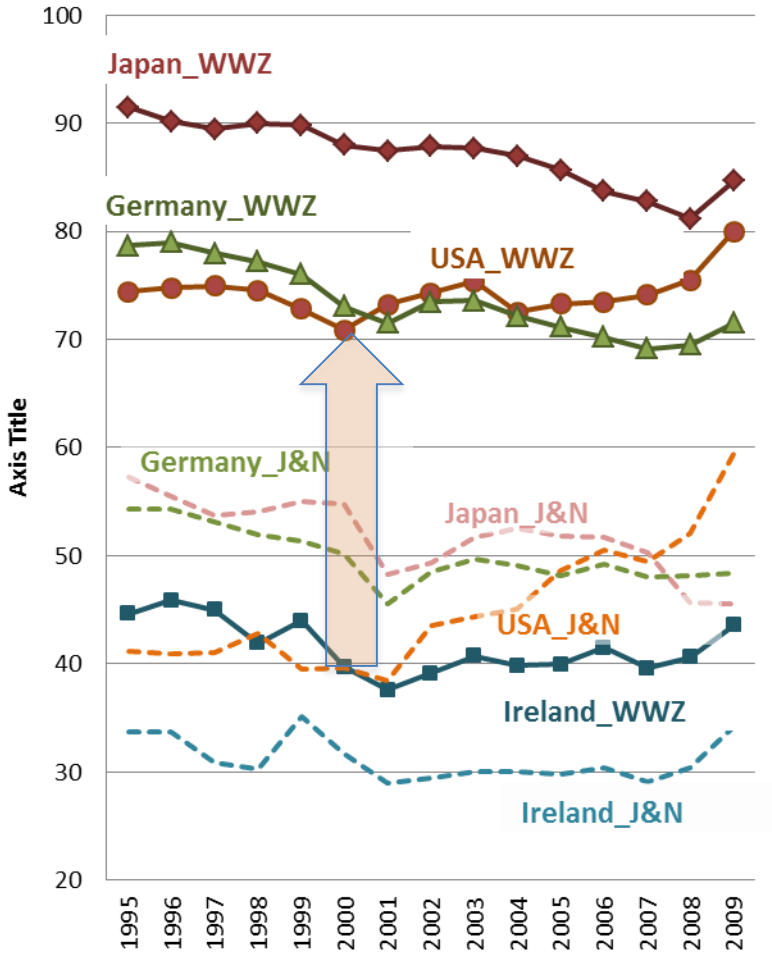



# VA exports (VAX) to gross exports ratio

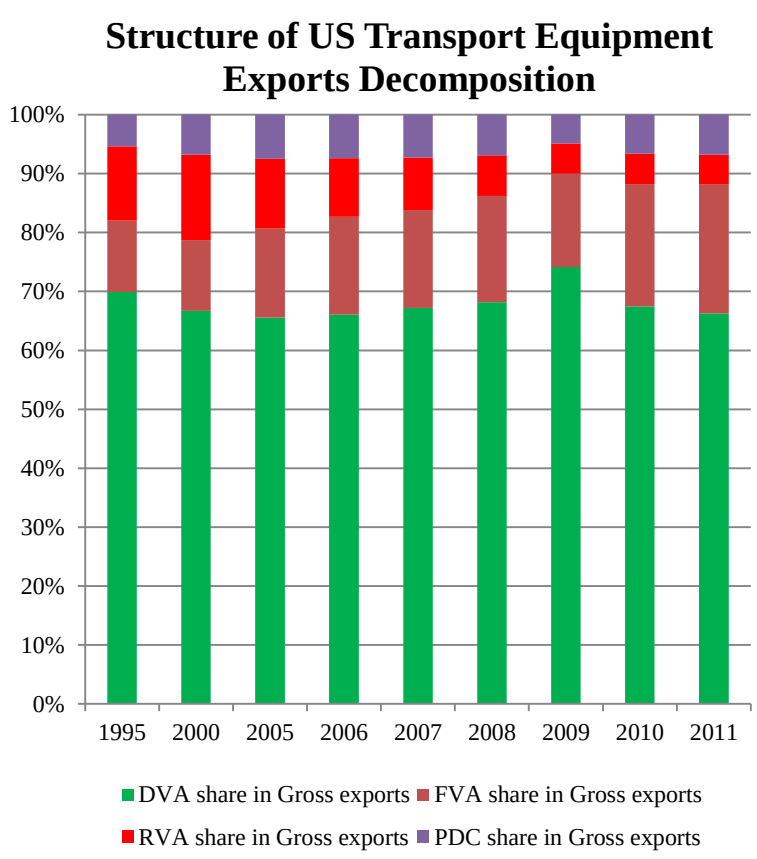
## - Electrical and optical equipment (WIOD sector14)

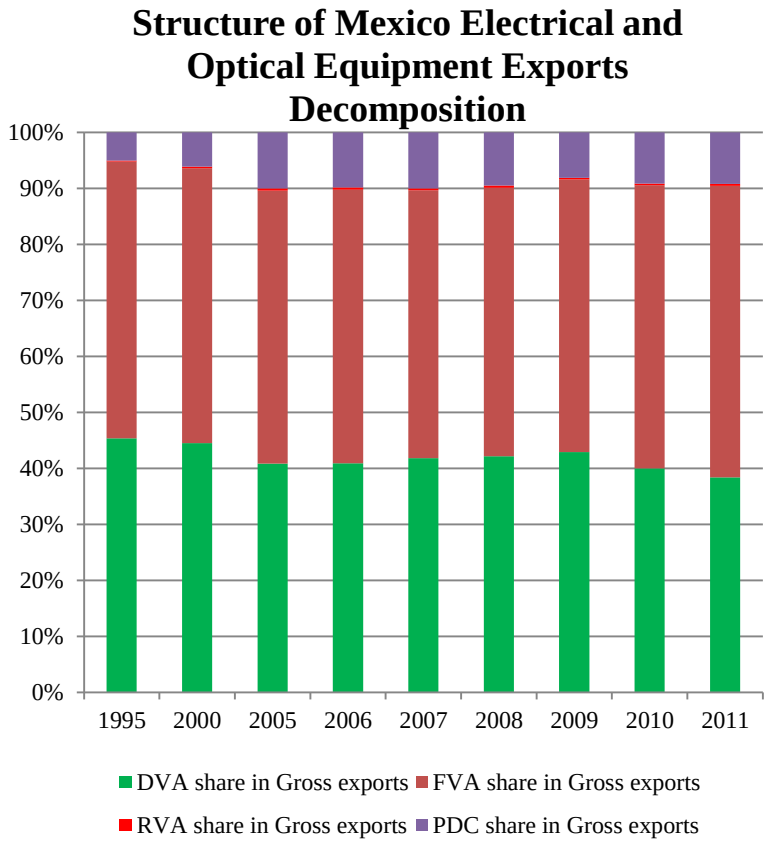
WWZ – forward and backward linkages, J&N – forward linkages only



# Decomposition of gross exports into its major components at country/sector level



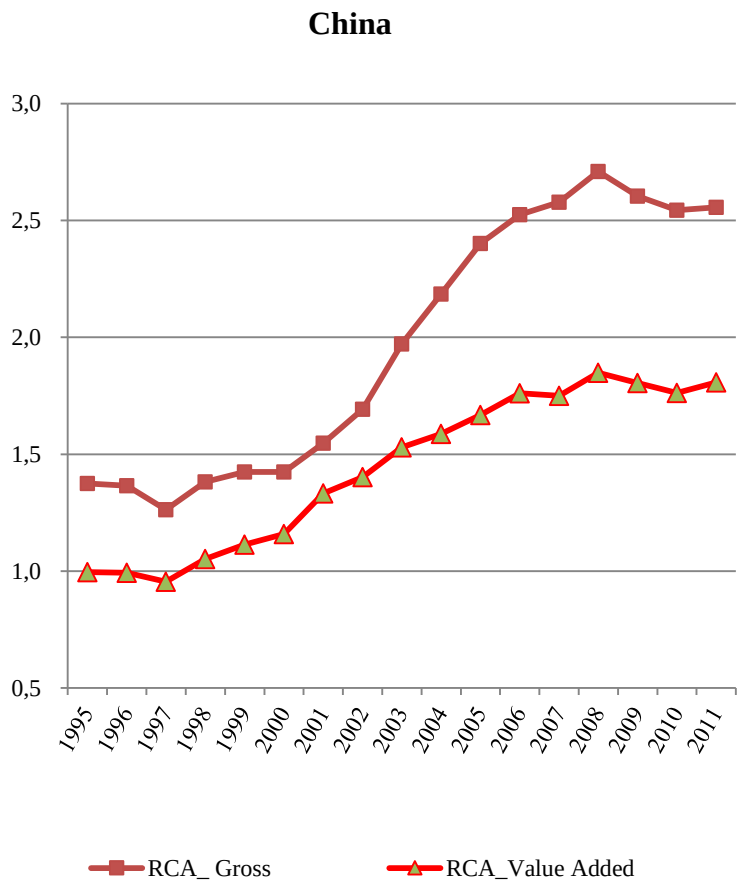
# Applications of Leontief insight measuring TiVA and quantifying GVC (3)

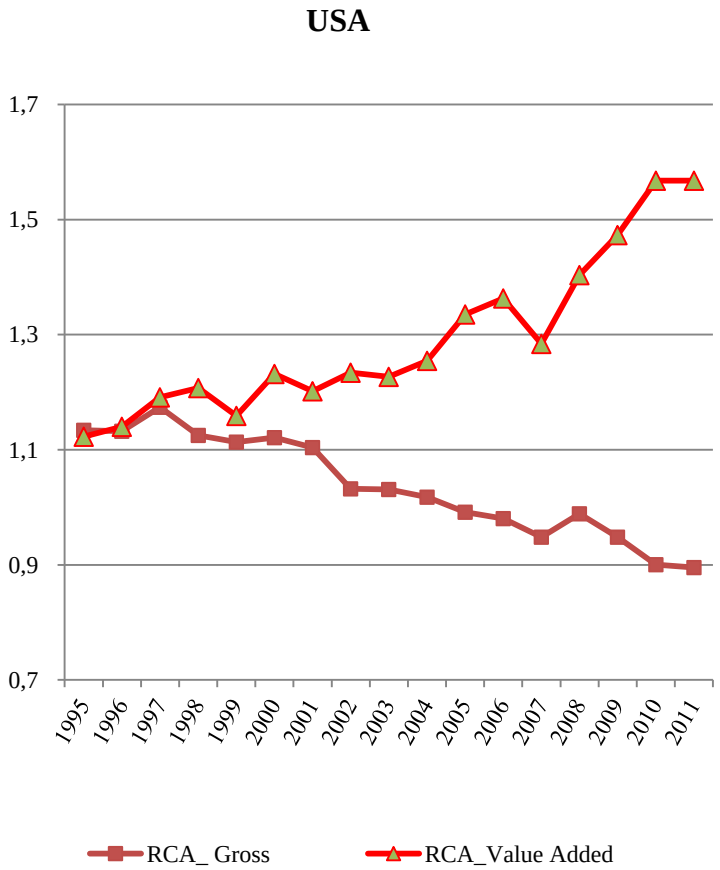
- To compute value added by forward or backward linkages, one only needs to apply the Leontief insight directly (i.e., using Leontief inverse multiplied with the final demand), and does not need to decompose intermediate goods trade.
- To decompose the gross exports flows into various value added components and double counted terms, intermediate goods trade has to be decomposed, this will go beyond the original Leontief insight.
- In Leontief's time of 1930s-1960s, intermediate goods trade is relatively unimportant. Today, it is about two thirds of the world gross trade. So being able to decompose intermediate goods trade is crucial to whether gross trade flows can de decomposed.

# RCA Index should take into account both domestic and international production sharing

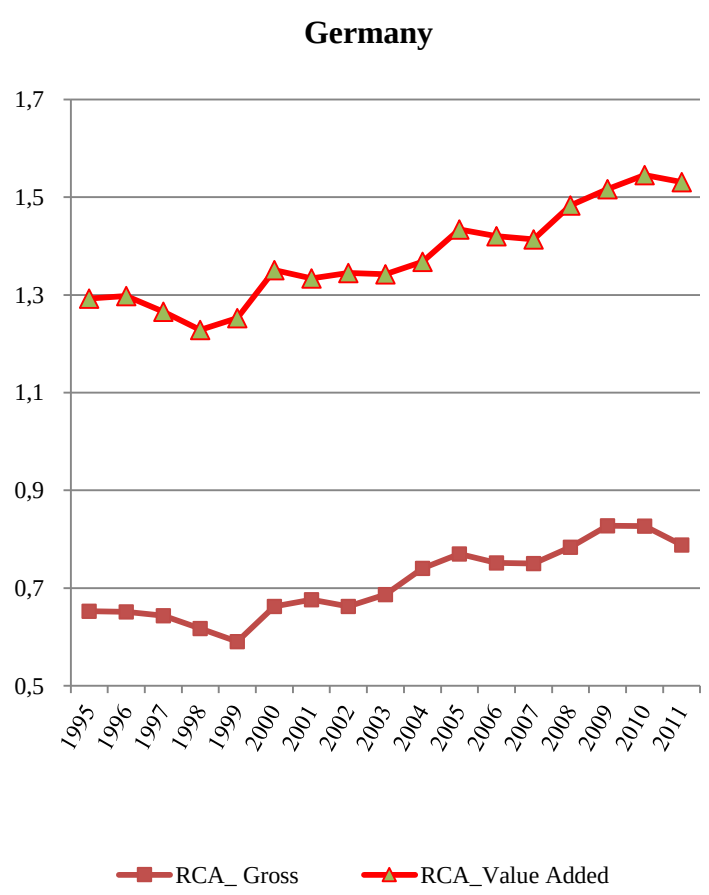
- Traditional RCA ignores two important facts:
  - A country-sector's gross exports include foreign value-added and double counted terms due to back and forth intermediate goods trade.
  - a country-sector's value added may be exported indirectly via the country's exports in other sectors.
  - A conceptually correct measure of comparative advantage needs to exclude foreign-originated value added and pure double counted terms but include indirect exports of a sector's value added through other sectors of the exporting country.

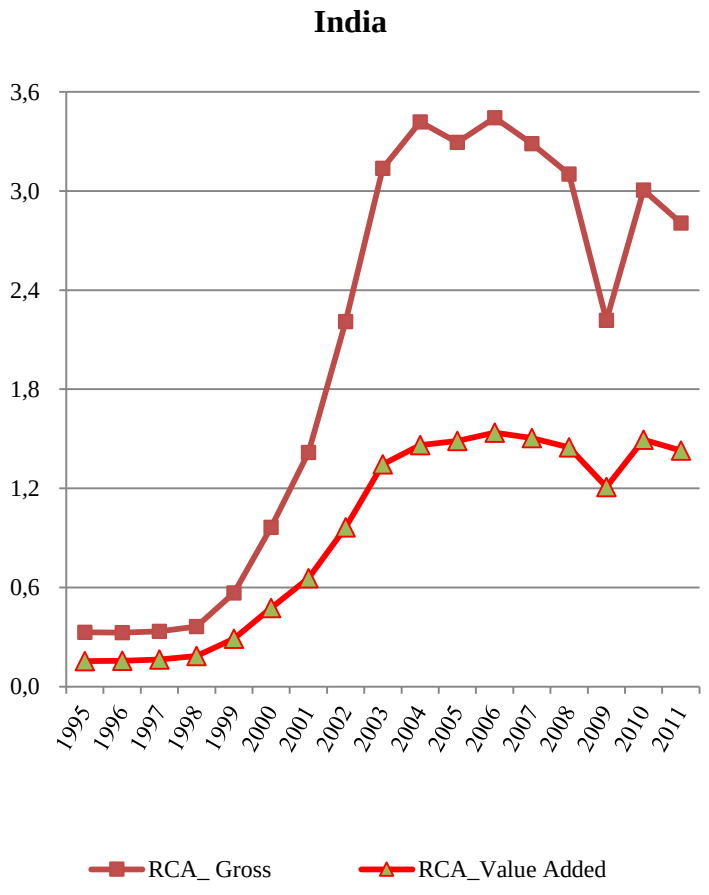
# RCA indexes for electric and optical equipment exports



# RCA indexes for business services exports



# Why TiVA indicators based on national IO tables are not sufficient

- What can be estimated from a national IO table:
  - Decompose a country's gross exports into domestic and foreign content by assume imports are 100% foreign sourced
  - Compute DVA in exports, including direct VA exports and indirect VA exports via upstream or downstream sectors

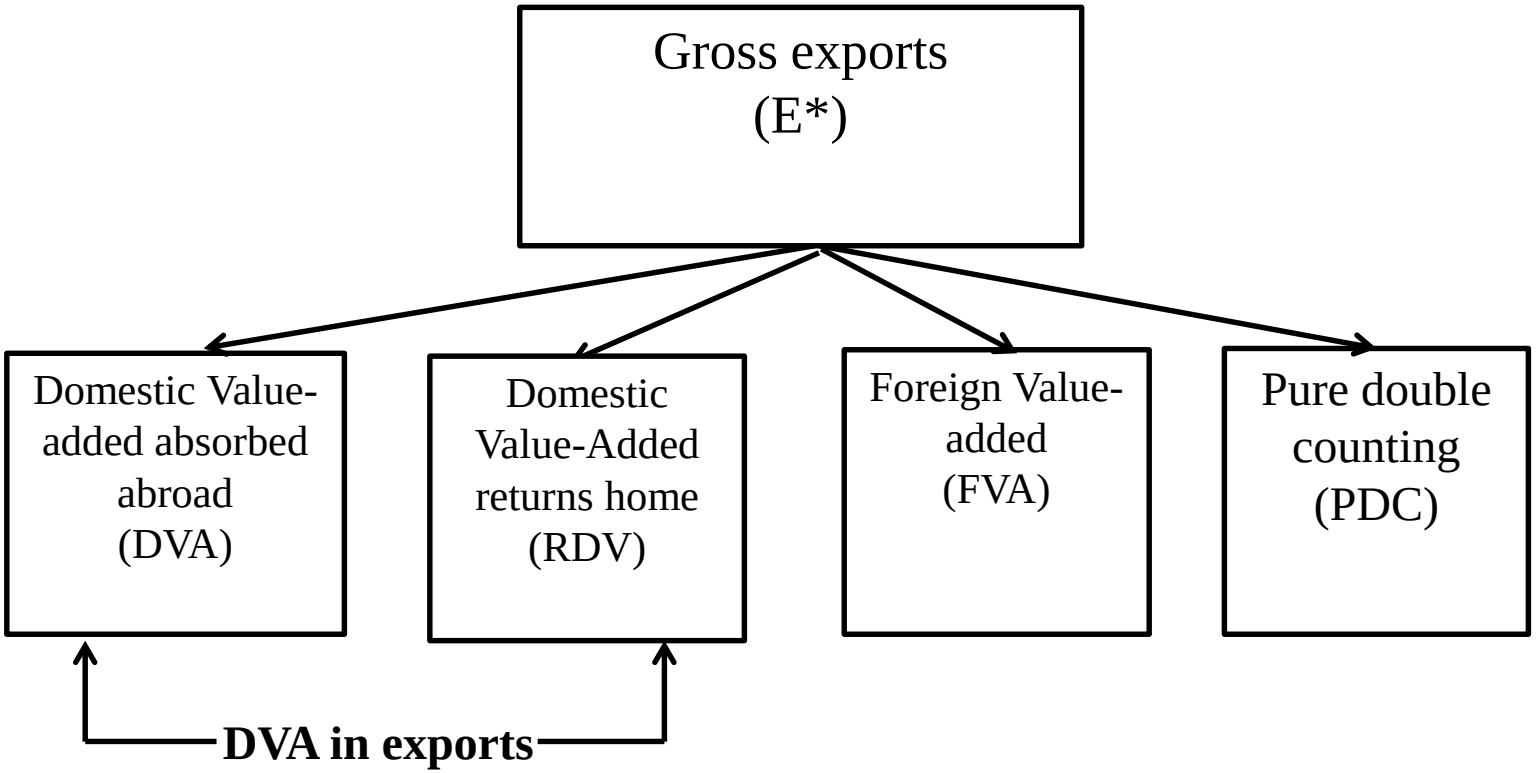
- What can not be estimated from a national IO table:
  - Domestic value-added first exported but return home via imports
  - Indirect exports of DVA via third countries
  - Double counting due to two way intermediate goods trade
  - Trace FVA/VS by country sources
  - Decompose bilateral trade flows

# Conclusion

- Our accounting method identifies
  - exports of domestic value added;
  - domestic value-added exported first but eventually returns home;
  - foreign value-added used in production of exports and absorbed by other countries;
  - and double counted items arising from two way intermediate goods trade.
- These conceptually different components sum up to 100% of official gross exports statistics at both sector and aggregate level.
- By identifying which parts of the official trade statistics are double counted and the sources of the double counting, we provide a effective way to correctly interpret official trade statistics in value-added terms and provide an index to quantitatively measure what and how much is double counted for each intermediate trade flows.

# Gross Exports Accounting: Major Categories

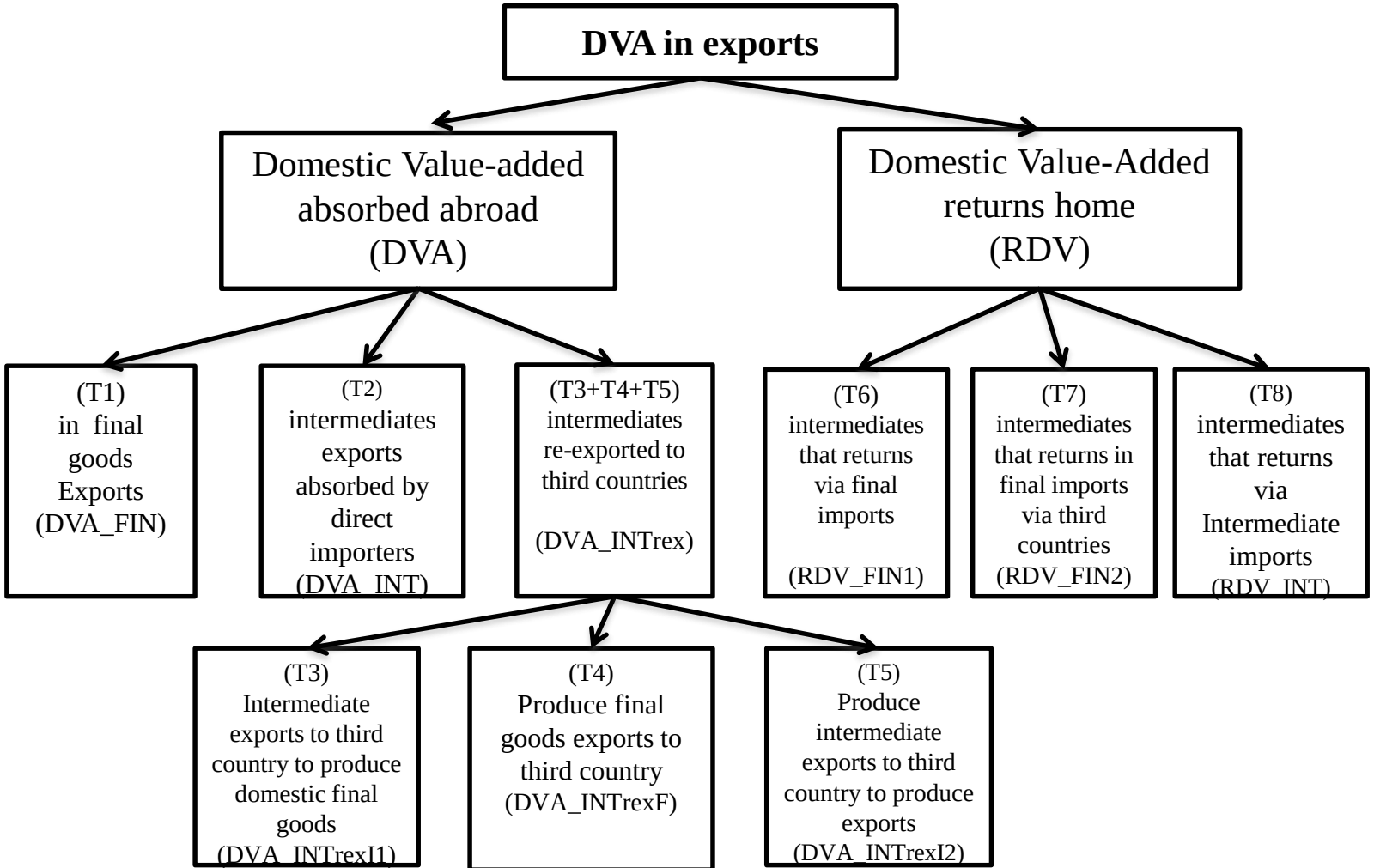
***based on but beyond Leontief insights***




E* can be at country/sector, country aggregate, bilateral /sector and bilateral aggregate; both DVA and RDV are backward-linkage based

# Gross Exports Accounting: Domestic Value-added

***based on but beyond Leontief insights***



# Gross Exports Accounting: Foreign Value-added and Pure Double Counting

***based on but beyond Leontief insights***