Trade in Value-Added and Comparative Advantage

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“How is TiVA Relevant to Inforum-type Models?”

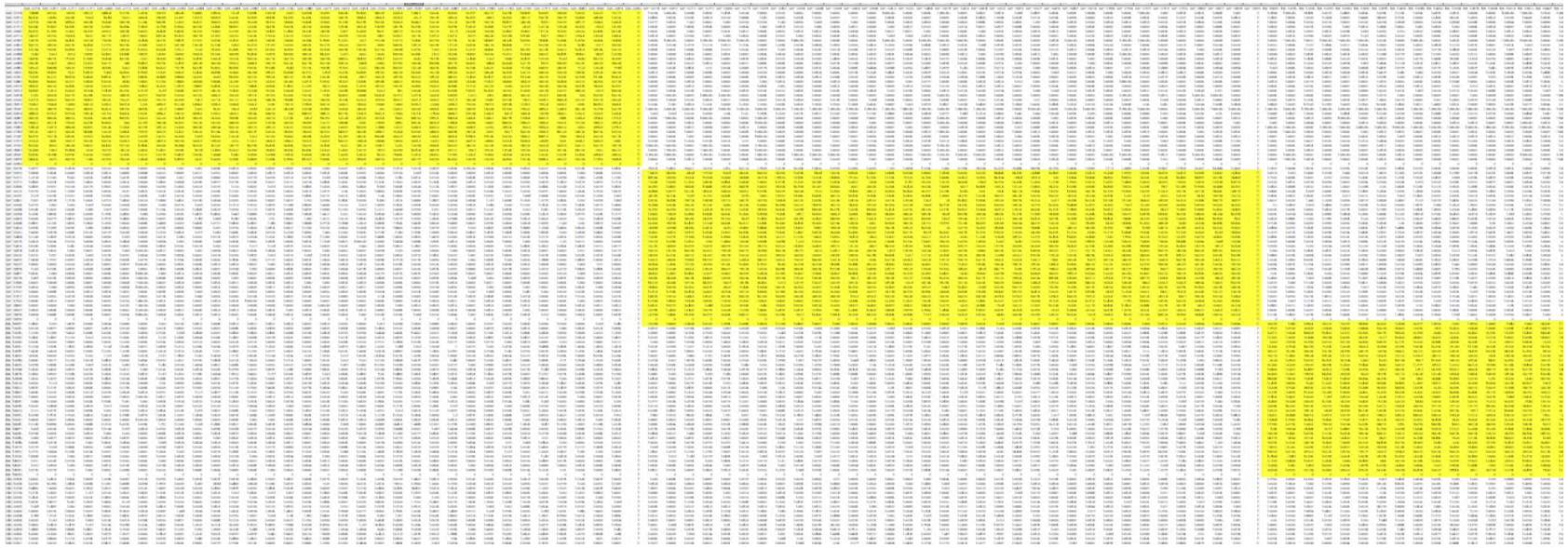
1. The mathematical question
   - Models include trade in terms of gross values
   - How would net VA flows be calculated, if desired
2. The application question:
   - Is it important to measure trade in net VA terms?
   - Are international value chains “important enough” to try to represent them?
   - Meaning, “important” for typical purposes of Inforum models

The Mathematical Question

Koopman, Wang, & Wei, “Trading Value-Added and Double Counting in Gross Exports” (2014)

- Decompose GV exports into net domestic, net foreign, and double-counted VA
- Double-counting isn’t “bad”, when measured consistently it can help to gauge depth and pattern of country participation in global production chains
- How to build an ICIO model

OECD Intercountry Input-output Table



This is a screenshot of intermediate transactions among AUS, AUT, and BEL in the OECD ICIO for 2011. The yellow submatrices are domestic intermediate transactions; domestic final demand is off to the right; one VA row.

- As written, the national source of imported intermediates is an aspect of the technical A matrix…of the "recipe"….Yes?
- Instead, could easily make Armington if data are rearranged
- $VBY = \tilde{V}_{2108x2108diag} \cdot B_{2108x2108} \cdot Y_{2108x353}$

Formulas for Some TiVA Measures (2-Country)

- OECD publishes many TiVA measures for ICIO countries
- Domestic VA exports:

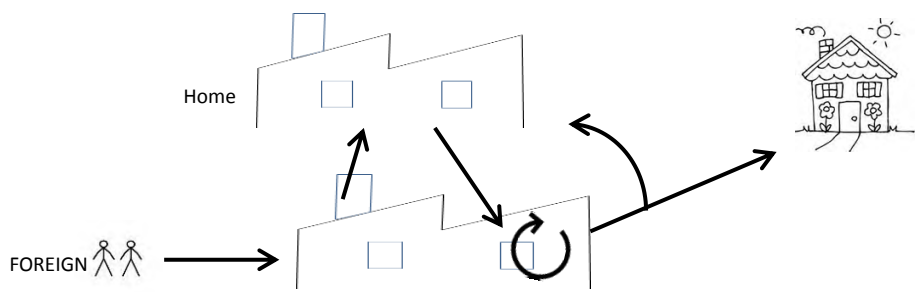
  VT12 = V1 . B11 . Y12 + V1 . B12 . Y22
- Vertical specialization: an indicator of foreign VA in domestic gross exports, includes some double counting:

  VS12 = V2 . B21 . Y12

  + V2 . B21 . A12 . Inv(I-A22) . Y22

  + V2 . B21 . A12 . Inv(I-A22) . TotalExport21

(3rd term Illustrated):



Metrics of Vertical Specialization

- While the intuition of “greater” participation, “placement” in a chain, etc seems clear, a number of different metrics for VS have been proposed
- E.g., Kwon & Ryou, “GVC of East Asia” (AsianEcJnl 2015) worked with 2 partly-correlated metrics:

  a. Their VSI focused on export of intermediate goods, implying more participation in GVC,

  b. And their VAX focused on the share of own VA in exporting – a lower share implies greater use of imported intermediates

- Interpretation of such metrics can be challenging as business cycle or other circumstances can have influence

How to Add ICIO & TiVA to Existing Model

Two theoretical approaches (Johnson 2014)

1. Write down the model entirely in value-added terms, ignoring intermediates trade
2. Write down the model in gross terms. Use ICIO data to parameterize cross-sector and cross-country inputs -- an open economy analog to closed economy models

Public Datasets for Research on Value-Added Export

Name of dataset	*Key features*
Global Trade Analyis Project Database	Input-output tables for over 100 countries for various benchmark years, mostly after 2000. https://www.gtap.agecon.purdue.edu
World Input-Output Database	Global tables covering OECD countries and major emerging markets from 1995–2011. http://www.wiod.org
IDE-JETRO Asian Input-Output Tables	Regional tables covering 8 East Asian countries at five-year intervals between 1985 and 2000. http://www.ide.go.jp
WTO-OECD TiVA Database (Trade in Value Added)	Value-added exports and other measures of global supply chain activity for 57 countries in 1995, 2000, 2005, 2008 and 2009. http://stats.oecd.org
OECD Input-Output Tables	Input-output tables for OECD countries and major emerging markets, available various years from 1970–2005. http://www.oecd.org

2011

R Johnson, JEP, 2014

Applications of TiVA-Based Measures

- Descriptive
  - Bilateral trade
  - Participation in international production chains
  - Comparative advantage
- Current issues
  - Trade/GDP elasticity
  - Free trade agreements
  - Value chains in trade, and growth

VA Exports

Table[GetVI[i] . GetBIJ[i,i] . GetFIJ[i,j] + GetVI[i] . GetBIJ[i,j] . GetFIJ[j,j], {i,Asia},{j,Asia}]

Export of VA Among E Asian Countries (Note: Read Along Row)

	JPN	KOR	BRN	CHN	HKG	IDN	KHM	MYS	PHL	SGP	THA	TWN	VNM
JPN	.	36 205.5	227.571	148 519.	5524.15	16 386.8	219.956	10 059.9	4727.54	4349.21	20 009.6	26 037.4	5102.59
KOR	24 198.	.	50.3413	77 996.1	1939.17	8185.36	186.103	2672.23	3277.47	2141.12	4164.88	4855.86	4380.83
BRN	4117.24	806.195	.	1010.72	15.1339	898.38	6.42483	96.3848	23.7805	30.1861	171.052	67.8695	302.822
CHN	141 487.	52 170.5	254.968	.	24 788.1	25 105.9	1012.07	12 502.2	6542.34	6940.3	16 289.5	22 927.9	11 898.9
HKG	4913.49	2365.38	17.9988	29 880.4	.	1398.66	68.3287	1452.01	1177.35	1954.7	1637.96	2288.92	311.918
IDN	27 427.9	9546.73	82.7797	27 558.	751.811	.	189.923	6622.26	2589.25	2932.51	4745.44	3386.15	1667.09
KHM	232.55	90.105	0.583268	251.531	3.7898	44.0847	.	45.5476	4.84316	67.872	159.424	38.3775	181.193
MYS	16 099.4	4499.42	299.06	27 260.	964.298	7907.06	133.274	.	1658.49	3502.22	5211.81	3086.35	1920.53
PHL	5970.5	2351.67	12.6946	9225.56	422.464	1261.53	21.8753	917.319	.	531.813	1872.44	1208.66	558.061
SGP	9182.41	4082.89	430.184	17 183.4	3933.74	8600.26	102.887	5732.01	2312.42	.	3961.54	2622.32	1516.37
THA	14 604.5	4102.54	80.9256	20 222.5	1016.37	7049.64	402.84	5105.08	2082.52	1569.42	.	2063.86	2838.06
TWN	13 198.8	5175.41	46.138	52 892.8	2876.48	3203.85	225.68	2561.41	1419.03	1416.79	2988.09	.	2148.69
VNM	6134.64	3281.18	3.59816	7644.04	191.947	1952.59	485.401	1344.92	761.994	399.999	1500.83	824.579	.

2011 $MM, from OECD 2011

Bilateral Balance of Total VA Exports

Column country export – row country export

Bilateral Balances of VA Export Among E Asian Countries

	JPN	KOR	BRN	CHN	HKG	IDN	KHM	MYS	PHL	SGP	THA	TWN	VNM
JPN	0.	.	.	.	.	.	.	.	.	.	.	.	.
KOR	12 007.6	0.	.	.	.	.	.	.	.	.	.	.	.
BRN	-3889.67	-755.854	0.	.	.	.	.	.	.	.	.	.	.
CHN	7032.	25 825.6	755.755	0.	.	.	.	.	.	.	.	.	.
HKG	610.661	-426.212	-2.86485	-5092.35	0.	.	.	.	.	.	.	.	.
IDN	-11 041.1	-1361.37	815.601	-2452.08	646.848	0.	.	.	.	.	.	.	.
KHM	-12.5937	95.9983	5.84156	760.534	64.5389	145.838	0.	.	.	.	.	.	.
MYS	-6039.43	-1827.18	-202.676	-14 757.7	487.717	-1284.81	-87.7265	0.	.	.	.	.	.
PHL	-1242.96	925.801	11.0859	-2683.22	754.882	1327.72	-17.0321	741.176	0.	.	.	.	.
SGP	-4833.2	-1941.78	-399.998	-10 243.1	-1979.04	-5667.75	-35.0147	-2229.79	-1780.61	0.	.	.	.
THA	5405.16	62.3405	90.1262	-3932.98	621.592	-2304.2	-243.416	106.725	-210.089	2392.12	0.	.	.
TWN	12 838.6	-319.552	21.7314	-29 964.9	-587.554	182.297	-187.303	524.945	-210.372	1205.53	-924.229	0.	.
VNM	-1032.05	1099.65	299.224	4254.81	119.971	-285.498	-304.208	575.612	-203.933	1116.37	1337.23	1324.11	0.

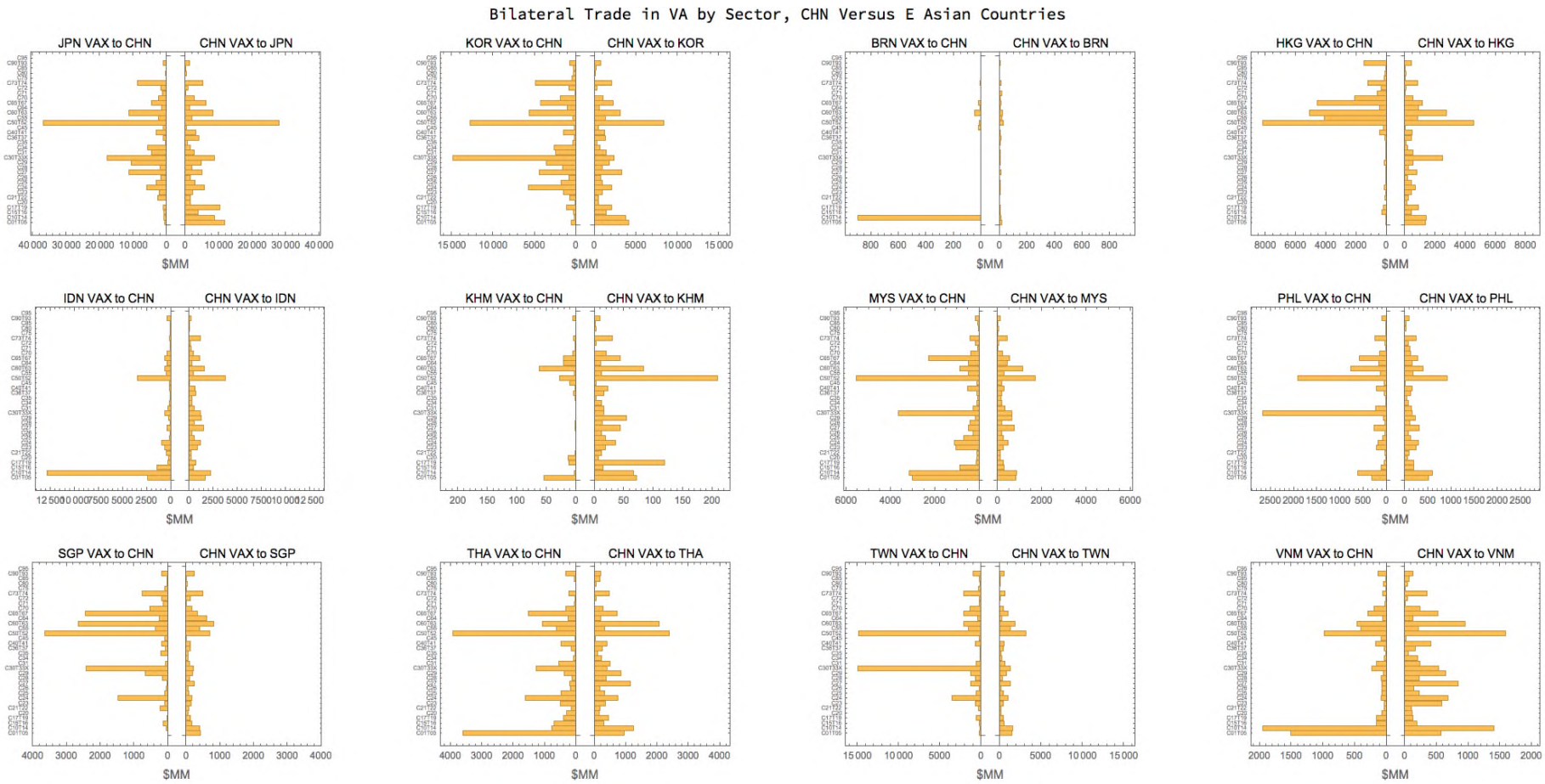
2011 $MM, from OECD 2011

Example of Detailed Bilateral VA Exports

		JPN->CHN	CHN->JPN	Balance
C01T05	Agriculture, hunting, forestry and fishing	638.274	11 860.2	-11 221.9
C10T14	Mining and quarrying	749.237	8741.72	-7992.49
C15T16	Food products, beverages and tobacco	681.516	3853.45	-3171.94
C17T19	Textiles, textile products, leather and footwear	1115.03	10 374.2	-9259.13
C20	Wood and products of wood and cork	143.1	1507.14	-1364.04
C21T22	Pulp, paper, paper products, printing and publishing	2676.87	1532.14	1144.72
C23	Coke, refined petroleum products and nuclear fuel	2217.6	2325.19	-107.588
C24	Chemicals and chemical products	5889.25	5841.5	47.7453
C25	Rubber and plastics products	3154.19	2995.57	158.618
C26	Other non-metallic mineral products	1809.84	1498.82	311.022
C27	Basic metals	11 147.1	5203.85	5943.21
C28	Fabricated metal products	2054.62	2061.73	-7.11569
C29	Machinery and equipment, nec	10 574.2	4927.37	5646.81
C30T33X	Computer, Electronic and optical equipment	17 804.8	8717.34	9087.43
C31	Electrical machinery and apparatus, nec	4435.03	2778.82	1656.21
C34	Motor vehicles, trailers and semi-trailers	5582.48	1493.24	4089.24
C35	Other transport equipment	322.7	690.109	-367.409
C36T37	Manufacturing nec; recycling	918.702	4074.06	-3155.36
C40T41	Electricity, gas and water supply	3115.51	3147.25	-31.7377
C45	Construction	1069.38	367.58	701.798
C50T52	Wholesale and retail trade; repairs	36 760.3	28 071.	8689.33
C55	Hotels and restaurants	2306.76	2085.33	221.428
C60T63	Transport and storage	11 356.5	8267.57	3088.91
C64	Post and telecommunications	1586.13	1450.83	135.293
C65T67	Financial intermediation	4537.56	6238.79	-1701.23
C70	Real estate activities	2404.95	2825.14	-420.19
C71	Renting of machinery and equipment	1365.63	163.984	1201.65
C72	Computer and related activities	1763.14	924.951	838.191
C73T74	R&D and other business activities	8708.97	5235.22	3473.75
C75	Public admin. and defence; compulsory social security	176.29	89.2241	87.0661
C80	Education	295.252	512.351	-217.099
C85	Health and social work	178.932	281.773	-102.841
C90T93	Other community, social and personal services	979.681	1350.04	-370.362
C95	Private households with employed persons	0.	0.	0.

CHN's Detailed Bilateral VA Trade

Sectors in Reverse Order, i.e. C95 on Top



… same sector correlation?

Same-sector Trade:
Correlation of CHN Bilateral Exports and Imports of VA

Below, all but HKG and KHM have significant positive statistics…

"Imports Make Exports"

Correlation of CHN's Import versus Export of VA, Omit Whole/Retail and HH

	Spearman's rho	*p*-value
JPN	0.482405	0.00517148
KOR	0.521628	0.00220049
BRN	0.462977	0.00762272
HKG	0.221041	0.224078
IDN	0.636364	0.0000903884
KHM	0.31085	0.0833326
MYS	0.839809	1.86733×10^{-9}
PHL	0.867669	1.29269×10^{-10}
SGP	0.481305	0.00528945
THA	0.788856	8.16893×10^{-8}
TWN	0.596774	0.000311828
VNM	0.59934	0.000289192

Participation in Global Value Chains

"VAX", the ratio of gross value exports to domestic VA in exports, relies on the extent of back and forth and double--counting, to imply value chains. These data relate to exports to the world. Kwon & Ryou compute a similar ratio for bilateral trade.

In order of ratio of gv to VA:

	Gross Value Export	VA in Export	Ratio Gross/VA
TWN	334 617.	156 452.	2.13878
KOR	620 073.	310 468.	1.99722
SGP	271 128.	137 082.	1.97785
MYS	263 485.	136 793.	1.92616
THA	249 451.	137 077.	1.81978
VNM	94 908.6	54 724.1	1.73431
KHM	6888.94	3996.99	1.72353
PHL	70 458.2	46 373.8	1.51935
CHN	1.96141×10^6	1.31224×10^6	1.4947
HKG	122 247.	86 963.3	1.40573
JPN	888 423.	640 504.	1.38707
IDN	222 123.	169 785.	1.30826
BRN	12 723.7	10 731.5	1.18563

GV in excess of domestic VA is partly foreign VA, partly double-counting.
Note: the rank of JPN reflects its generally large DOMESTIC VA coefficients in 2011

Related Indicator: VA Exports Leaving E Asia

… one can group the countries and treat E Asia as a bloc…

Ranking of VA Exports Out of EAsia, 2011

	$MM		$MM/cap
CHN	990 320.	SGP	14 888.8
JPN	363 134.	BRN	7584.16
KOR	176 420.	HKG	5562.84
IDN	82 285.6	KOR	3600.42
SGP	77 421.8	TWN	2943.93
THA	75 939.	JPN	2834.77
TWN	68 299.3	MYS	2223.23
MYS	64 251.4	THA	1092.65
HKG	39 496.2	CHN	735.805
VNM	30 198.4	IDN	345.448
PHL	22 019.2	VNM	343.554
BRN	3185.35	PHL	230.085
KHM	2877.09	KHM	195.721

Analysis of a Country's Position in GVC

Another example of applying TiVA is Escaith, "Case Study: NAFTA and the Evolution of Mexico's Competitive Advantages…," 2017

- Upstream vs downstream GVC positioning of Mexico in various sectors
- Trends in share of Mexico VA in meeting US final demand
- Trade costs, currency revaluation, and NAFTA

GVC and Income Shares

- In most cases where GVC are introduced, there is a strong shift towards VA by capital and high-skilled labor, and away from less-skilled labor.
- GVC's may facilitate specialization in advanced nations, specializing in activities carried out by high-skilled workers….
- Yet, as participants in GVCs, emerging economies also specialize in capital-intensive activities (perhaps contrary to the H-O theory); the capital share in their VA is rising too, not share of unskilled labor.

Timmer 2014 JEP

Comparative Advantage

- Revealed comparative advantage (RCA) in terms of domestic VA in Exports (same as earlier)
  - Relatively large VA export of a sector implies a relative VA “price” advantage … where there’s smoke, there’s fire
  - Can have quirky results
- Ratio of two ratios, numerator is ratio(s) for the country and denominator for the reference set (e.g., world)
- Example: Numerator of JPN (#18)... a vector of 34 sector ratios of VA export to sum of JPN VA exports

```
r34J = Total[Table[(GetBIJ[18, 18] . GetFIJ[18, j]) * GetVI[18]
     + (GetBIJ[18, j] . GetFIJ[j, j]) * GetVI[18] , {j, Delete[Range[62], 18]}]];
numertabJ = r34J / Total[r34J]
```

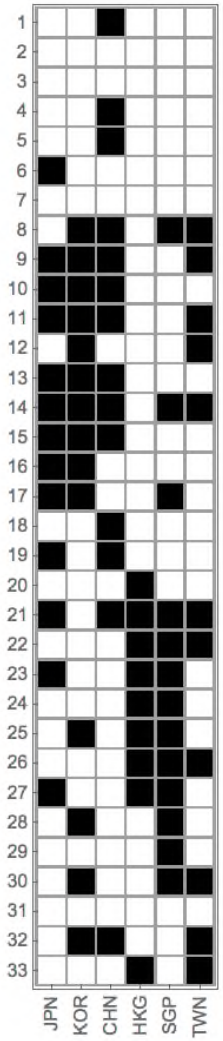
Example: RCA for JPN sectors

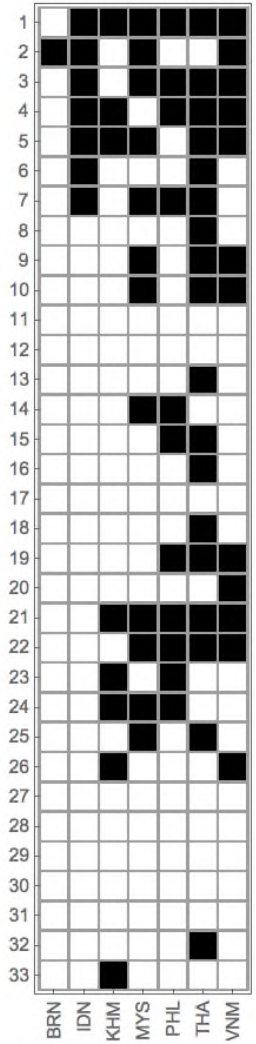
RC Advantage when Ratio > 1

Motor vehicles, trailers and semi-trailers	2.87135
Basic metals	2.60364
Computer, Electronic and optical equipment	2.20762
Machinery and equipment, nec	1.83627
Other non-metallic mineral products	1.78085
Rubber and plastics products	1.76494
Wholesale and retail trade; repairs	1.53764
Electrical machinery and apparatus, nec	1.50814
Other transport equipment	1.49495
Transport and storage	1.21615
Pulp, paper, paper products, printing and publishing	1.14837
Renting of machinery and equipment	1.12062
Electricity, gas and water supply	1.05244
Computer and related activities	0.88995
Chemicals and chemical products	0.843511
R&D and other business activities	0.828393
Construction	0.817885
Coke, refined petroleum products and nuclear fuel	0.814332
Hotels and restaurants	0.782578
Fabricated metal products	0.759741
Manufacturing nec; recycling	0.726062
Real estate activities	0.712468
Post and telecommunications	0.691707
Health and social work	0.543974
Financial intermediation	0.529578
Education	0.381577
Other community, social and personal services	0.364946
Food products, beverages and tobacco	0.273548
Textiles, textile products, leather and footwear	0.269358
Wood and products of wood and cork	0.254734
Public admin. and defence; compulsory social security	0.23617
Agriculture, hunting, forestry and fishing	0.129176
Mining and quarrying	0.0366065

RCA for E Asia, by Income Group

Black when RCA ratio > 1





1 Agriculture, hunting, forestry and fishing
2 Mining and quarrying
3 Food products, beverages and tobacco
4 Textiles, textile products, leather and footwear
5 Wood and products of wood and cork
6 Pulp, paper, paper products, printing and publishing
7 Coke, refined petroleum products and nuclear fuel
8 Chemicals and chemical products
9 Rubber and plastics products
10 Other non–metallic mineral products
11 Basic metals
12 Fabricated metal products
13 Machinery and equipment, nec
14 Computer, Electronic and optical equipment
15 Electrical machinery and apparatus, nec
16 Motor vehicles, trailers and semi–trailers
17 Other transport equipment
18 Manufacturing nec; recycling
19 Electricity, gas and water supply
20 Construction
21 Wholesale and retail trade; repairs
22 Hotels and restaurants
23 Transport and storage
24 Post and telecommunications
25 Financial intermediation
26 Real estate activities
27 Renting of machinery and equipment
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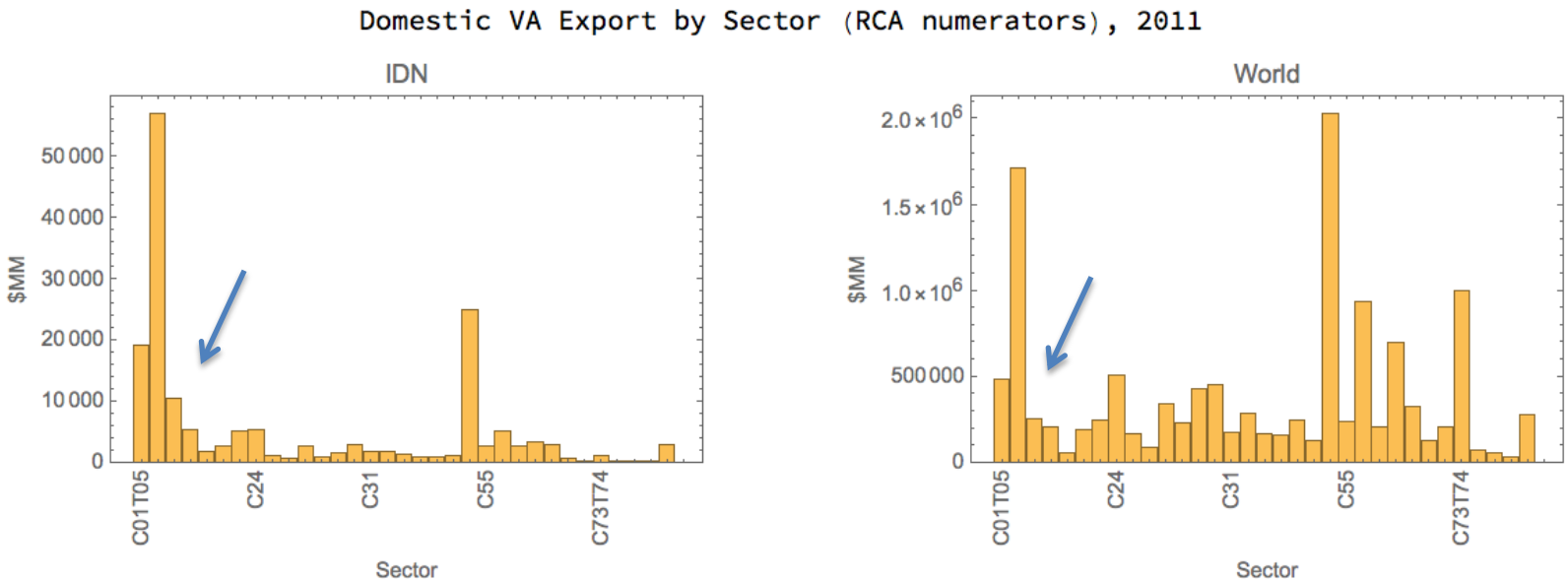
29 R&D and other business activities
30 Public admin. and defence; compulsory social security
31 Education
32 Health and social work
33 Other community, social and personal services

From OECD OCIO 2011

RCA: Case of IDN

Arrow indicates 7 resource sectors



Q:Is resources emphasis in IDN the future that *must* be, or that *might* be (Dickens)?

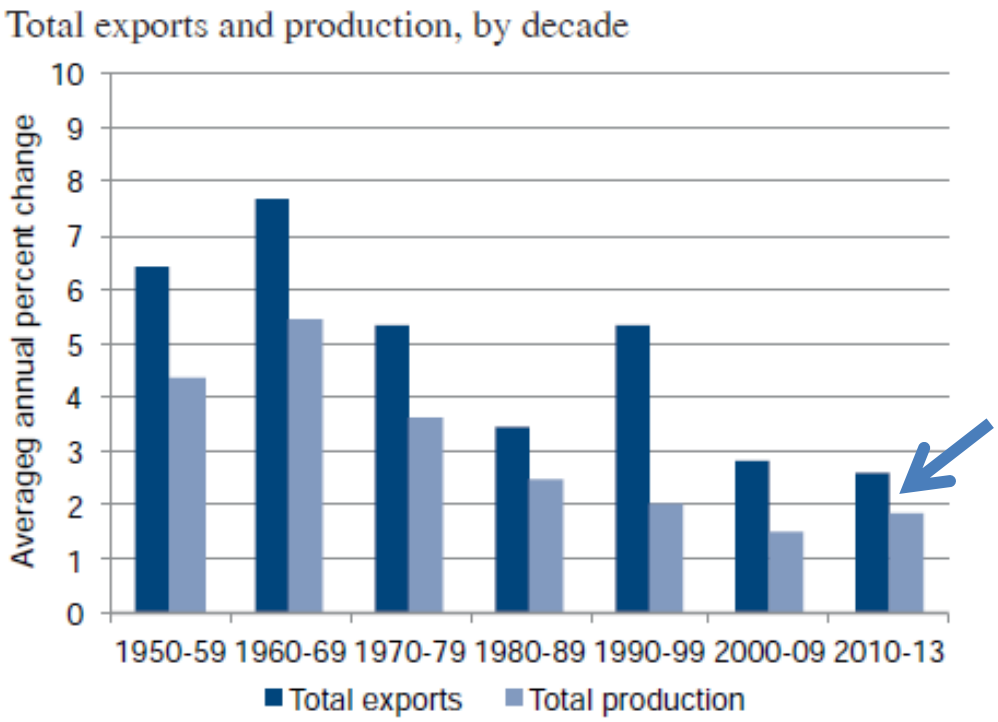
Growth Accounting

- When GVCs are taken into consideration, the relative contribution of consumption, investment and net exports to economic growth are resized according to their net domestic VA.
- While counter-cyclical policies may favor public consumption because of its higher GDP multiplier (due to lower direct import content), the additional demand eventually "filters-out" to other countries thanks to the indirect imports required.
- Even if the world Trade-GDP ratio stops increasing, it will likely do so at levels higher than today's.

H Escaith, "Aggregate Demand, Vertical Specialization, and Growth Accounting", Oct 2016
Johnson in JEP 2014: Value-Added Exports and Implications for Macroeconomics

Role of GVCs in Recent Trade "Slowdown"

The Global Trade Slowdown (Hoekman ed, 2015 CEPR) is a whole book about whether GVC's aren't becoming more pervasive as much as before the recession, and whether this is retarding trade growth…



Lower trade-production (also trade-GDP) elasticity

Irwin p25