



OECD WORK ON INTER-COUNTRY INPUT-OUTPUT TABLES (ICIO) AND TRADE IN VALUE ADDED (TIVA) INDICATORS



PROLOGUE



ICIO 2018 – Construction Under Way

OECD Inter-Country Input-Output (ICIO) infrastructure

Main improvements/changes from ICIO 2016:

- SNA 2008, ISIC Rev. 4
- More up-to-date information
 - Core years: 2005-2015
- Under consideration:
 - Methods and coverage for projections to 2016
- New countries and industries are also being considered
 - Pending on data and resource availability



ICIO 2018 – Construction Under Way

- Main improvements/changes from ICIO 2016:
 - New procedures for industries and estimation of “Rest of World”, allowing:
 - Improvement in estimation of international trade flows;
 - Reduction in values of “*discrepancies*”;
 - A more flexible processing system allowing for “easier” inclusion of new industries and/or countries.
- Note:
 - China and Mexico split will be kept in ICIO 2018



ICIO 2018 – Release Timetable

- Q1 2018
 - Preliminary results
- Q2-Q3 2018
 - ICIO and TiVA indicators
- Q3-Q4 2018
 - Embodied Jobs and embodied CO₂ estimates and analysis



TIVA INDICATORS



TiVA indicators: meeting various needs

Experienced I-O practitioners / GVC analysts

- With appropriate IT skills and software tools, carry out a wide range of GVC-related analyses. Just need the ICIO “objects” i.e. vectors and matrices (<http://oecd/icio>)
- Understand and discuss indicators with equations (matrix algebra etc.)
- *“OECD produces too many indicators!”*

Researchers and policy analysts not familiar with I-O techniques

- Demand for easy-to-use, and understand, TiVA indicators
- Require ‘simple’ explanations of indicators and their use
- *“More indicators please!”*

Based on user feedback (e.g. from users in ECO) :

- Metadata for TiVA indicators has been updated (in [OECD.STAT](#) “cubes”)
- **The [TiVA indicator document](#) is being updated to provide “simpler explanations” for the uninitiated**

This presentation: Trying to explain TiVA indicators with few equations



Starting point: ICIO structure

<u>Inter-country I-O</u> <i>at basic prices</i>		Intermediate demand						Final consumption and GFCF (+ changes in inventories)			Direct purchases by non-residents			Output (X)
		Cou A		Cou B		Cou C		Cou A	Cou B	Cou C	Cou A	Cou B	Cou C	
		Ind 1	Ind 2	Ind 1	Ind 2	Ind 1	Ind 2							
Cou A	Ind 1													X (A1)
	Ind 2													X (A2)
Cou B	Ind 1													X (B1)
	Ind 2													X (B2)
Cou C	Ind 1													X (C1)
	Ind 2													X (C2)
Taxes less subsidies ..		... on intermediate products						... on final products						Global GDP
		NTZA1	NTZA2	NTZB1	NTZB2	NTZC1	NTZC2	NTYA	NTYB	NTYC	NTYA	NTYB	NTYC	
Value-added (VA)		VA (A1)	VA (A2)	VA (B1)	VA (B2)	VA (C1)	VA (C2)							
Output (X)		X (A1)	X (A2)	X (B1)	X (B2)	X (C1)	X (C2)							
								Global GDP						

Key:

Cross-border flows of **intermediate** goods and services

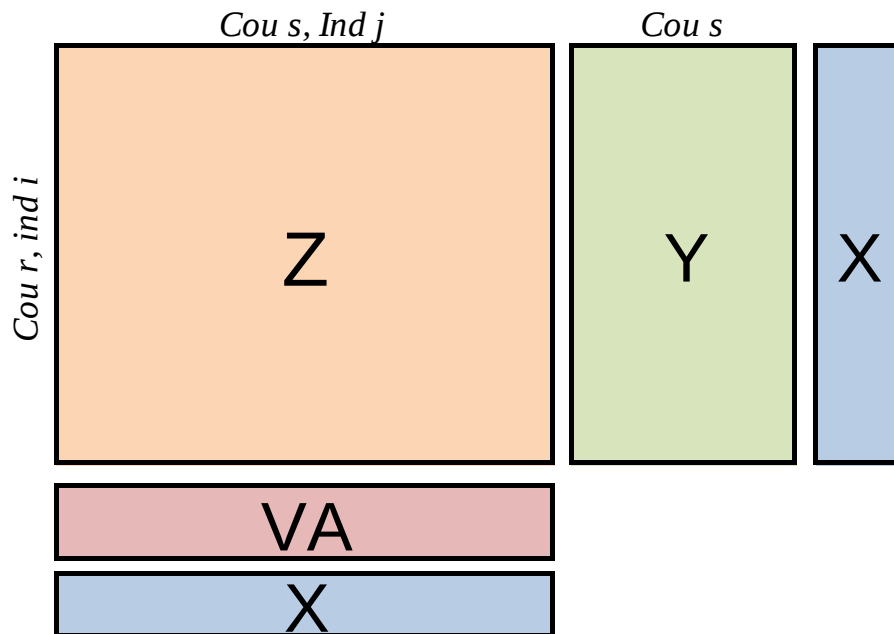
Domestic flows of **intermediate** goods and services

Cross-border flows of **final** goods and services

Domestic flows of **final** goods and services



Basic equations



$$VA = Y$$

$$X = AX + Y$$

where A is the input coefficient matrix: $a_{ij}^{rs} = Z_{ij}^{rs} / x_j^s$

Leontief inverse:

$$B = (I - A)^{-1}$$

b_{ij}^{rs} = direct and indirect inputs from industry i in country r for the production of one unit of output by industry j in country s .

vBe

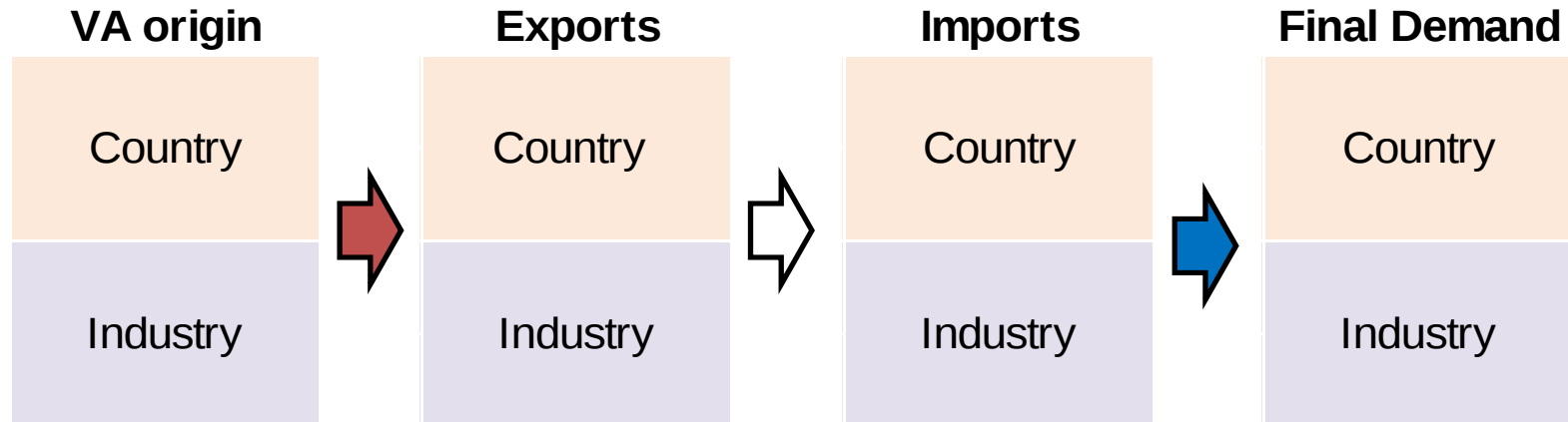
$v_j^s = va_j^s / x_j^s$ i.e. VA/output ratios

e is exports, final demand etc.



Global flows of goods and services

4 perspectives, 8 dimensions



Direct flows of Intermediate and final goods and services.

Note: exports of final products meet final demand in importing country



From the country and industry of value added origin, *intermediate* goods and services may be processed by many firms in many countries before being processed by the exporting country. Note: the exporting country is often the main origin of value added.



Intermediate goods and services processed by an importing country may pass through many countries and industries before final demand goods and services reach the ultimate destination of demand. Note: the importing country may be the country of final demand.



Many combinations

In theory, could show indicators to reveal e.g.

- *value added from Chinese basic metals industry*
- *embodied in Japanese exports of ICT components*
- *imported by Mexican machinery industry*
- *ultimately meeting US final demand for motor vehicles*

But with 63 countries and 34 industries/product groups:

$(63 \times 34)^4$ combinations $\approx 21,000,000,000,000$

This is without considering regional groups, industry aggregates, splitting FD into GFCF and HHFC, splitting exports into intermediates and final goods and services etc.

Challenge: to produce easy-to-use and easy-to-understand TiVA indicators for policy analysts and researchers

(i.e. reduce 8 dimensions to 2,3 or 4)



Indicators overview (published on OECD.STAT)

Core indicators (2 or 3 dimensions)

Gross exports based:

e.g. Domestic and foreign VA content of exports (EXGR_DVA and EXGR_FVA)

Final demand based:

e.g. DVA embodied in Foreign final demand, Foreign VA in domestic demand

Four cubes with 4 dimensions (for the more adventurous)

Value added origin of gross exports, Value added origin of gross imports

Value added origin of final demand.

Value added origin of gross exports by final demand destination

All accessible from <http://oe.cd/tiva>

Common confusion: what does industry refer to?

Value added origin industry? exporting industry? or final demand industry/product group?



Gross trade based indicators

Gross exports, EXGR

VA origin	Exports	Imports	Final Demand
	Country (c)	Country (p)	
	Industry (i)		

Gross imports, IMGR

VA origin	Exports	Imports	Final Demand
	Country (p)	Country (c)	
	Industry (i)		

Gross trade balance, BALGR = EXGR_(c,p,i) – IMGR_(c,p,i)

**Domestic Value Added
content of gross exports
EXGR_DVA**

VA origin	Exports	Imports	Final Demand
country = c	Country (c)	Country (p)	
	Industry (i)		

Indicator dimension

Measured attribute



Gross trade based indicators (cont)

**Direct DVA content of
Gross exports**
EXGR_DDC

VA origin *	Exports	Imports	Final Demand
country =c	Country (c)		
industry =i	Industry (i)		

**Indirect DVA content of
Gross exports**
EXGR_IDC

country =c	Country (c)	
	Industry (i)	
Σ industry $\neq$ i		

** does not include DVA that has returned, via imports, after previously being exported
i.e. only the VA directly generated by the domestic exporting industry*

**DVA content of
gross imports**
IMGR_DVA

VA origin	Exports	Imports	Final Demand
country = c	Country (p)	Country (c)	
	Industry (i)		

DVA share of gross imports **IMGR_DVASH**

$$= \text{IMGR_DVA}_{(c,p,i)} / \text{IMGR}_{(c,p,i)}$$



Backward and forward participation in GVCs (*narrow definition*)

**Foreign VA content
of gross exports**
EXGR_FVA

VA origin	Exports	Imports	Final Demand
	Country (c)		
$\sum \text{country} \neq c$			
	Industry (i)		

Foreign value added share of gross exports (industry **intensity** measure)

$$\text{EXGR_FVASH}(c,i) = \text{EXGR_FVA}(c,i) / \text{EXGR}(c,i)$$

Industry FVA contribution to gross exports (industry **magnitude** measure)

$$\text{EXGR_TFVAIND}(c,i) = \text{EXGR_FVA}(c,i) / \text{EXGR}(c)$$

**Domestic VA
embodied
in foreign exports**
EXGR_DVAFX

VA origin	Exports	Imports	Final Demand
Country (c)			
	$\sum \text{country} \neq c$		
Industry (i)			

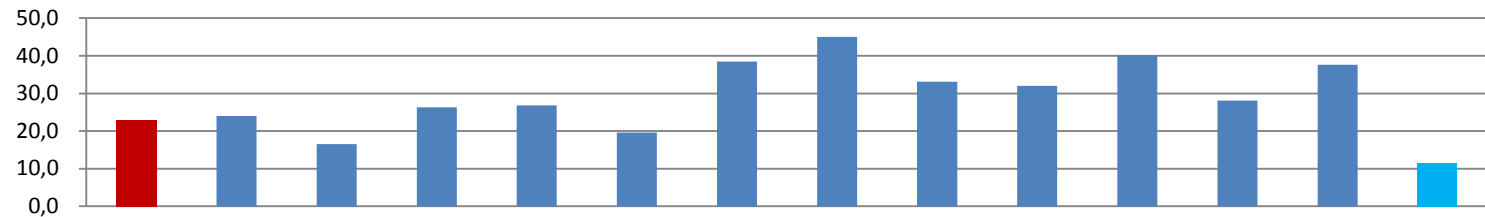
$$\text{EXGR_DVAFXSH}(c,i) = \text{EXGR_DVAFX}(c,i) / \text{EXGR}(c)$$



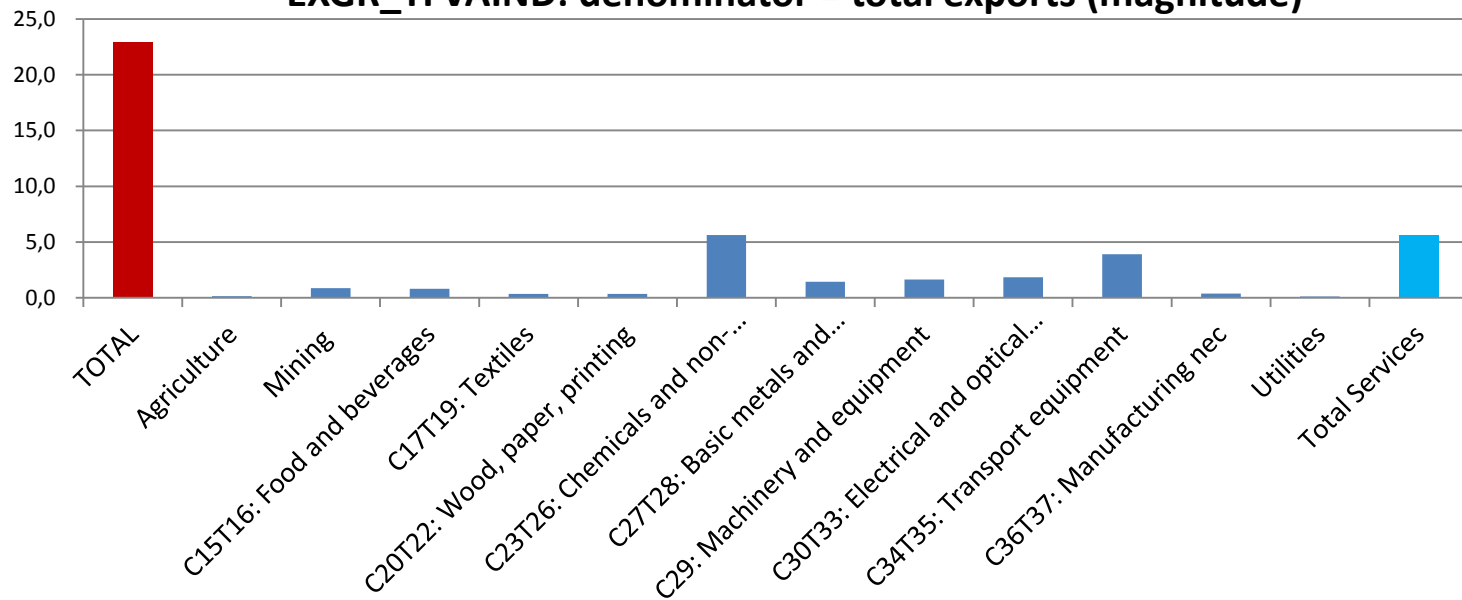
Different denominators

e.g. based on Foreign VA content of gross exports (EXGR_FVA)

EXGR_FVASH: denominator = industry exports (intensity)



EXGR_TFVAIND: denominator = total exports (magnitude)



Total shares are the same



Service content of Gross exports

**Domestic Services VA
content of Gross exports**
EXGR_SERV_DVA

VA origin *	Exports	Imports	Final Demand
country =c	Country (c)		
	Industry (i)		
$\sum$ services			

**Foreign Services VA
content of Gross exports**
EXGR_SERV_FVA

VA origin *	Exports	Imports	Final Demand
	Country (c)		
$\sum$ country $\neq$ c	Industry (i)		
$\sum$ services			

$$\text{EXGR_SERV_DVASH} = \text{EXGR_SERV_DVA}_{(c,i)} / \text{EXGR}_{(c,i)}$$

$$\text{EXGR_SERV_FVASH} = \text{EXGR_SERV_FVA}_{(c,i)} / \text{EXGR}_{(c,i)}$$



Using 4 dimensions

1. VA origin of gross exports

VA origin	Exports	Imports	Final Demand
Country (s)	Country (c)		
Industry (h)	Industry (i)		

2. VA origin of gross imports

VA origin	Exports	Imports	Final Demand
Country (s)	Country (c)	Country (p)	
	Industry (i)		

Gross trade-based core TiVA indicators (2, 3 dims) can be derived from these cubes

For example, from 1. above:

EXGR_DVA (set source country *s* = “DXD: Domestic”, source industry *h* = “CTOTAL”)

hence **EXGR_FVA**, **EXGR_DVASH**, **EXGR_FVASH**, **EXGR_TFVAIND**

Also, **EXGR_SERV_DVASH** (set source industry = “C45t95”)

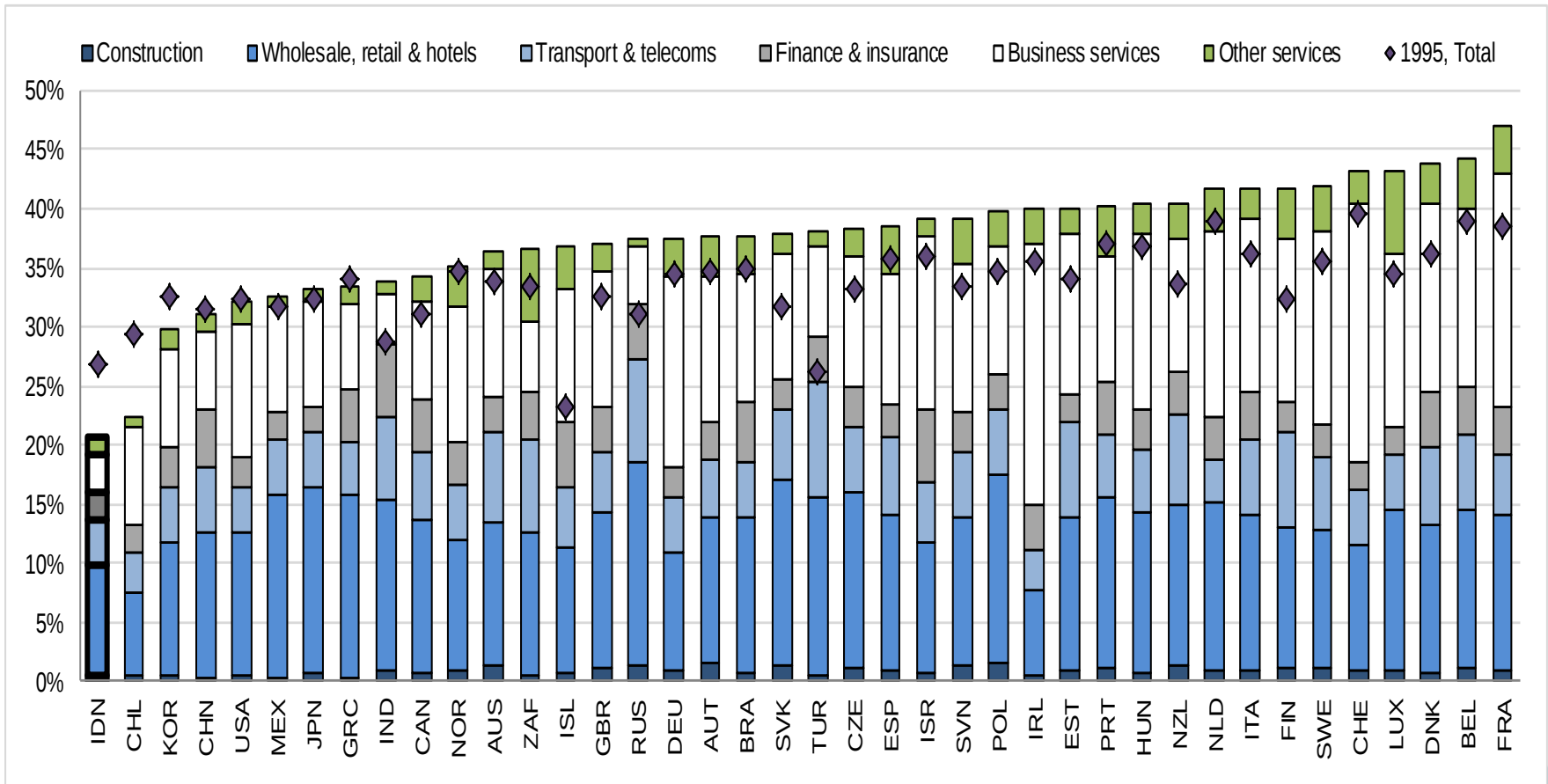
and, **EXGR_DVAFXSH**.

Many other variations for users to play with ...



Origin of value added in gross exports

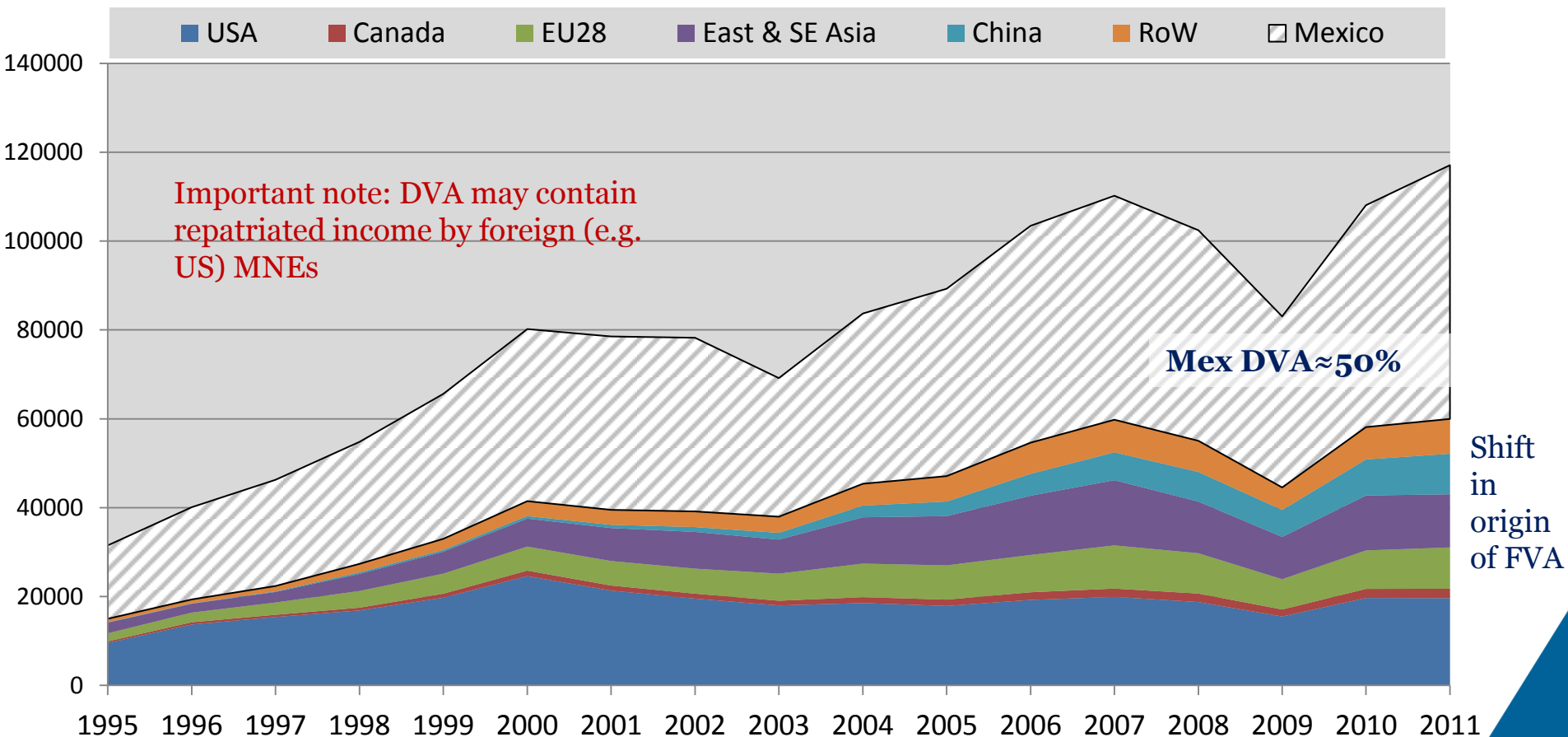
Services Value Added content of manufacturing exports





Origin of value added in gross imports

VA source of US imports of machinery and transport equipment from Mexico



http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2016_C5



Final demand based indicators

**Domestic VA embodied
in foreign final demand**
FFD_DVA

VA origin	Exports	Imports	Final Demand
Country (c)			Country $\neq$ c
Industry (i)			

Share of Domestic VA embodied in foreign final demand
VALU_FFDDVA = FFD_DVA(c,i) / Value Added (c,i)

**Foreign VA embodied
in domestic final demand**
DFD_FVA

VA origin	Exports	Imports	Final Demand
Country $\neq$ c			Country (c)
Industry (i)			

Value added balance, $BALVAFD = FFD_DVA - DFD_FVA$

Note: at the total economy level $BALVAFD = BALGR$

i.e. Gross trade balance = VA trade balance: differences for bilateral relations



Using 4 dimensions

VA origin of
Final Demand

VA origin	Exports	Imports	Final Demand
Country (s)			Country (d)
Industry (h)			Industry (k)

VA origin of
Gross exports by
Final Demand
destination

VA origin	Exports	Imports	Final Demand
Country (s)	Country (c)		Country (d)
	Industry (i)		

Final Demand-based core TiVA indicators (2, 3 dims) can be derived from these cubes e.g. FFD_DVA and DFD_FVA but also many other variations



Using VA origin of final demand

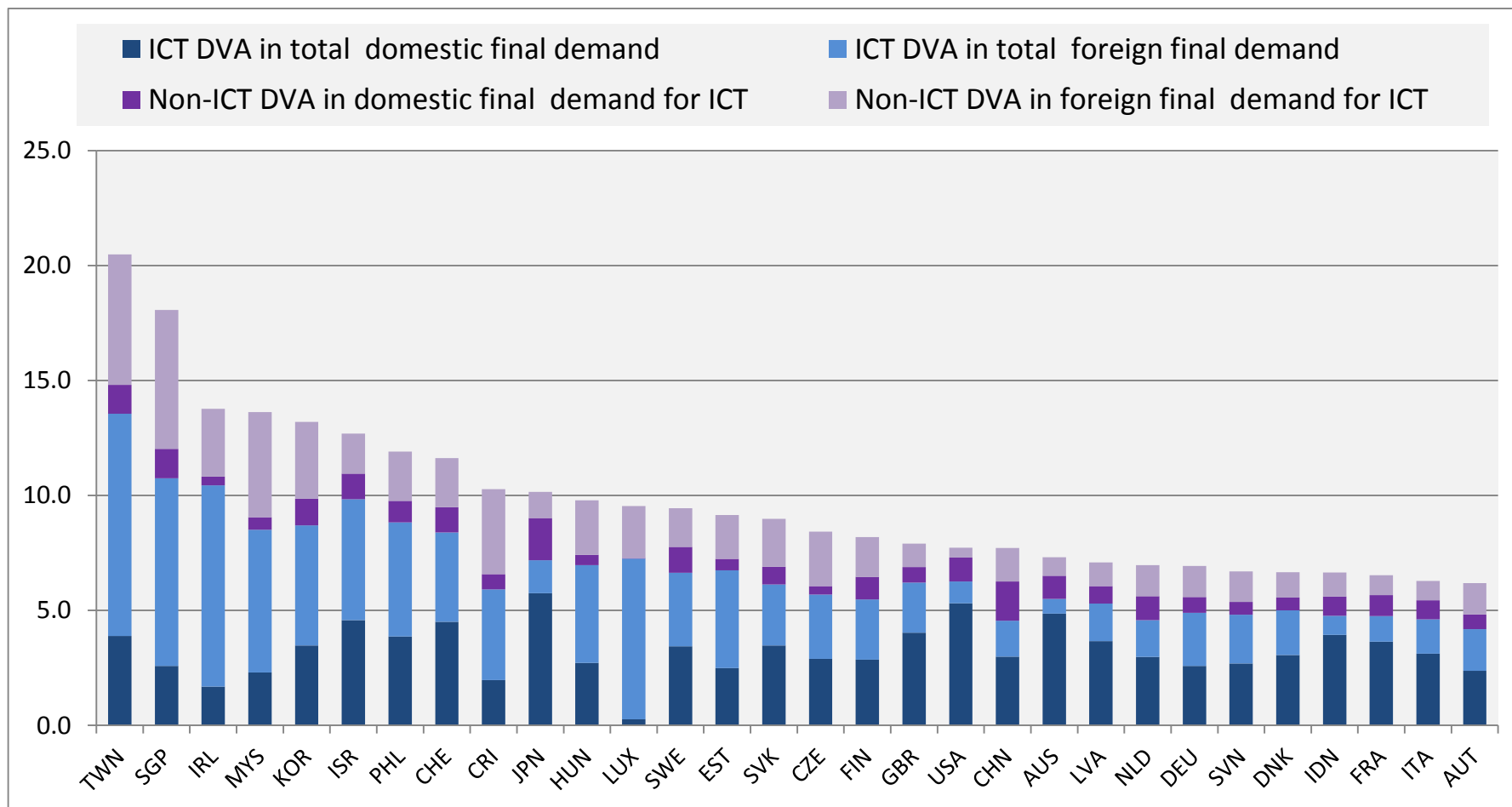
		Demand for final products				
		Domestic		Foreign		
VA Origin		ICT	non-ICT	ICT	non-ICT	
Domestic	ICT					Domestic ICT industry VA
	non-ICT					Domestic non-ICT VA in demand for ICT products
Foreign	ICT					Foreign ICT VA in Domestic final demand
	non-ICT					Foreign non-ICT VA in Domestic demand for ICT products



“ICT footprint”

(see also [Scoreboard 2017](#))

2011, as % of total VA



http://stats.oecd.org/Index.aspx?DataSetCode=TIVA_2016_C3



Other core indicators

**Re-exported
Intermediate imports
REII**

imports	Exports	Imports	Final Demand
	Country (c)		
	Industry (i)		
Σ intermediates			

$$\text{IMGRINT_REII} = \text{REII}_{(c,i)} / \text{IMGR_INT}_{(c,i)}$$

**Domestic VA in exports
of intermediate products
EXGR_INTDVA**

VA origin *	Exports	Imports	Final Demand
country =c	Country (c)		
	Industry (i)		
	Intermediates		

$$\text{EXGR_INTDVASH} = \text{EXGR_INTDVA}_{(c,i)} / \text{EXGR}_{(c,i)}$$

Also, $\text{EXGR_FNLDVASH} = \text{EXGR_FNLDVA}_{(c,i)} / \text{EXGR}_{(c,i)}$ for final products

**VA content of total
Consumption, by source
CONS_VA**

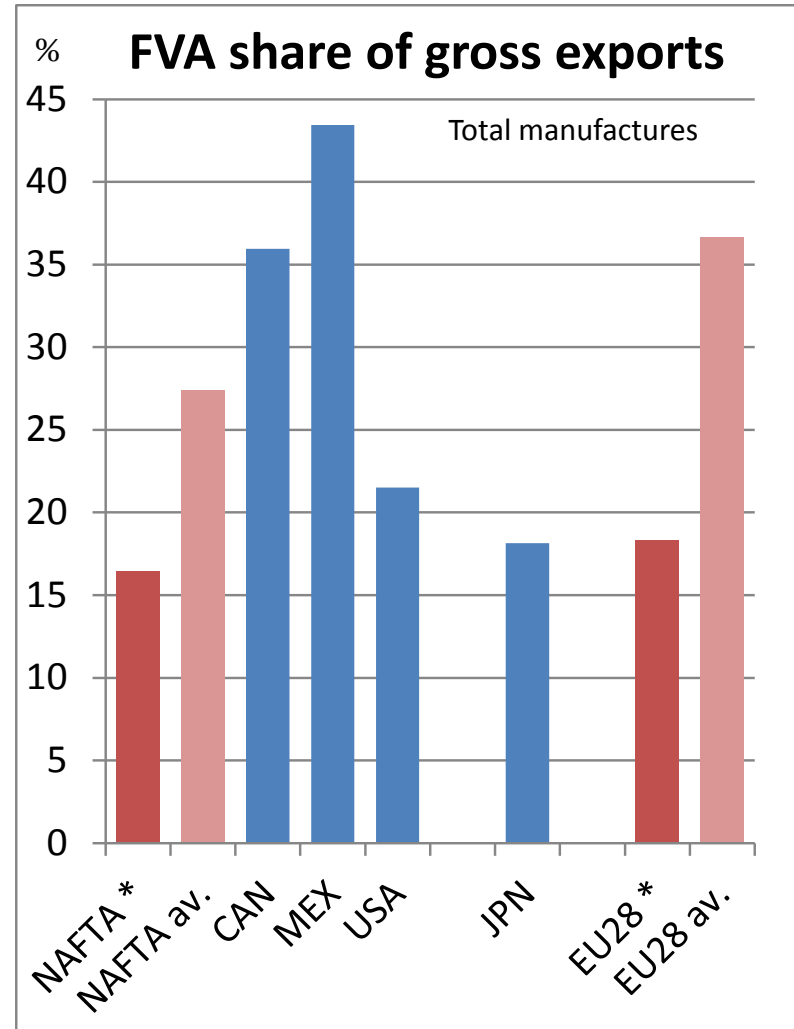
VA origin	Exports	Imports	Final Demand
Country (s)			Country (c)
Industry (i)			consumption goods

$$\text{CONS_VASH} = \text{CONS_VA}_{(c,p,i)} / \text{CONS_VA}_{(c,\text{total},i)} \quad (\text{also GFCF})$$



Indicators for regions

- Regions = country groups e.g. EU
- For indicators such as EXGR_FVA, can include or exclude intra-region trade flows and/or VA flows.
- Including is equivalent to showing average of countries e.g. intra-region VA flows treated as FVA
- Excluding is treating the region as a single economy e.g. intra-region VA flows treated as DVA
- **EXGR_FVA**: incl. intra-region VA
- **VA origin of EXGR** (4 dims): excl. intra-region VA flows
- Under review ...



* excl. intra-region VA and trade flows



Caveats:

Average industry production functions [from vBe]

- At the detailed level of industry:
$$\frac{\text{DVA (FVA) share (\%) of exports}}{\text{DVA (FVA) share in output for domestic consumption}}$$

(except for China and Mexico)
- Also, the same for each importing partner country
- Differences at the aggregate level (e.g. total manufactures) reflect differing industry compositions of exports to each partner
- Using a more detailed industry list would result in changes in indicators at aggregate levels (e.g. total manufactures, total services)
- Also, dividing industries to account for firm heterogeneity, e.g. exporters v. non-exporters, also changes indicators:
This is what we do for China and Mexico in the ICIO

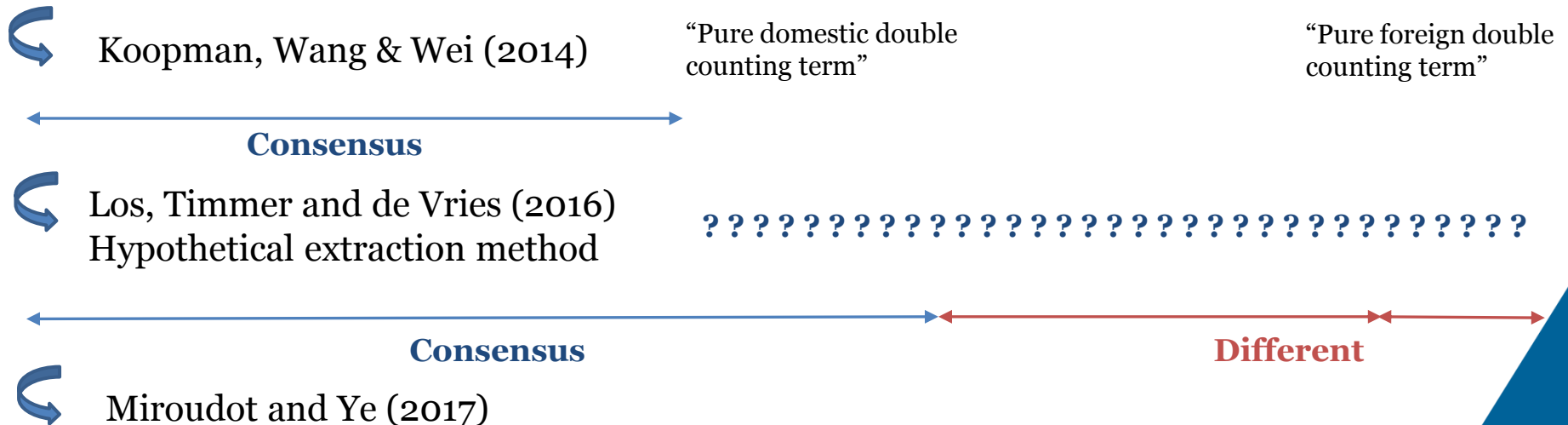


Caveats: “double counting”

- Presence of double-counting in EXGR-based indicators when comparing across countries
- Double counted value-added comes in different flavours in gross exports:
 - The foreign value-added in exports can already be regarded as ‘double counting’ because it is domestic value added in the exports of another country
 - At the world level, this is ‘double counting’
 - But not when measured for a given exporting economy
 - Also, the same FVA can be included in the gross exports of different countries
 - An additional source of double counting comes from intermediate inputs that come back to the exporting economy
 - Domestic inputs can return back home and the domestic value-added embodied in them is counted twice (as well as any foreign value-added embodied in them)
 - Foreign inputs can also return back to the exporting economy (and they have foreign value-added or domestic value-added that will also be counted several times)
 - Therefore, a full decomposition of gross exports should also include domestic double counted VA and foreign double counted VA.
- Does it matter?
 - Double counting is generally small but at the industry level and in specific countries, it is non negligible.
 - It matters when the domestic value-added has to be consistent with GDP (e.g. jobs embodied in exports).



Foreign VA content





FAQ – “*why are TiVA gross trade stats different from official trade stats?*”

1. TiVA aggregate trade compared to SNA and BoP sources

e.g. different trade in goods / trade in services split

ICIO is consistent with SNA in construction.

SNA in “*purchasers’ prices*”, while ICIO in “*basic prices*”

Alternative source of trade stats = official SUTs and IOTs

From *purchasers’ prices* to *basic prices*, main adjustments are:

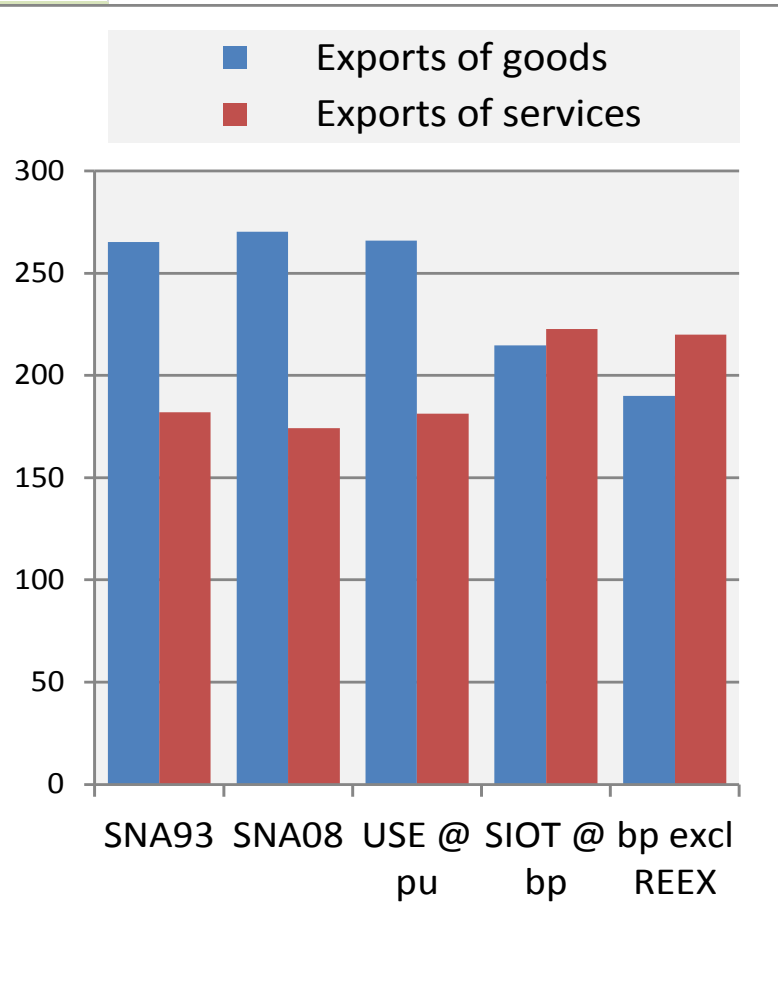
- Taxes (*less subsidies*) on products excluded
- Domestic trade and transport margins allocated to service sectors



1. example with official stats, UK 2010

2010

PRODUCTS (CPA*64)	Re-exports			Exports FOB, @ bp, excl. re-exports
	USE @ pu	SIOT @ bp Total	SIOT @ bp Imports	
	Exports FOB	Exports FOB	Exports FOB	
Agriculture, forestry and fishing [A]	2.7	2.5		2.5
Mining and quarrying [B]	23.6	22.6	1.0	21.6
Total manufactures [C]	234.5	184.5	23.6	160.9
Coke and petroleum [19]	16.7	11.2		11.2
Chemicals [20]	27.6	22.7		22.7
Pharmaceuticals [21]	23.3	17.7		17.7
Basic metals [24]	11.6	9.9	2.0	7.9
ICT equipment [26]	24.0	17.6	10.5	7.2
Electrical equipment [27]	8.8	7.8	2.6	5.2
Machinery and equipment [28]	23.1	20.5	3.8	16.7
Motor vehicles [29]	25.7	22.9		22.9
Other transport equip [30]	20.8	20.4	4.7	15.8
Other manufactures	52.8	33.8		33.8
Utilities [D-E]	5.3	5.1		5.1
Construction [F]	1.4	1.4		1.4
Wholesale and retail trade [G]	4.2	48.3	0.3	48.0
Transport services [H]	17.3	17.5	2.4	15.2
Other services	158.3	155.5		155.5
Total	447.3	437.4	27.3	410.2
Taxes less subsidies on products		9.8	6.2%	
Total		447.3		





FAQ – “*why are TiVA gross trade stats different from official trade stats?*”

2. Bilateral relationships compared to Merchandise trade and Trade in Services stats

Significant asymmetries in reported bilateral trade stats

Country A reported exports to B $\neq$ Country B reported imports from A

Reasons include:

- Re-exporting activities,
- cif/fob differences,
- Confidential data,
- reporting errors etc.



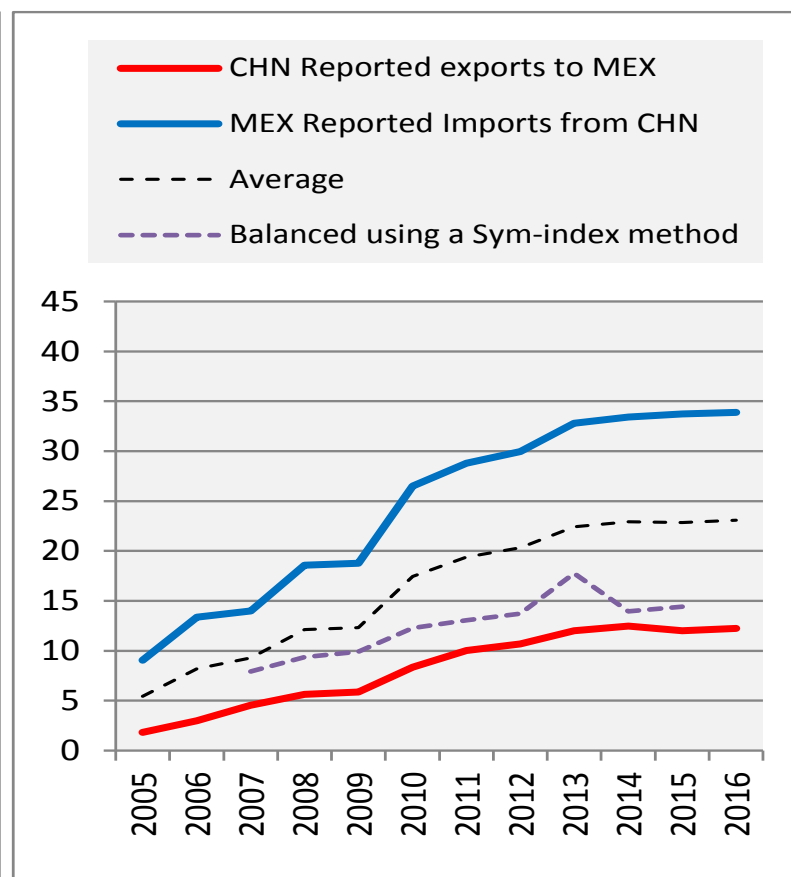
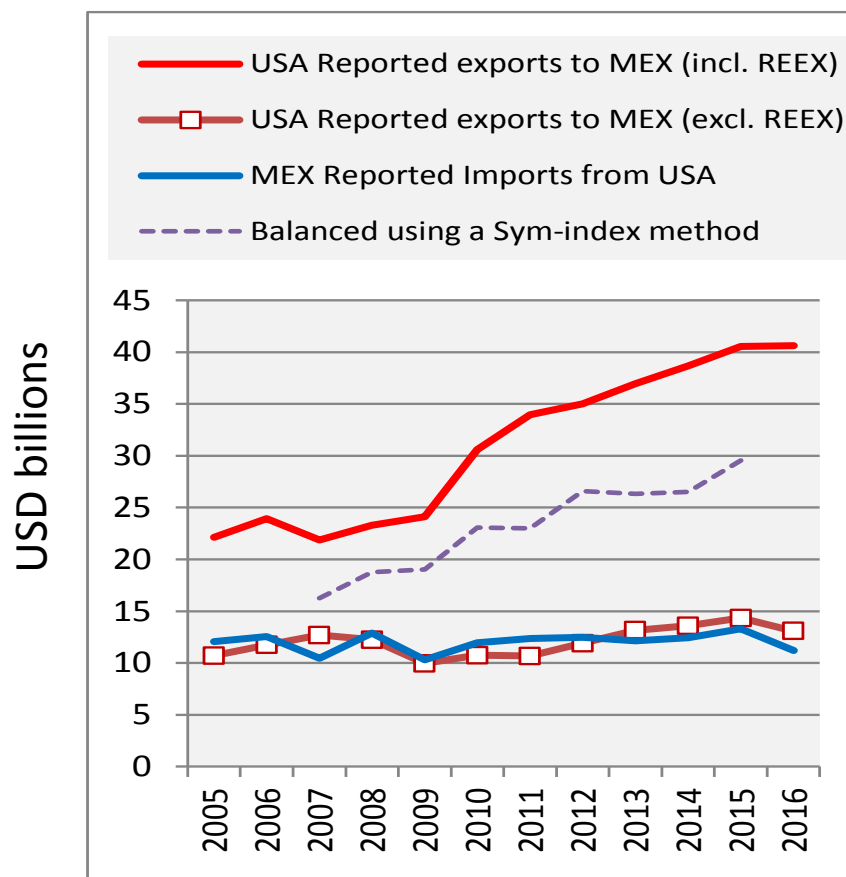
2. Re-exports: example of reporting differences

Trade in ICT goods: USA and China's exports to Mexico

Reporting recommendations of IMTS manual:

Exports: country of last known destination (often country of consignment)

Imports: country of origin





A little more on re-exports

- Re-exports can be concentrated in a few sectors
 - 15% of USA reported exports of goods are re-exports;
 - 43% for ICT goods (2016)
 - 68% for ICT goods exports to Mexico, 58% to Canada (2016)
- USA report re-exports by product and partner destination; but not by country of origin of the goods (c.f. HKG)
- However, *at least*, we have detailed re-export data for USA. For most ICIO target countries, such data not reported by product - for many EU countries we have total re-exports e.g. NLD (40%). Problems for non-EU trading hubs e.g. SGP (50%)
- In general, in construction of ICIO, *for partner shares of trade in goods*, reported imports are prioritised as initial values.



Finally... Features of OECD ICIO

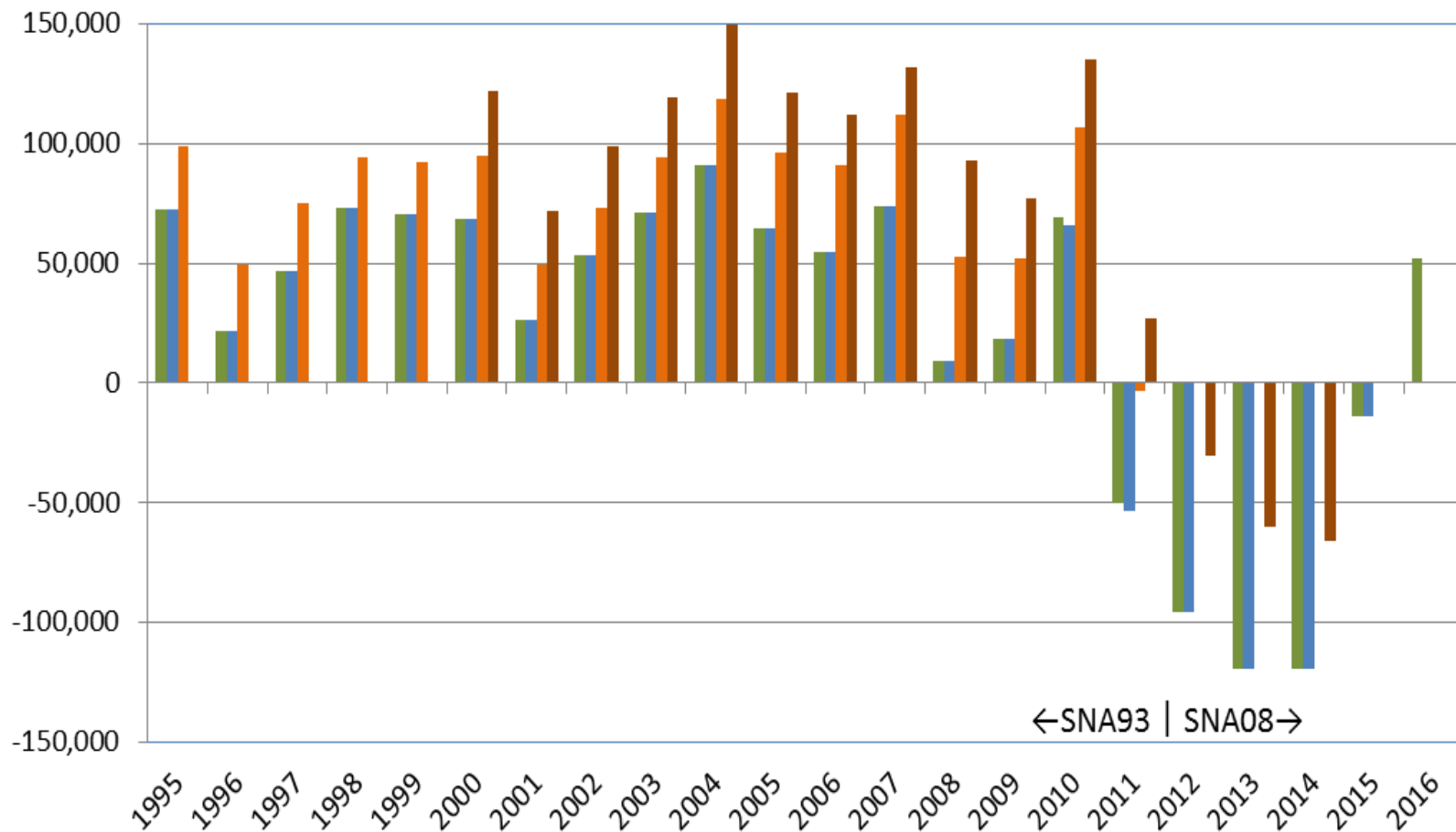
- Exports and imports benchmarked on National accounts (SNA)
- Separation of direct purchases by non-residents (from cross-border trade)
- Country coverage (all OECD members, G20 and Asian manufacturing system)
- Heterogeneity (China, Mexico)
- International margins allocated to the country providing the trade and transport services



Japan Trade Balance: SNA, ICIO and WIOD

Net exports (Japan, M USD)

■ SNA ■ OECD ICIO2018 & 2016 ■ WIOD2014 ■ WIOD2016





Concluding remarks

- Quality of indicators depends on quality of ICIO which, in turn, depends on quality and availability of underlying national stats (SNA, SUTs, IOTs bilateral trade etc.) and, the balancing and estimation techniques used
- Review of indicators for next edition (2018)



THANK YOU

Colin Webb
Norihiko Yamano
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