Slicing Up Global Value Chains

and some lessons for competitiveness research

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Intro

- GVC analysis is increasingly multi-disciplinary, now spanning sociology (e.g. Gereffi), international business (e.g. Porter), economic geography (e.g. Venables), and international economics. High potential as it bridges firm-, region- and country-perspectives.

- Aims of this presentation:
  - Elucidating the concept of a Global Value Chain accounting (Wood, 1999).
  - How to measure and account for them (vertically integrated production function).
  - Some recent findings for Europe from research based on the World Input-Output Database (WIOD)
  - Some lessons for competitiveness research

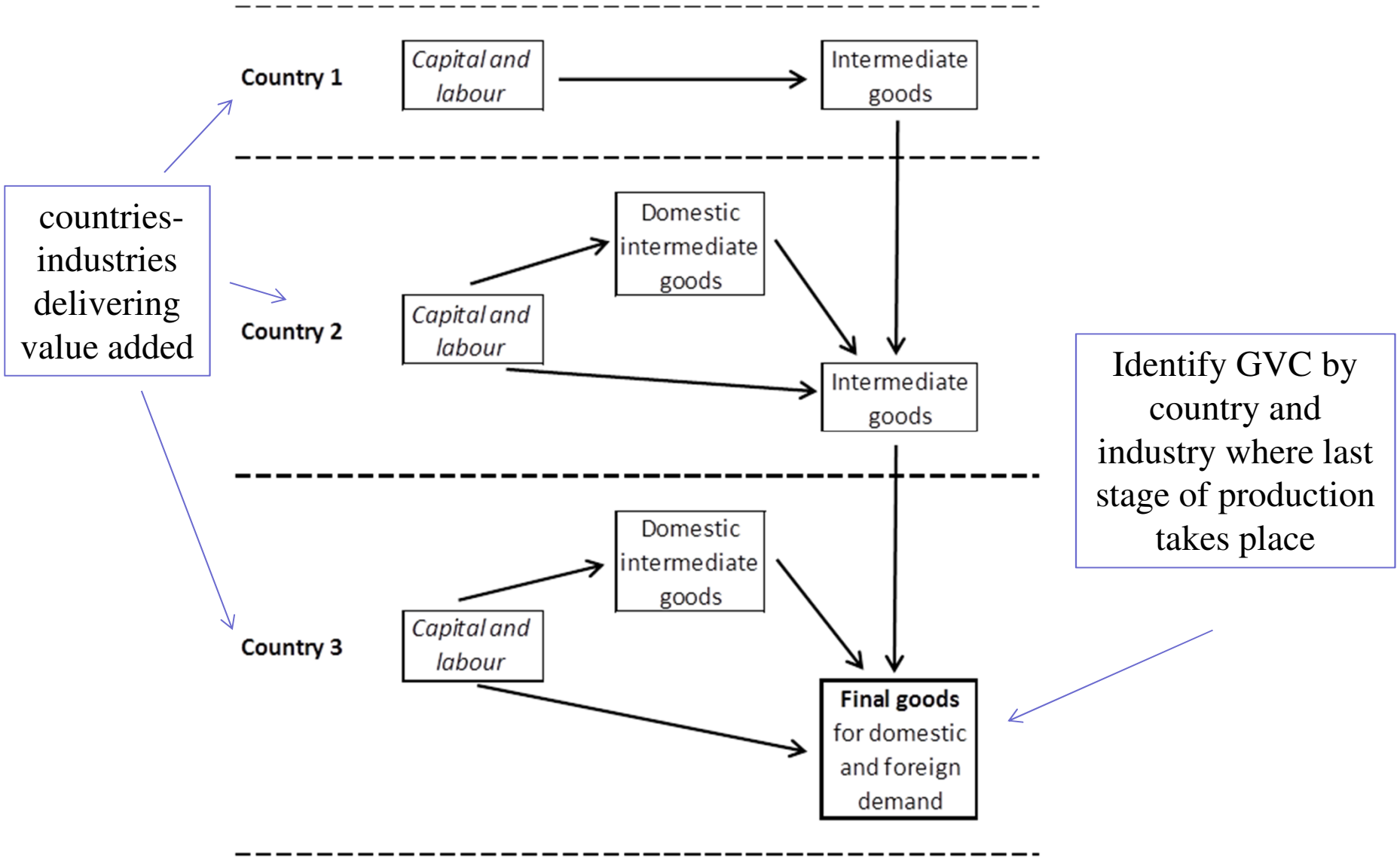
Background studies

- Timmer, Los, Stehrer and De Vries (2013), "**Fragmentation, Incomes and Jobs. An analysis of European Competitiveness**", *Economic Policy* (forthcoming October).

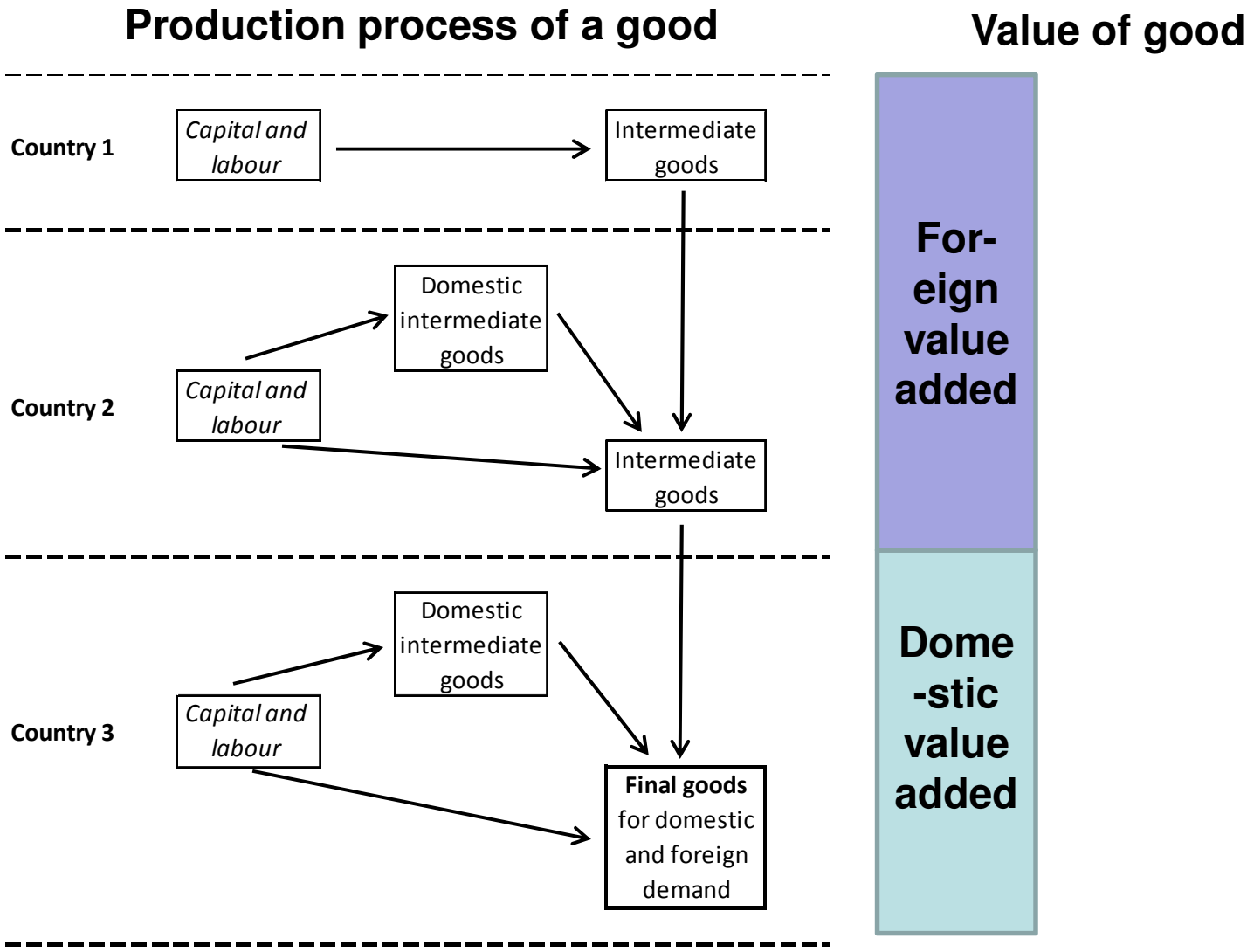
- Timmer, Erumban, Los, Stehrer and De Vries (2013), "**Slicing Up Global Value Chains**", GGDC ResMemo 135.
- Los, Timmer and De Vries (2013), "**Globalization or Regionalization? A New Approach to Measure International Fragmentation of Value Chains**", GGDC ResMemo 138.
- Van Ark, B. et al. (2013) "**Recent Changes in Europe's Competitive Landscape and Medium-Term Perspectives: How the Sources of Demand and Supply are Shaping Up**", *European Economy*. Economic Papers. 485.
- Foster, N., R. Stehrer and M. Timmer (2013) "**International fragmentation of production, trade and growth: Impacts and prospects for EU member states**", *European Economy*. Economic Papers. 484.

Elucidating the concept of Global Value Chain accounting

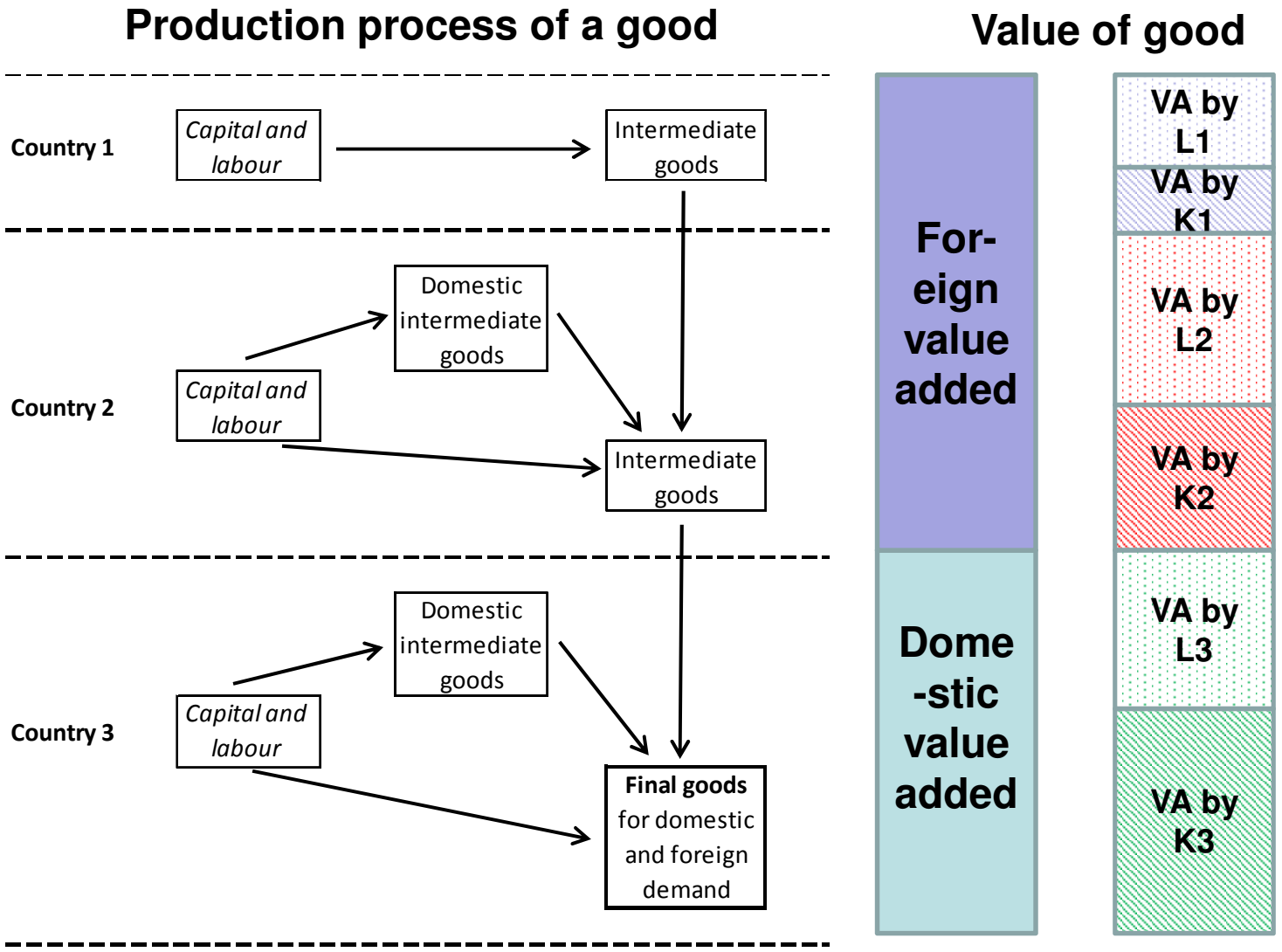
Stylized Global Value Chain (GVC)



Value added content of a GVC

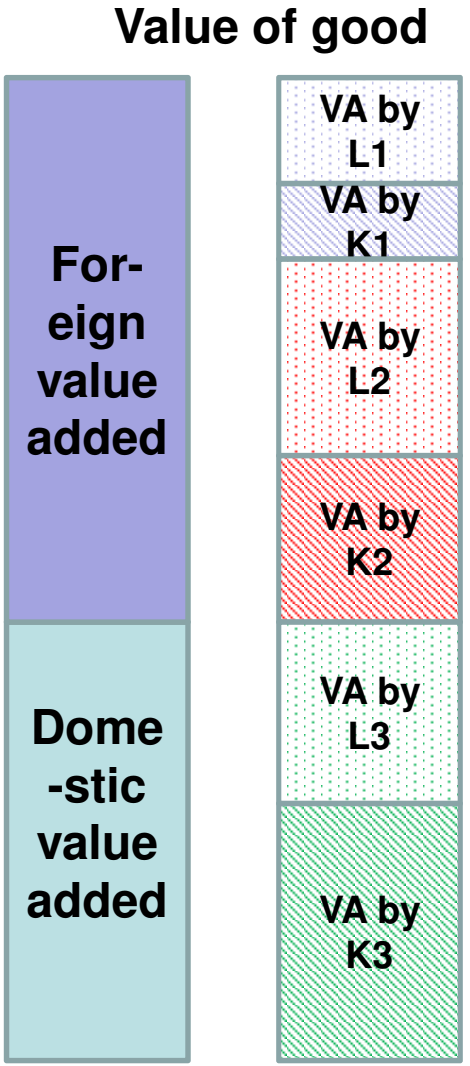


Factor content of a GVC



Link with GVC case studies

Case-study approach: e.g. iPod by Dedrick, Kraemer and Linden, 2010



Challenge : how to go beyond beyond first tier suppliers (and capital) and how to generalize?

Some characteristics of GVC accounting

- GVCs can only be analysed by choosing a particular ***final product*** (group) as unit of analysis, not an industry or country. (*e.g. industry 1 in country A delivers value added to production of final good X from country B*)

- In work so far we focus on *final manufacturing goods* as they are most fragmented.

- Note that no distinction is made between products ***exported*** or used **domestically**

- Focus on ***value added*** rather than gross output or gross export.

A new competitiveness measures

- Leads naturally to new indicator of competitiveness.

- **GVC income** of a country is the value added by the country *in a particular product GVC* by performing activities in its production.

- This activity can be:
  - any type of business function (manufacturing, design, R&D, branding, logistics, distribution, etc .)
  - in any industry and country

- When summed over all product GVCs, the overall GVC income of a country is equal to its GDP.

How to measure and account for GVCs (vertically integrated production function).

Vertically integrated production

Neo-classical gross output production function:

Gross output = value added + domestic interm.+ imports (*in values)*

Vertically integrated production function, as in Von Neumann / Leontief / Sraffa (1960) tradition; Pasinetti, *MetE*1973):

Gross output of a final product = value added in all activities that are directly and indirectly needed to produce the product (*in values)*

Vertically integrated production

- Problem is that vertically integrated production is typically not observable due to joint production and multiple use of intermediates. GVCs are more complex than “snakes” or “spiders”.

- Leontief’s (1936) solution: model the production system in an economy by a set of linear equations, one for each product (the so-called Leontief production functions)

- Using this one can derive a decomposition method that provides an exhaustive and complete decomposition of final output

Leontief's trick

This set **F** can be found by:

$$\mathbf{F = R(I-Z)^{-1}Y \quad (2)}$$

Y matrix of final output of all products (i,j);

Z the matrix of intermediate input use of all products per unit of output for each product;

I is identity matrix and $\mathbf{(I-Z)^{-1}}$ is the Leontief inverse (= $1+Z+Z^2+Z^3+\ldots$);

R a matrix with direct factor requirements per unit of gross output of

Related literature

- Variations of this approach are also used in literature on
  - *vertical specialisation in trade:* Johnson and Noguera (2012, JIE) who extended Hummels, Ishi and Yi (2001, JIE) multi-regional.
  - *Value added content of exports*: Koopman, Wei and Zhang (2013, AER) and Bems, Johnson and Yi (2011, AER)
  - *Factor content of trade*: Reimer (2006, JIE) and Trefler and Zhu (2010, JIE)

- Our analysis starts from vertical integrated production chain of final goods
  - *Length of production chains:* Dietzenbacher and Romero (2007, IRSR) and Antràs et al. (2012, AER) who compute the average number of 'transactions' a dollar will go through before final use.

DATA: World Input-Output Tables (www.wiod.org)

- **World Input-Output Table (WIOT)** represents flows of goods and services across industries *and* countries (40 countries and rest-of-the -world region), 1995-2011. Two data challenges in construction:

1. Times-series of input-output tables.

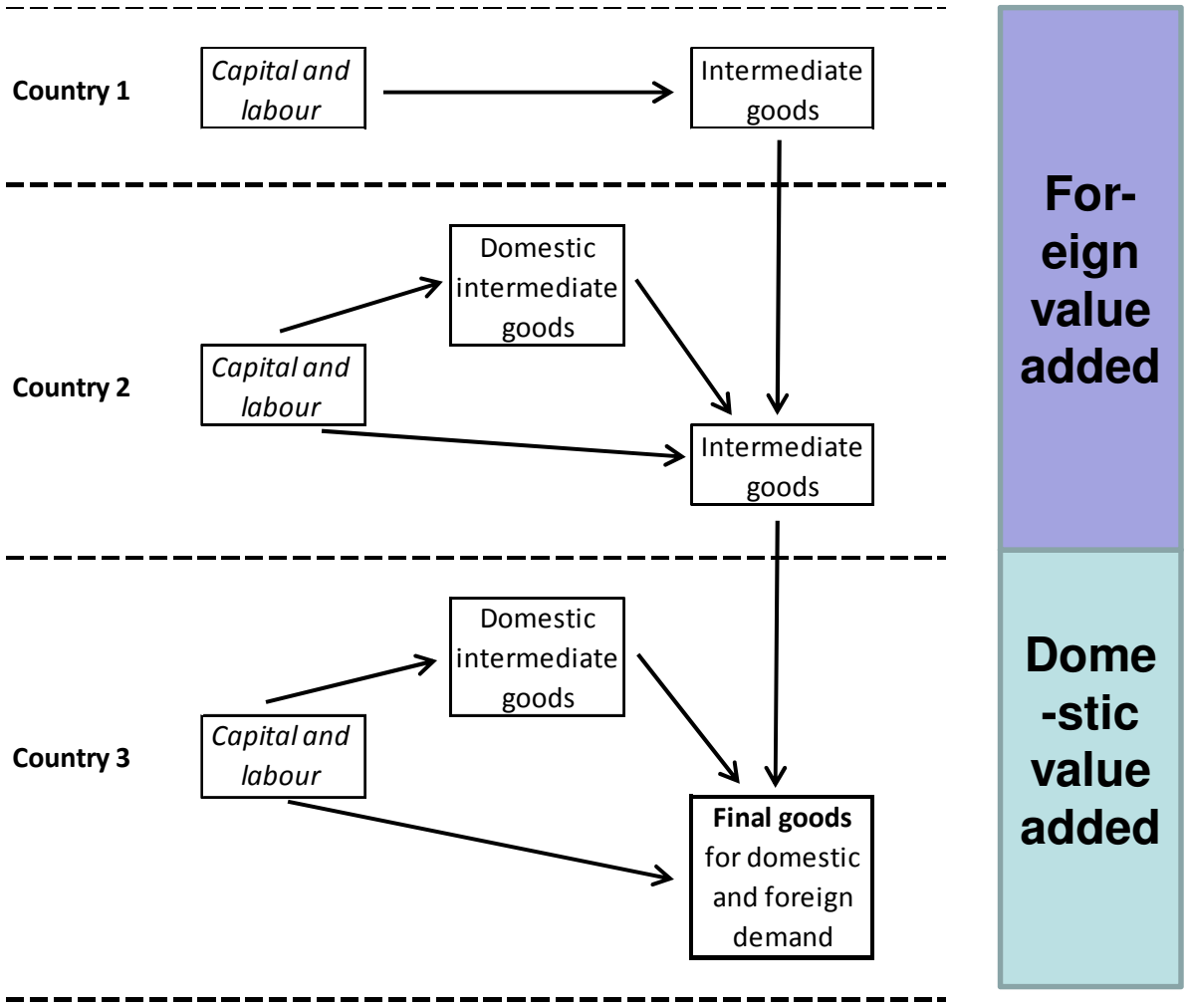
- Based on harmonised official benchmark national supply and use tables (34 industries and 59 product groups)
- Adjusted to, and interpolated with, industry output and main final demand time series from the National Accounts (RAS-like method)

2. Allocation of imports to three use categories

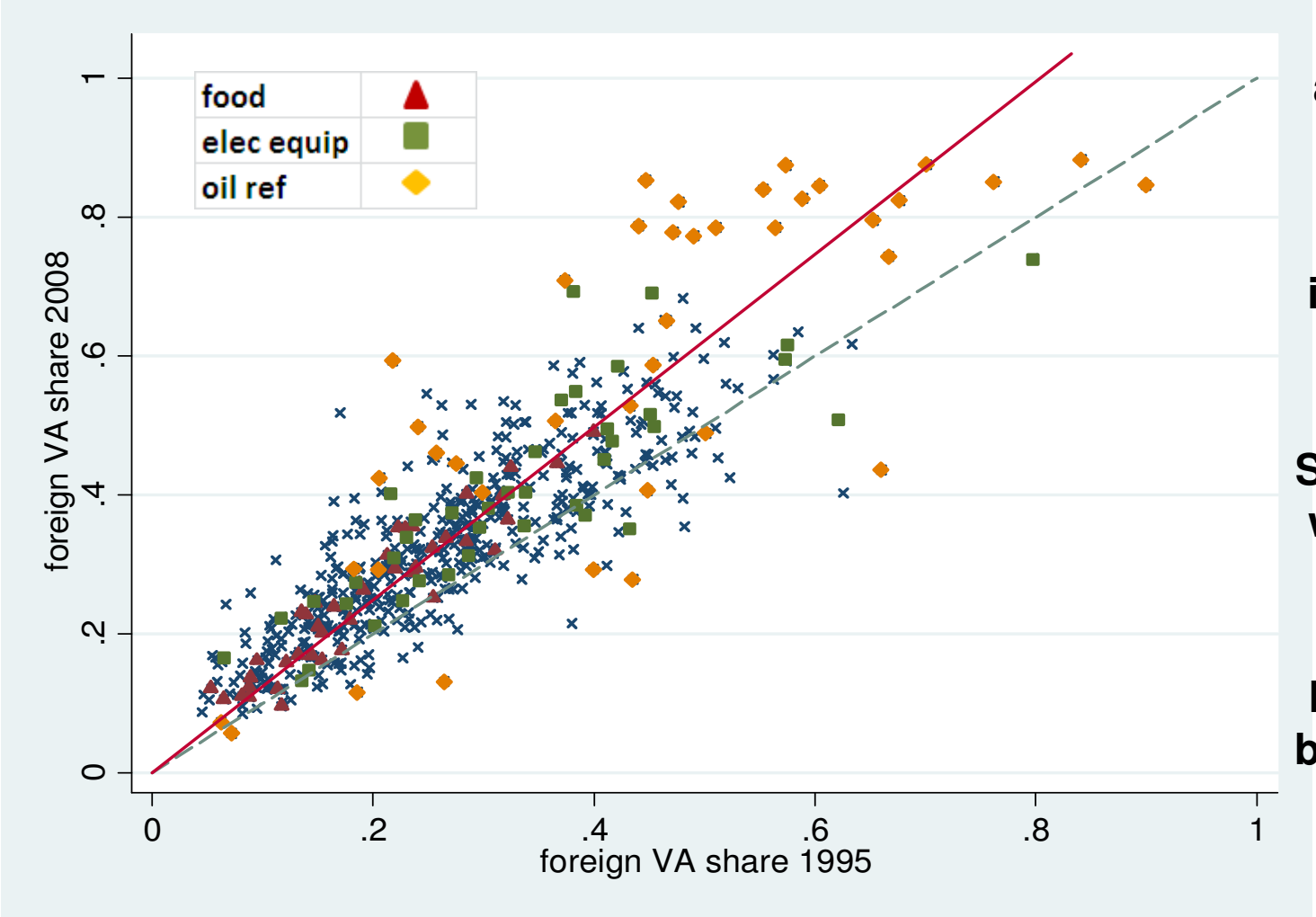
- using improved BEC-classification (based on COMTRADE HS 6-digit level) rather than standard proportionality assumption (Feenstra and Jensen, 2012)
- Breakdown of imports by country of origin, using bilateral trade statistics on goods and services (export shares by mirroring imports)

Some recent findings for Europe

Factor content of a global value chain: graphical representation



Increasing fragmentation between 1995 and 2008, (560 GVCs worldwide)

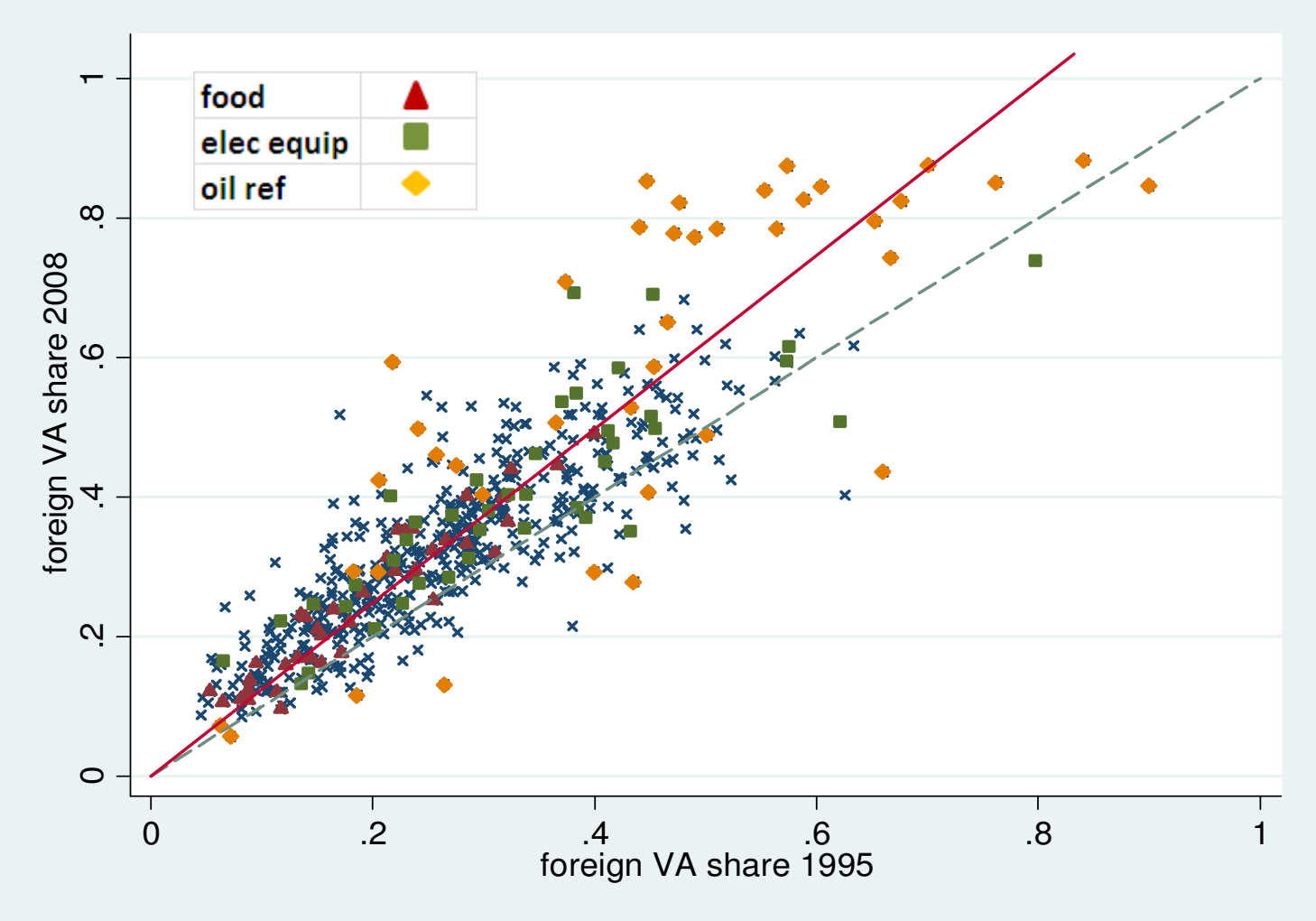


Foreign value added share in final output of each of 14 manufacturing industries in 40 countries

Solid line is OLS with significant slope of 1.20.

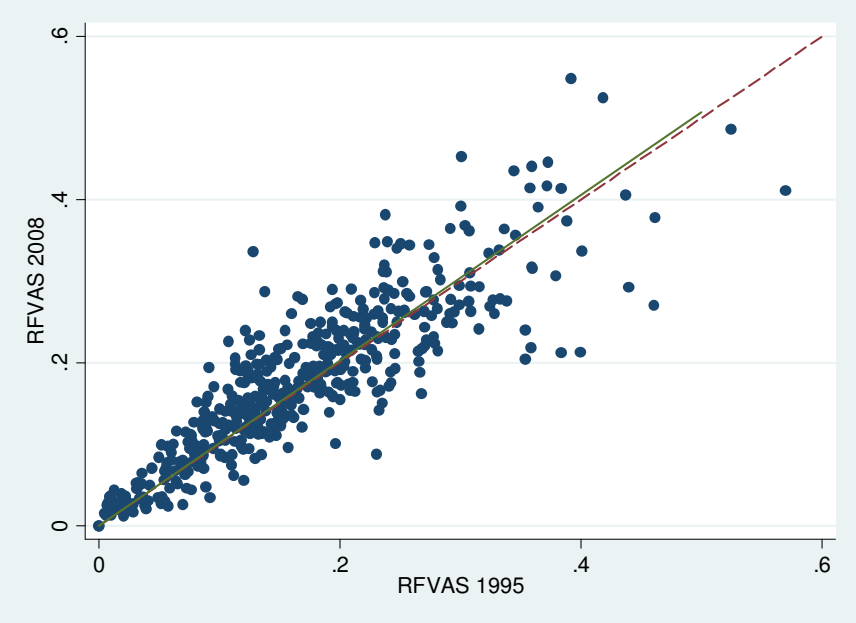
NB Output is at basic (ex-factory gate) prices

but potential for further fragmentation is still high

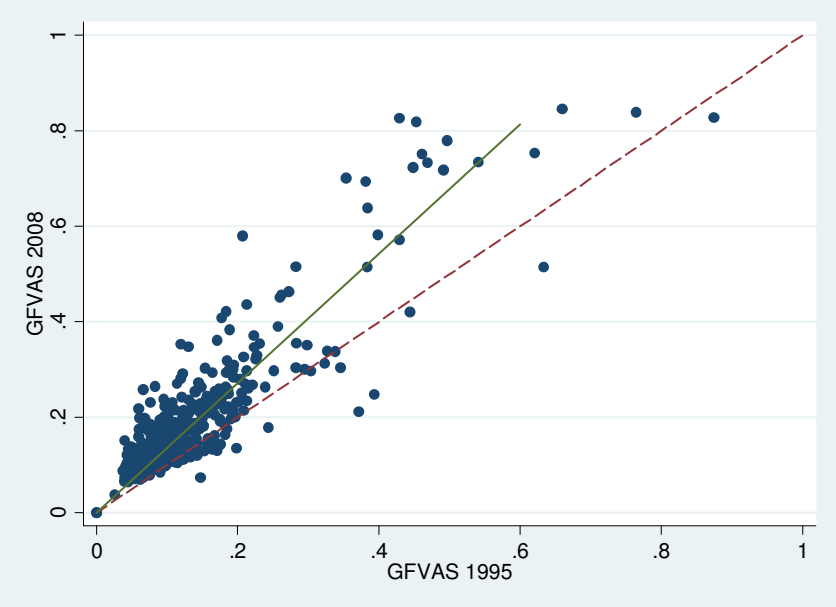


In 2008, majority of foreign value added share in 2008 is still below 35 per cent

FACT 1 Increasing value is added outside the region to which the country-of-completion belongs



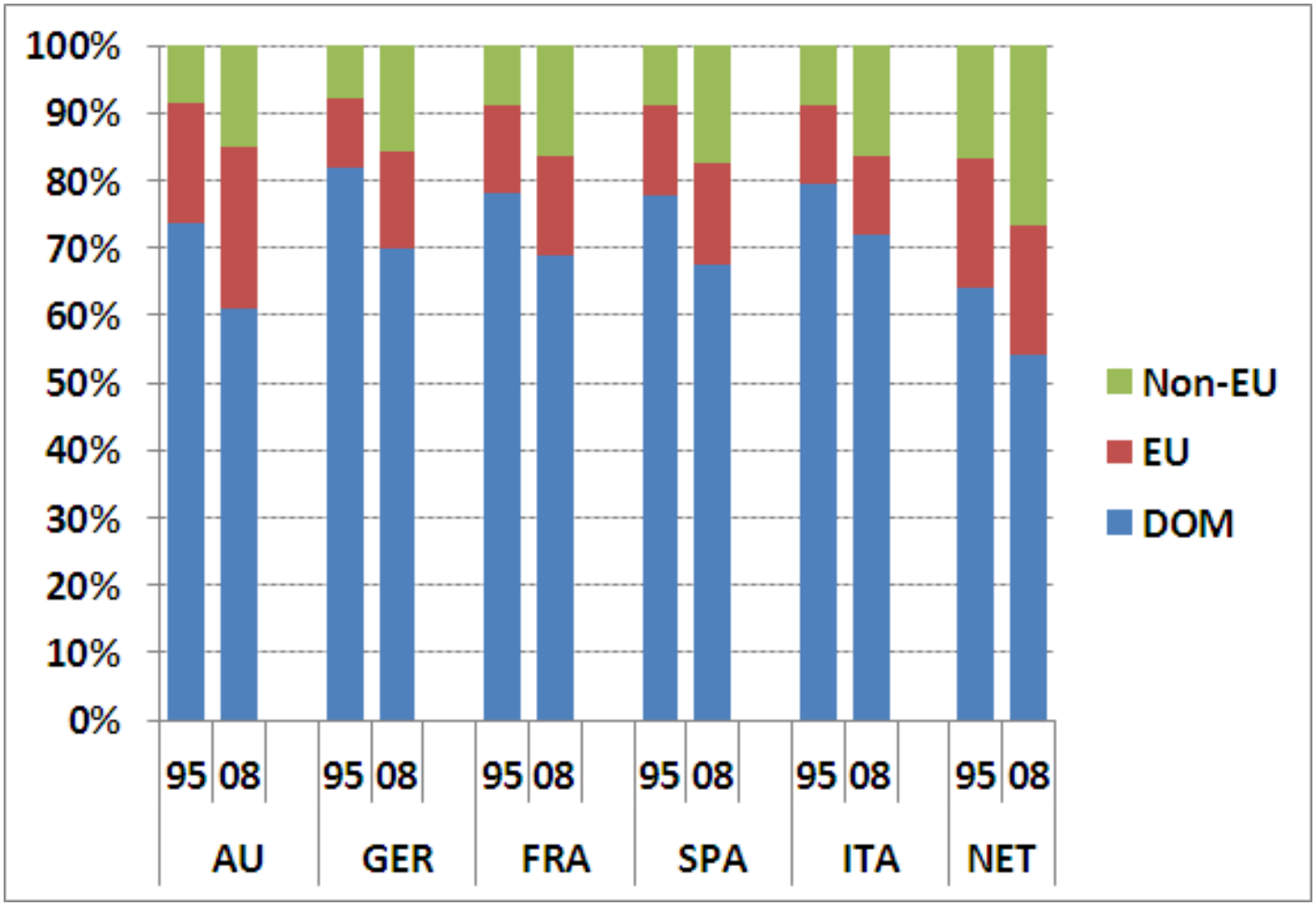
Regional value added



Outside region value added

Note: Foreign Value Added shares in output of final manufactures, 1995 and 2008. Observations have been included for 474 value chains, identified by 14 manufacturing industries-of-completion in 27 EU, 3 NAFTA and 3 East Asian countries. The dashed line is the 45 degree line. The solid line has been obtained by OLS regression through the origin.

FACT 1 Increasing value added outside the EU
(average of 14 manufacturing chains ending in an EU country)



Note: Origin of value added of final manufactures output for which a country is the country-of-completion, selected EU countries

GVC income

- GVC income of a country in global manufactures is the sum of its value added in each of the 560 manufactures GVCs worldwide

- GVC income increases when
  - A country increased the value added share in a particular product chain ("upgrading")
  - Global demand increased for those final products in which the country has an above average value added share

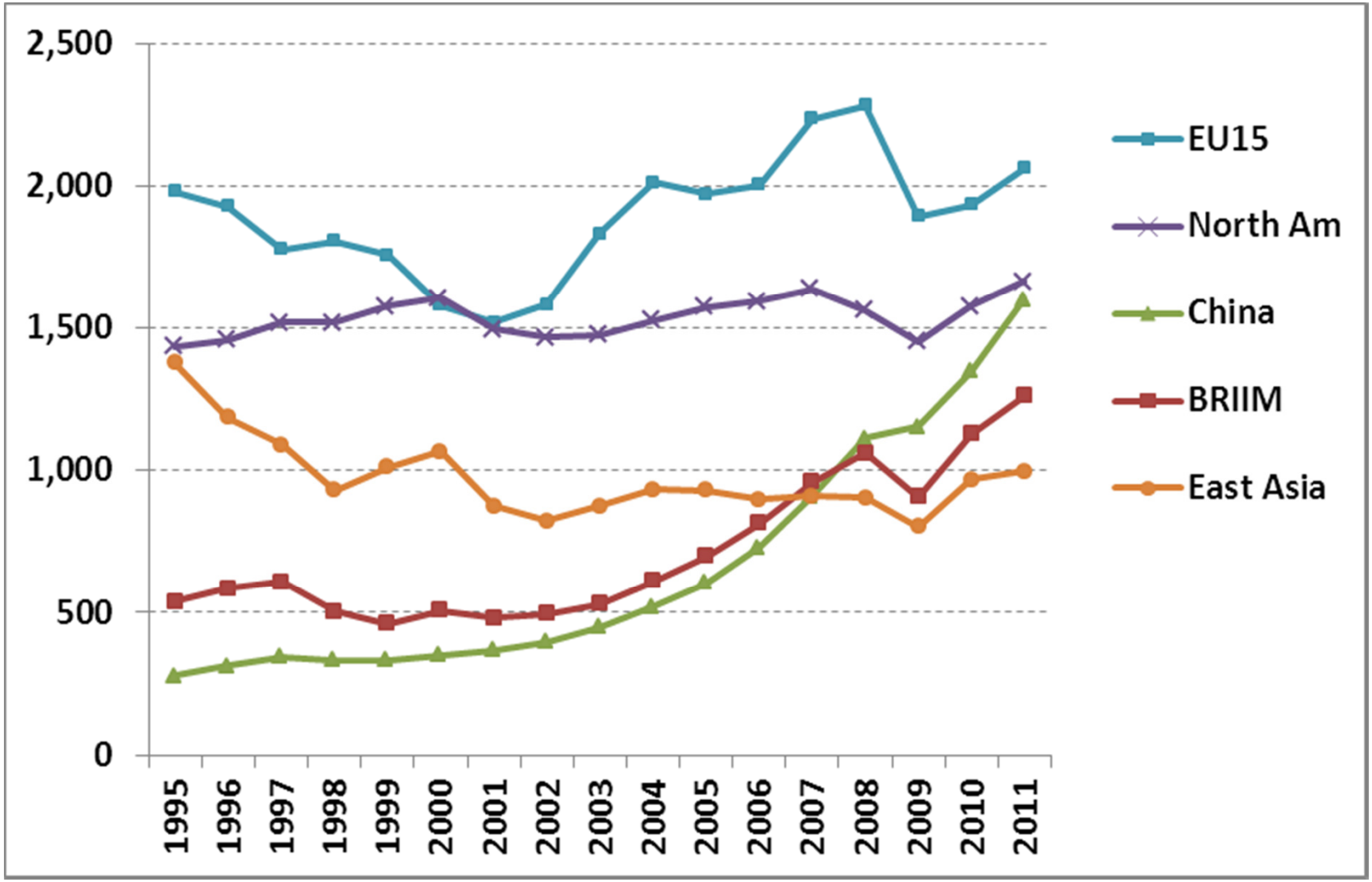
E.g. Czech GVC income might increase because:

It is capturing a larger share of German car GVCs, and/or

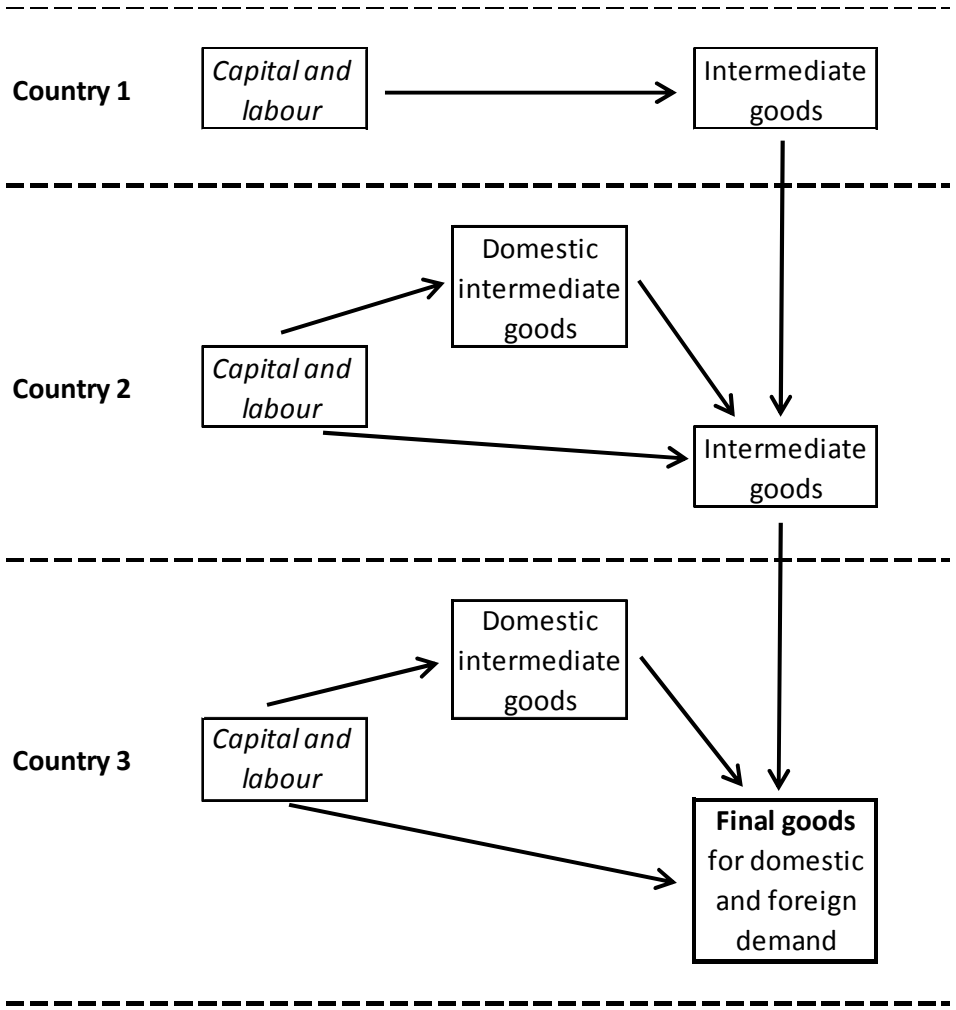
Chinese demand for German cars has increased

FACT 2 GVC income in EU is holding up

Value added by regions to all manufactures GVCS (billion 1995US$)



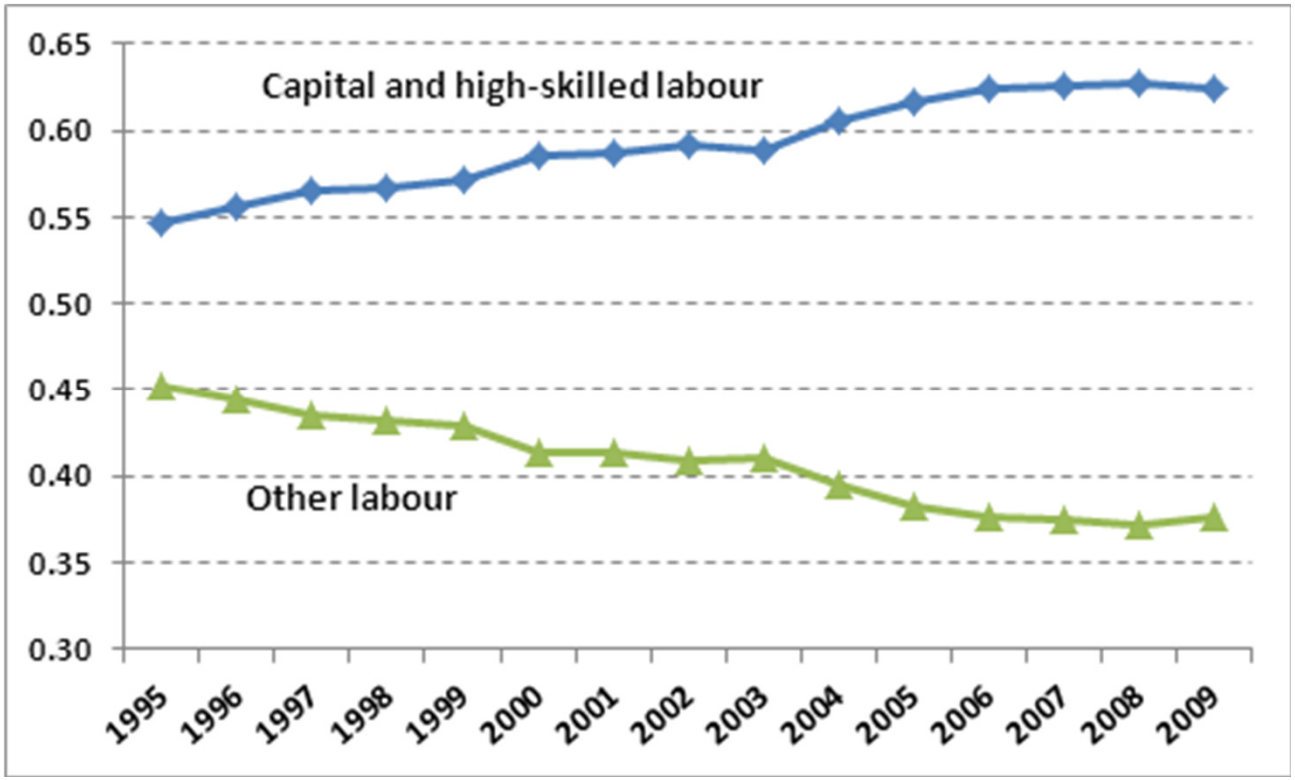
Factor content of a global value chain: graphical representation



DATA: factor incomes by industry-country

- **Wages and quantities of labour** by skill type
  - Number of workers (incl. self-employed) by three skill types based on levels of educational attainment (ISCED classification)
  - Wages reflect total costs for employer, including imputed wage for self-employed workers (Gollin, JPE, 2002)
  - For advanced countries data taken from EU KLEMS database (see O'Mahony and Timmer, 2009)
  - Other countries: similar methodology based on country-specific labour force surveys and additional materials (Erumban et al., 2011)
- **Capital income** is defined as residual such that the accounting identity will hold:
  - capital income = *value added minus labour compensation*.
  - It reflects income to *all* capital assets, including intangibles

Increasing value added by capital and high-skilled labour, (all manufactures GVCs)



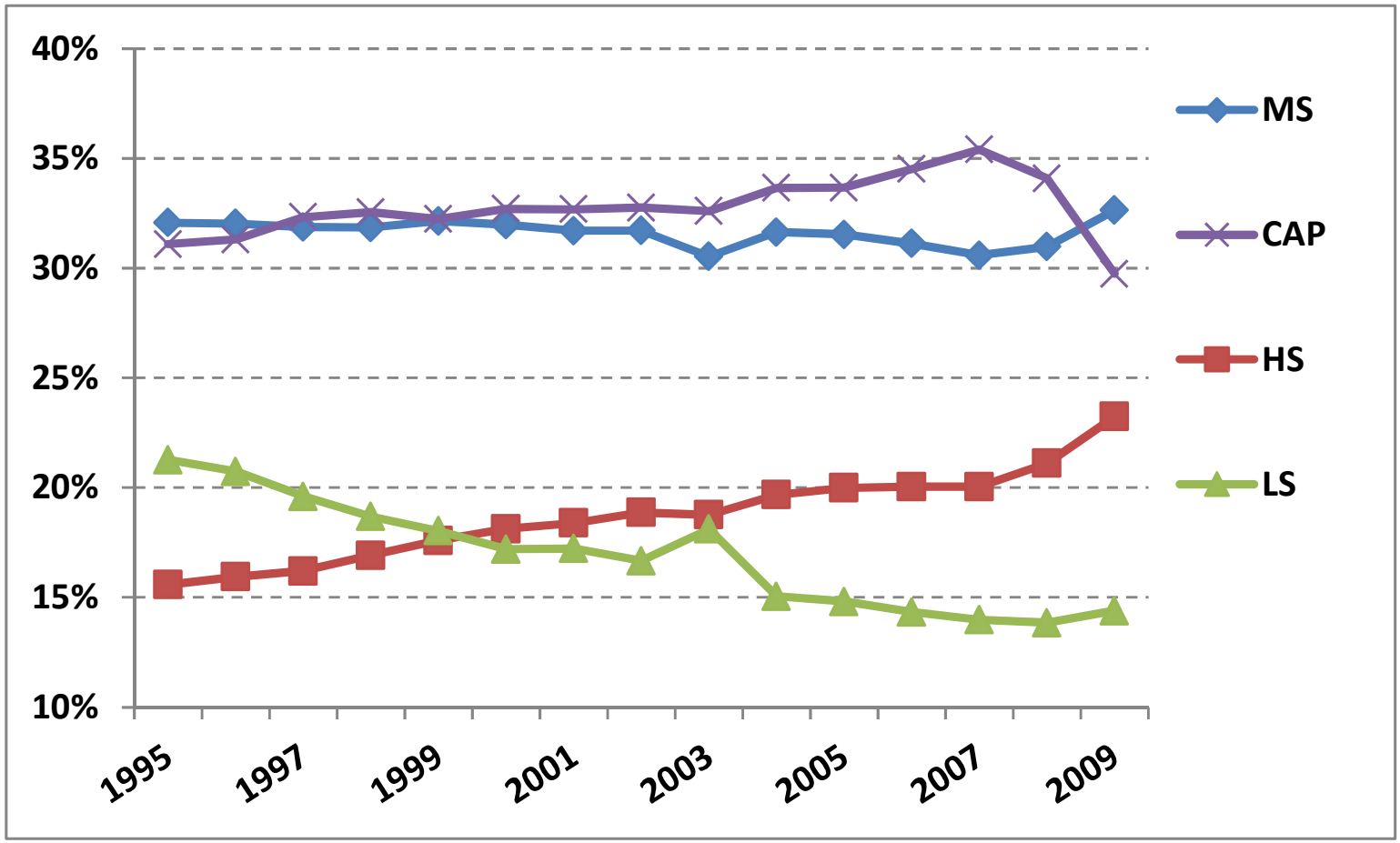
Note: The graph shows value added by factors as share of global final manufactures output.

Value added to global output of final manufactures, 1995 and 2008

	1995	2008	Change
Total value added (billion US$), by	**6,586**	**8,684**	**2,098**
capital (%)	40.9	47.4	6.5
high-skilled labor (%)	13.8	15.4	1.5
medium-skilled labor (%)	28.7	24.4	-4.2
low-skilled labor (%)	16.6	12.8	-3.8

Note: Breakdown of value added to global output of all final manufactures by factor of production. Value added is at basic prices (hence excluding net taxes, trade and transport margins on output). It is converted to US$ with official exchange rates and deflated to 1995 prices with the US CPI. Figures may not add due to rounding.
Source: Author's calculations based on World Input-Output Database, April 2013.

FACT 3 Specialisation in the EU towards value added by high-skilled workers and capital (all manufactures GVCs)



Note: The graph shows value added by factors in EU 27 in global final manufactures output (% of total EU value added)

Possible determinants of factor value added shares

From production theory: change in cost shares can be explained by:

- changes in factor prices,
- substitution elasticities acrosss all factors in all countries and
- factor-biased technical change (in the vertical chain)

Some potential explanations:

- Declining costs of international fragmentation has increased substitution possibilities of low-skilled labour across countries
- Prices of natural resources increased + limited substitution possibilities
- Declining ICT prices + complementarity of ICT and high skills
- Expansion of demand for final products with large fixed capital costs (e.g. brand names or software system) in imperfect sales markets

Characteristics of GVC jobs

- Ultimately goverments are concerned about “good” jobs.
- And capital income earned on the domestic territory is not necessarily accruing to domestic capital owners.

- GVC analysis can also be done based on jobs (*GVC jobs*), rather than value added by properly modifying the industry requirement matrix.

- What type of workers participate in the global production of manufactures, and in which sector?

FACT 4 Increasing number of EU jobs outside the manufacturing sector, all manufactures GVCs

Figure 3. Change in number of workers in the EU27 involved in manufactures GVCs, by sector of employment and by level of educational attainment between 1995 and 2008 (in millions).

Concluding remarks

- This paper proposed a new method to identify and analyse the factor content of vertically integrated production at a macro-economic level.
- Two new measures of competitiveness: GVC income and GVC jobs. Based on activities that countries perform in production process of a particular set of products.

- Based on the new world input-output database (WIOD) we found four trends in the activities of the EU in **GVCs *of manufactures*:**
  - FACT 1 In GVCs ending in the EU there is increasing value added outside the EU
  - FACT 2 GVC income in EU is holding up over 1995-2011
  - FACT 3 Specialisation in the EU towards value added by high-skilled workers and capital
  - FACT 4 Increasing number of jobs outside the manufacturing sector

Possible ways forward for competitiveness research from GVC perspective

- New measures
  - Decomposing changes in GVC income into changes in demand across chains and changes in value added contribution per chain
  - RCA on basis of GVC incomes
- If one wants to concentrate on exports only, *also* analyse the contribution of firms that deliver inputs to the exporting firms (but might not be exporting themselves).

- For the future: The "micro-micro" turn. Look inside the firms and study activities
  - Occupational data to characterize the jobs
  - Business functions ("*International sourcing of business functions*", new Eurostat survey)