

# International fragmentation of production and employment

Robert Stehrer

The Vienna Institute for International Economic Studies (wiiw)

[www.wiiw.ac.at](http://www.wiiw.ac.at)

[Robert.Stehrer@wiiw.ac.at](mailto:Robert.Stehrer@wiiw.ac.at)

**22<sup>nd</sup> TEN meeting,**  
wiiw, December 5-6, 2012, Vienna

## Internationalization effects on employment

- Two sides of internationalisation of production
  - Access to new (dynamic) markets
  - Intensified competition at home and third markets
  - Sourcing and vertical specialisation
- Effects on employment levels unclear
  - Theory does not provide clear predictions
  - Productivity effect: Offshoring diminishes demand for labour (in advanced countries)
  - BUT: What about developing countries?
  - Scale effect: Offshoring leads to increased competitiveness which leads to higher sales
- Effects on employment structures unclear
  - Theory does not provide clear predictions
  - Negative impact on low educated (in advanced countries)
  - SBTC is more important

## Theory is undecided

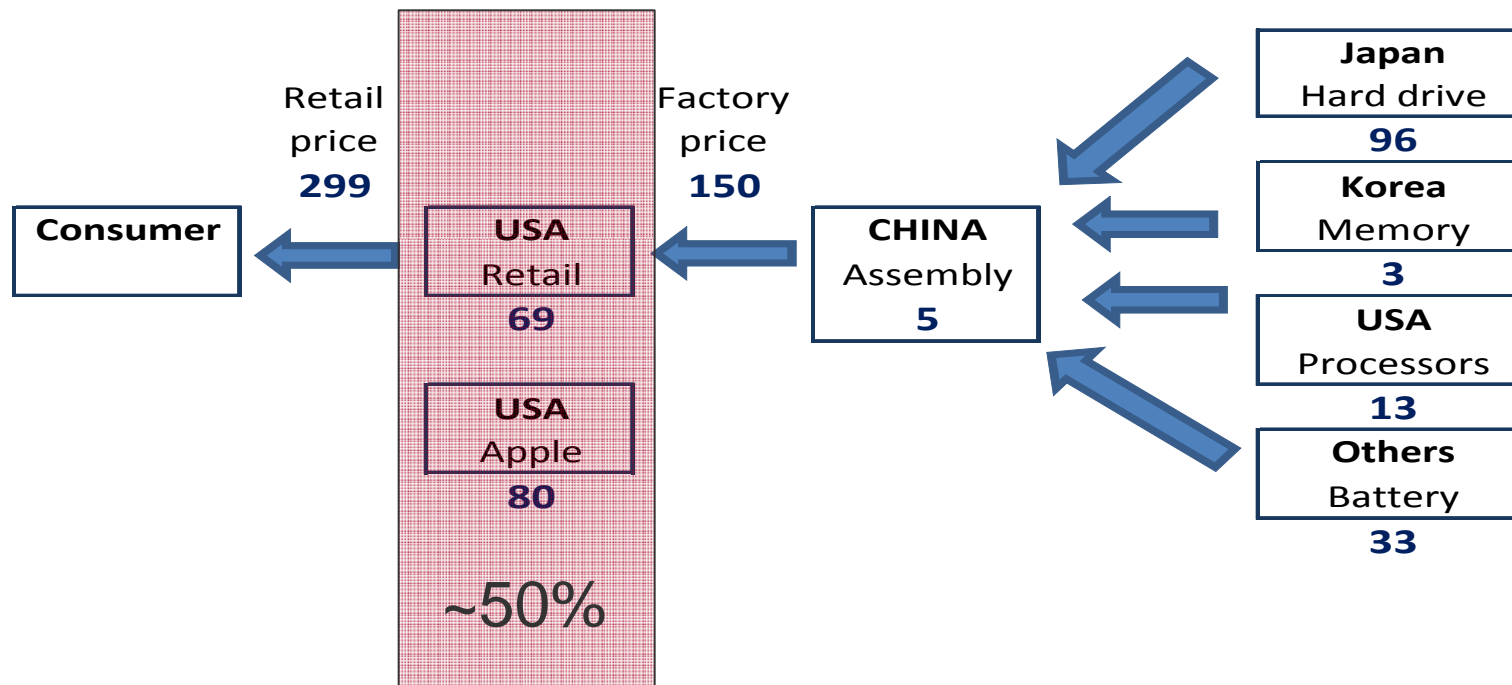
- Standard trade model (HO 2x2x2) + fragmentation
  - Results depend very much on which sector is offshoring which fragment (Deardorf, 2001)
  - Example: Is offshoring more pronounced in high-tech (skill intensive) sectors?
- Feenstra-Hanson maquiladoras
  - Advanced country is offshoring low-skill intensive fragments leading to a rise in relative demand for skilled workers
  - Offshored fragments are relatively skill intensive in target countries leading to a rise in relative demand for skilled workers
  - Demand for skilled workers is rising in both countries
- Using WIOD data allows to test for offshoring effects on
  - Employment levels
  - Cost share structures
  - for various skill types

## Overview of presentation

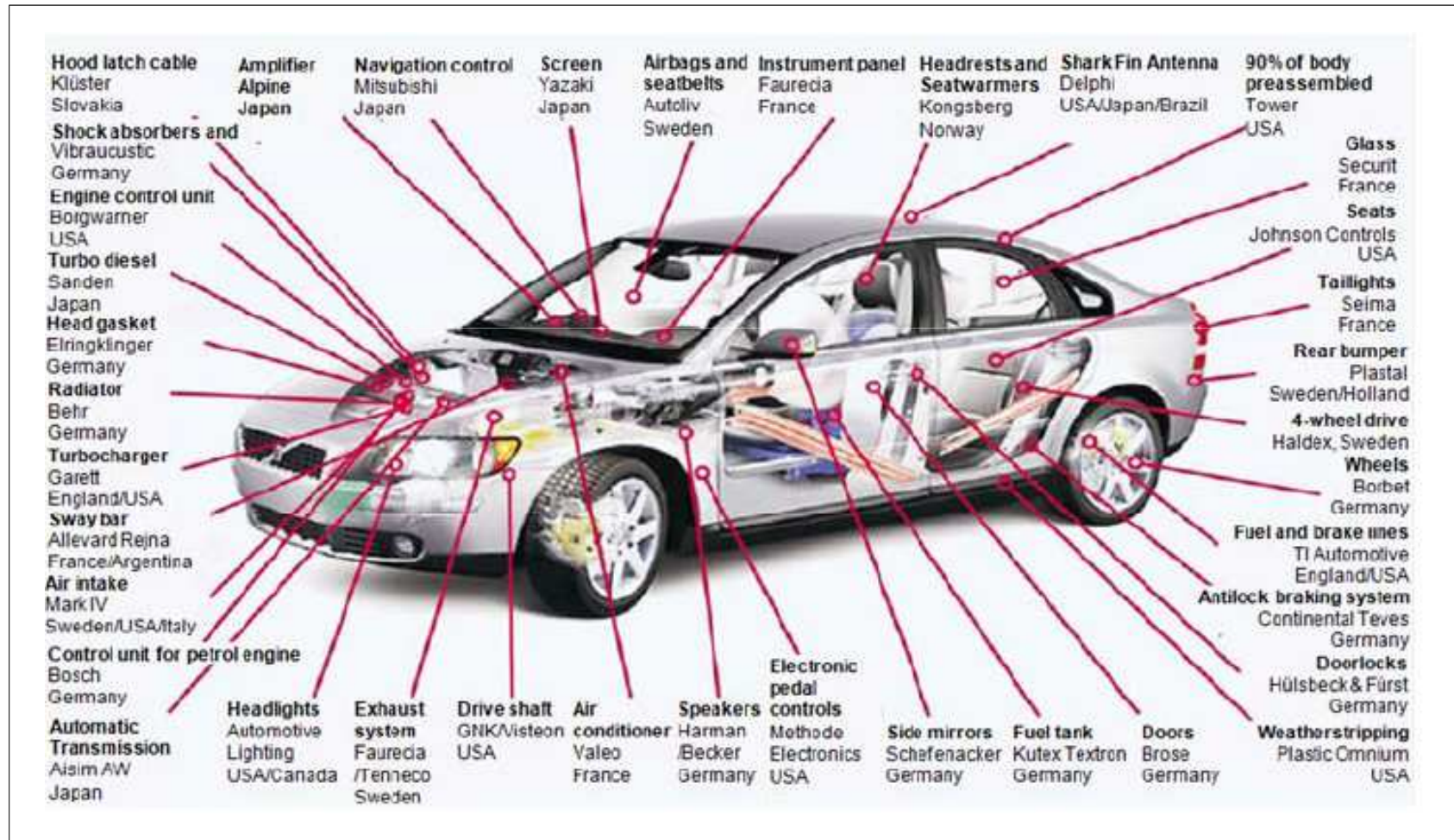
- Trends for EU and member states
- Econometric results
  - Disentangling productivity and scale effects
  - By skill-type
  - Change in wage elasticity?

## Internationalization of production – The iPod case

The iPod-case

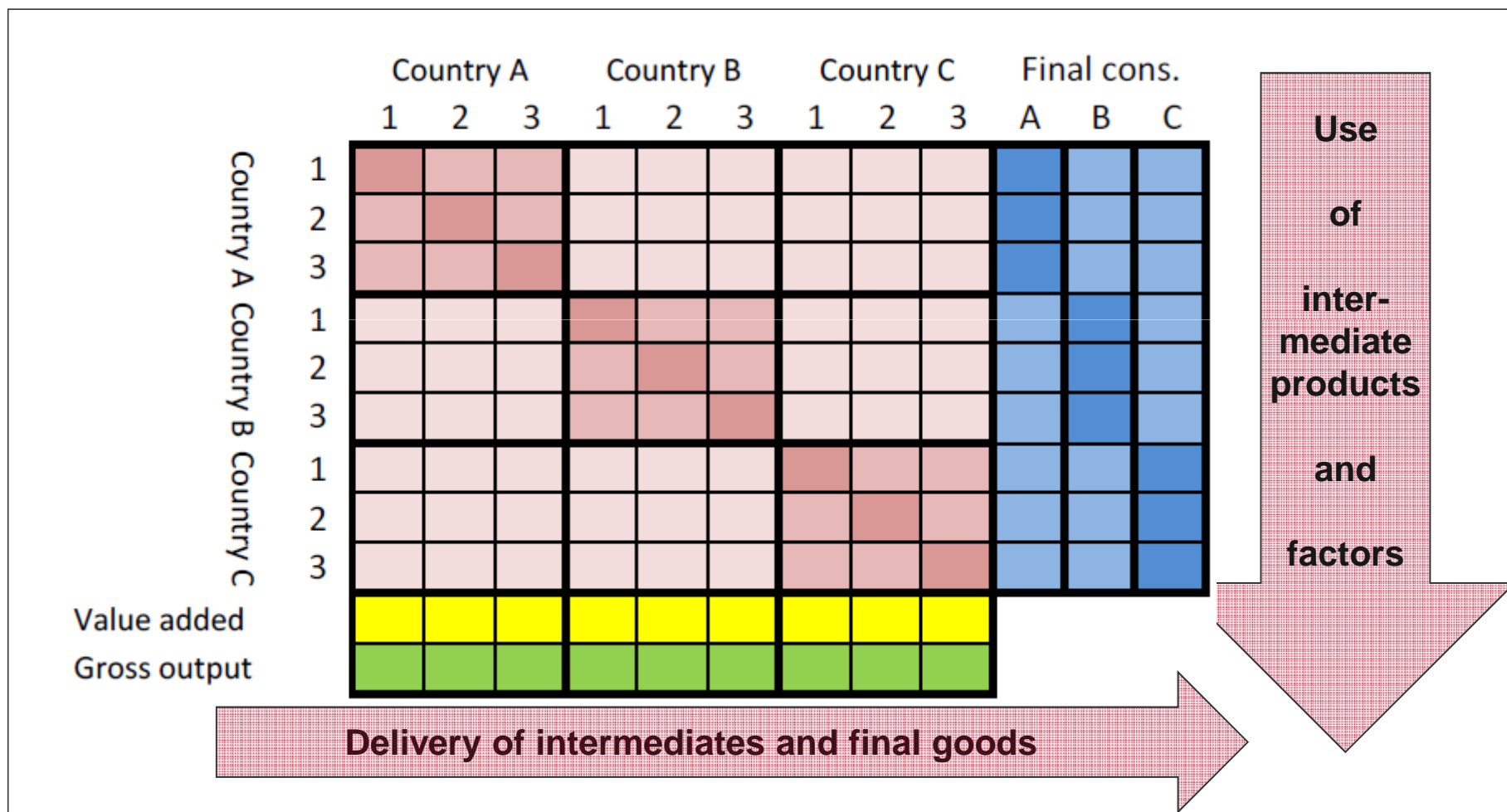


## Example: Volvo S40



Source: Baldwin, R. (2009)

# World Input-Output Table – Schematic scheme



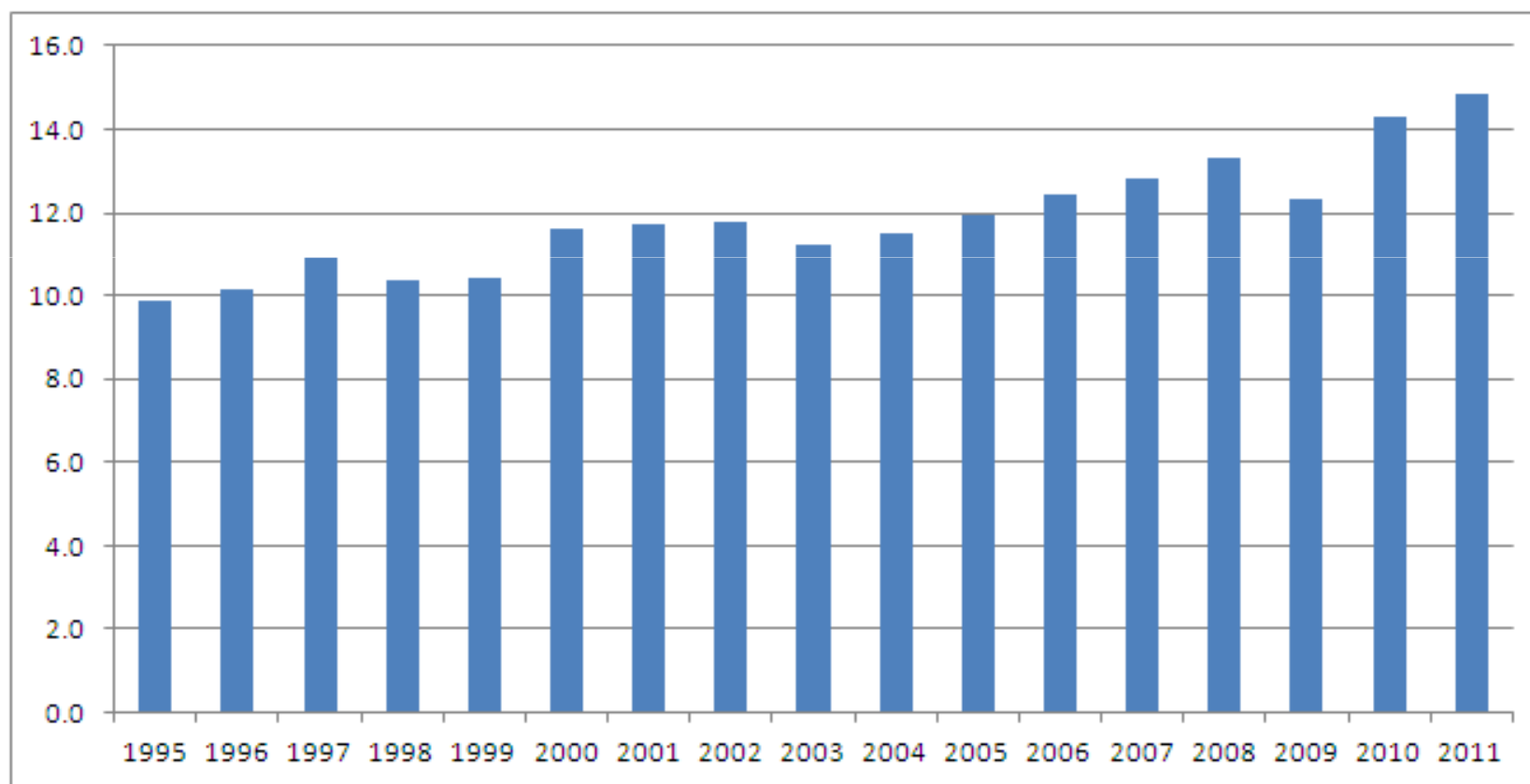
## Accounting for World Input-Output Linkages

- Some descriptive results based on world input-output modeling
  - Based on WIOD data
    - World IO data for period 1995-2009 (2011)
    - Comprehensive accounting of internationalization effects
- Demand side (scale effect)
  - VA created in EU due to final demand somewhere else
    - Takes account of international inter-linkages
    - VA created in A due to demand from C in B (which needs inputs from A)
- Supply side (productivity effect)
  - Intermediates imports of A from B which already includes inputs from C
- EU-27 and individual member states
  - Relative importance of GVCs
  - Differences across EU member states



## Increasing importance of extra-EU demand

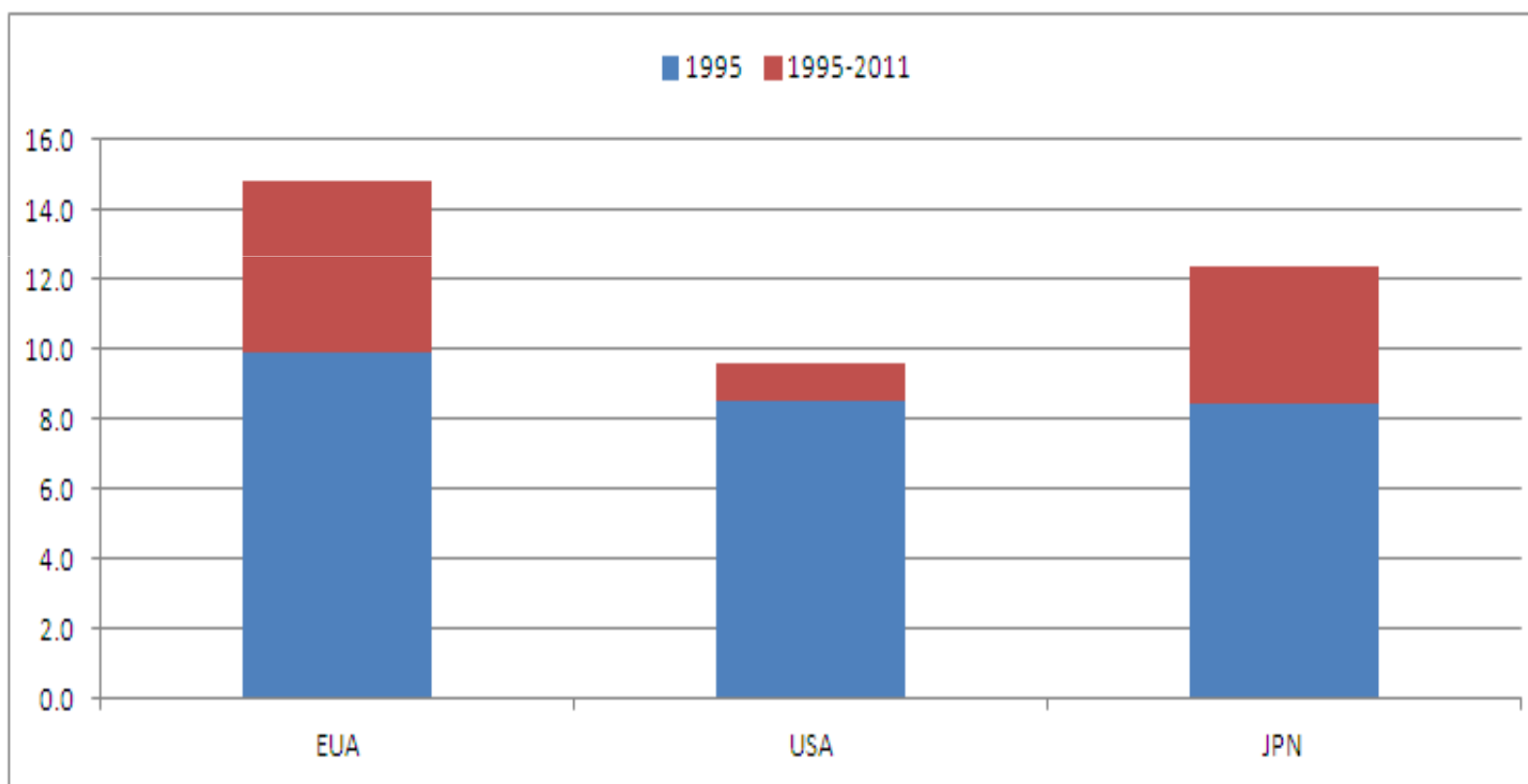
Value added created in EU-27 due to foreign final demand (in % of total GDP)



Source: WIOD database, own calculations.

## Comparison to other advanced countries

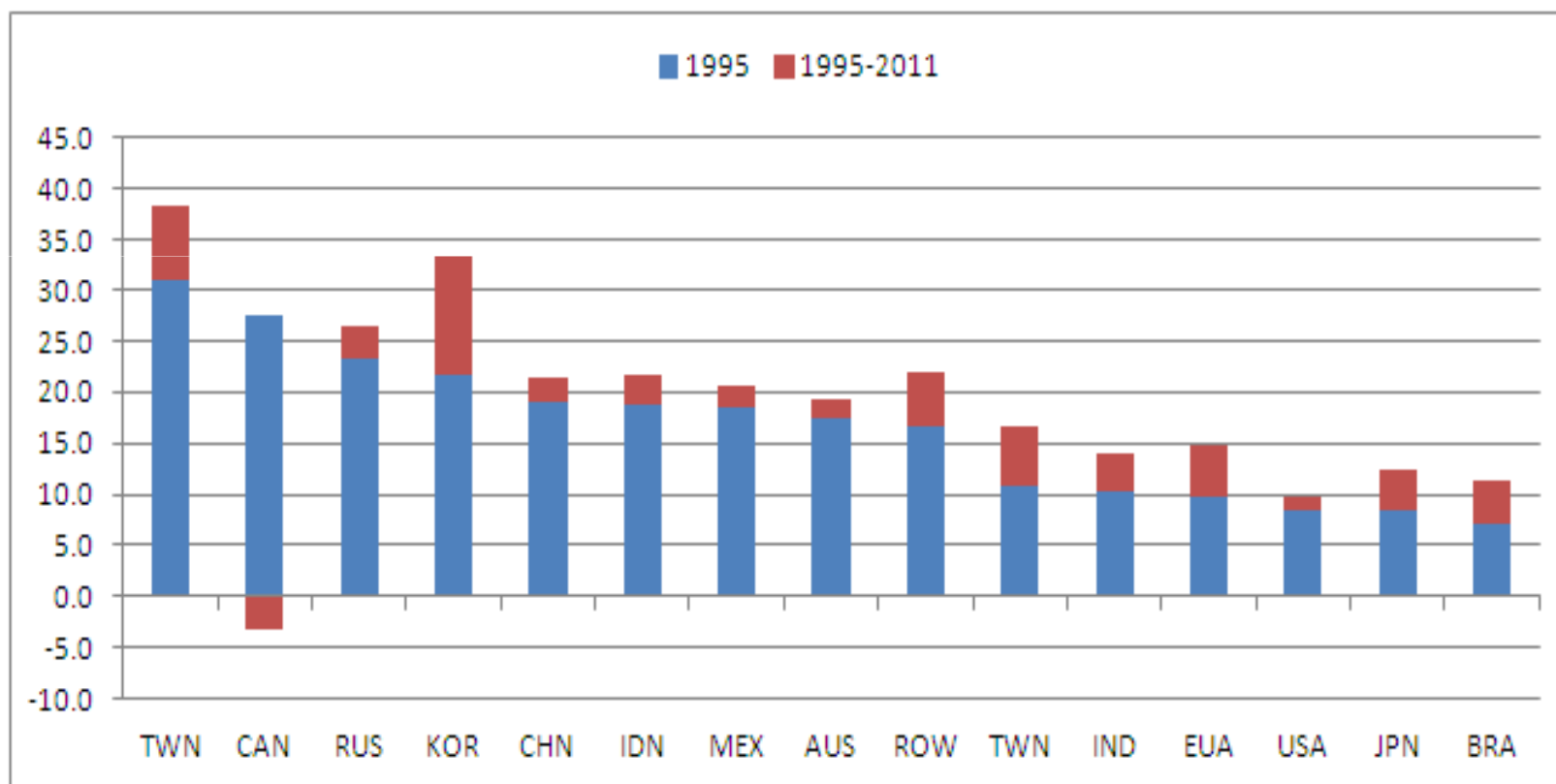
Value added due to foreign demand (in % of total GDP), 1995-2011



Source: WIOD database, own calculations.

Similar trends for all countries ....

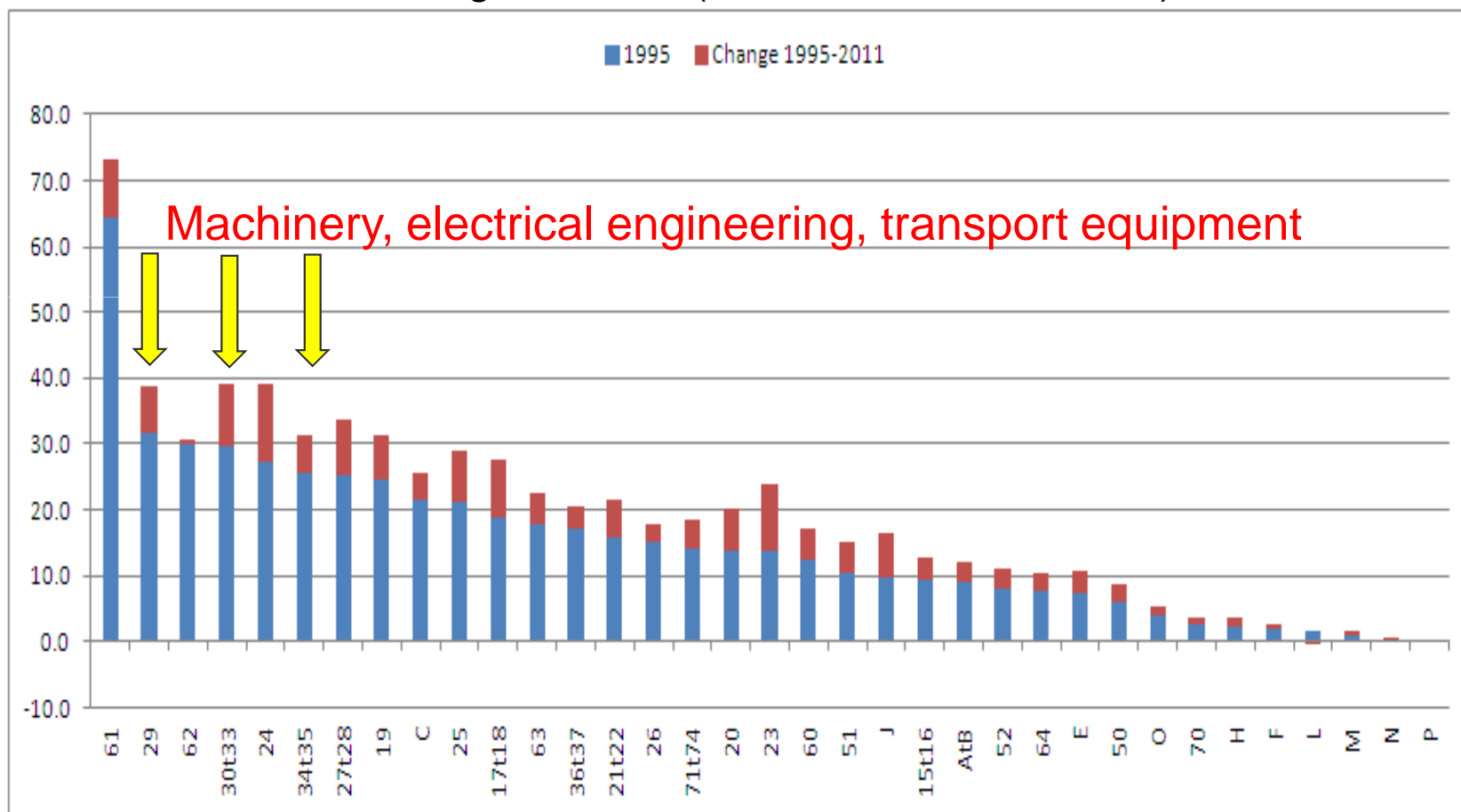
Value added due to foreign demand (in % of total GDP), 1995-2011



Source: WIOD database, own calculations.

## Strong differences across sectors

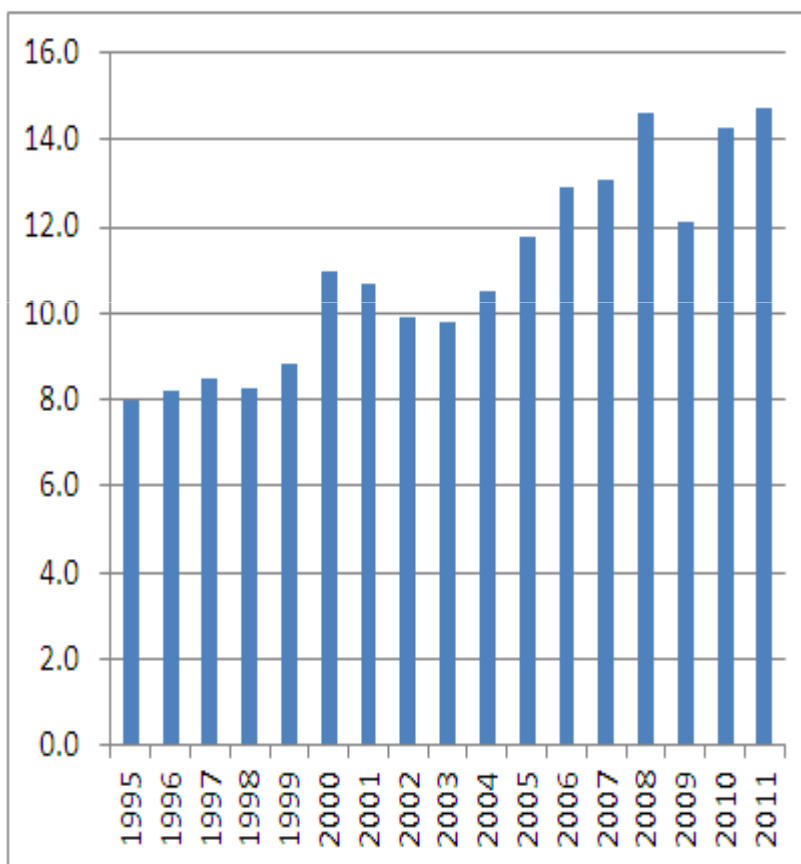
Value added due to foreign demand (in % of total sectoral VA)



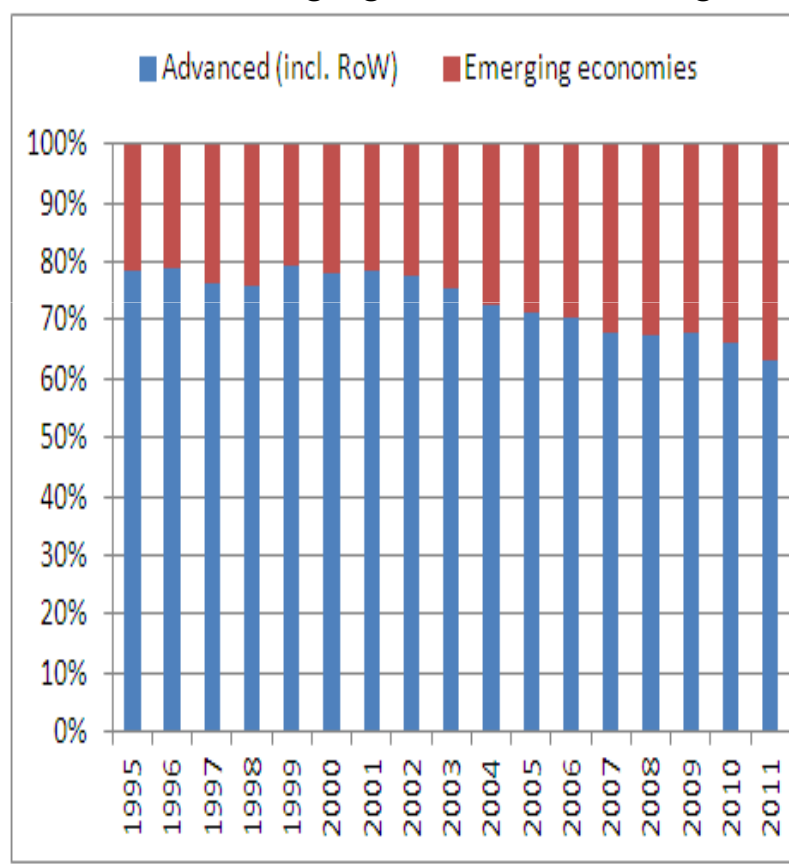
Source: WIOD database, own calculations.

## Supply side: Increasing importance of offshoring and extra-EU sourcing (Vertical specialization)

Foreign value added in exports (in %)

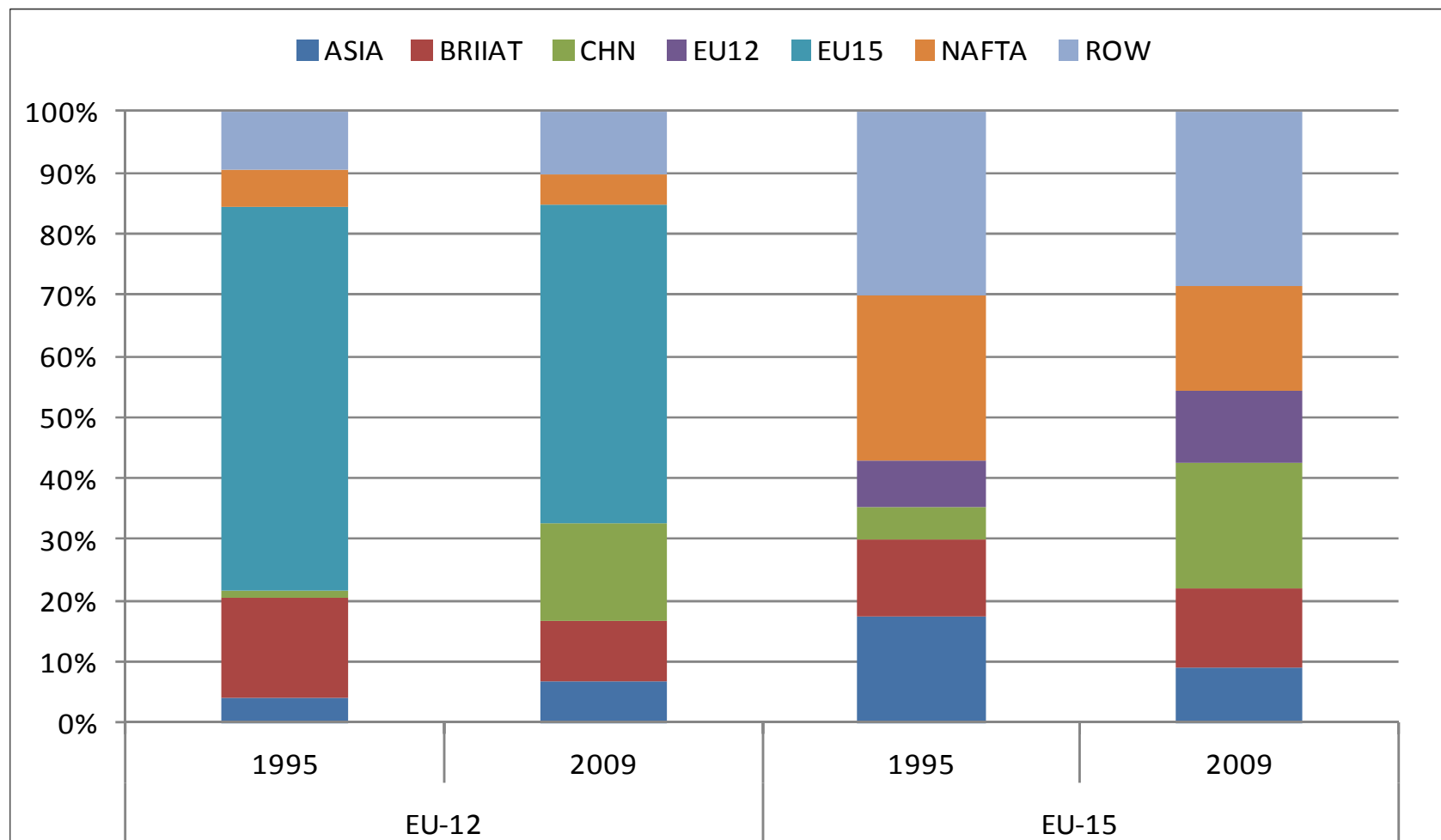


Share of emerging economies rising



Source: WIOD database, own calculations.

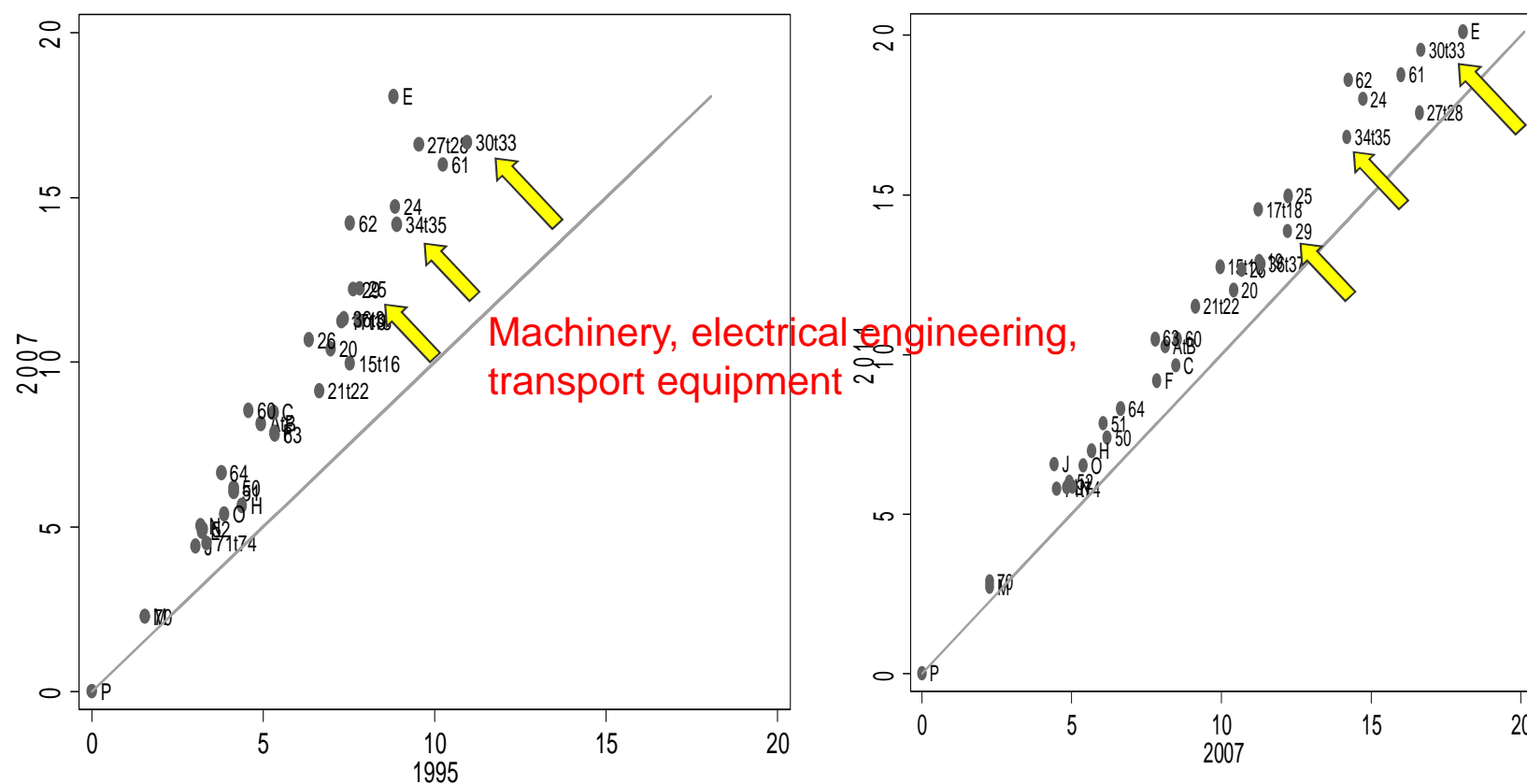
## EU sourcing structures, 1995 and 2009



Source: WIOD database, own calculations.

# Vertical specialization is dominant in high-tech industries (together with transport and energy)

Foreign value added in exports (in %): 1995 to 2007 and 2007 to 2011



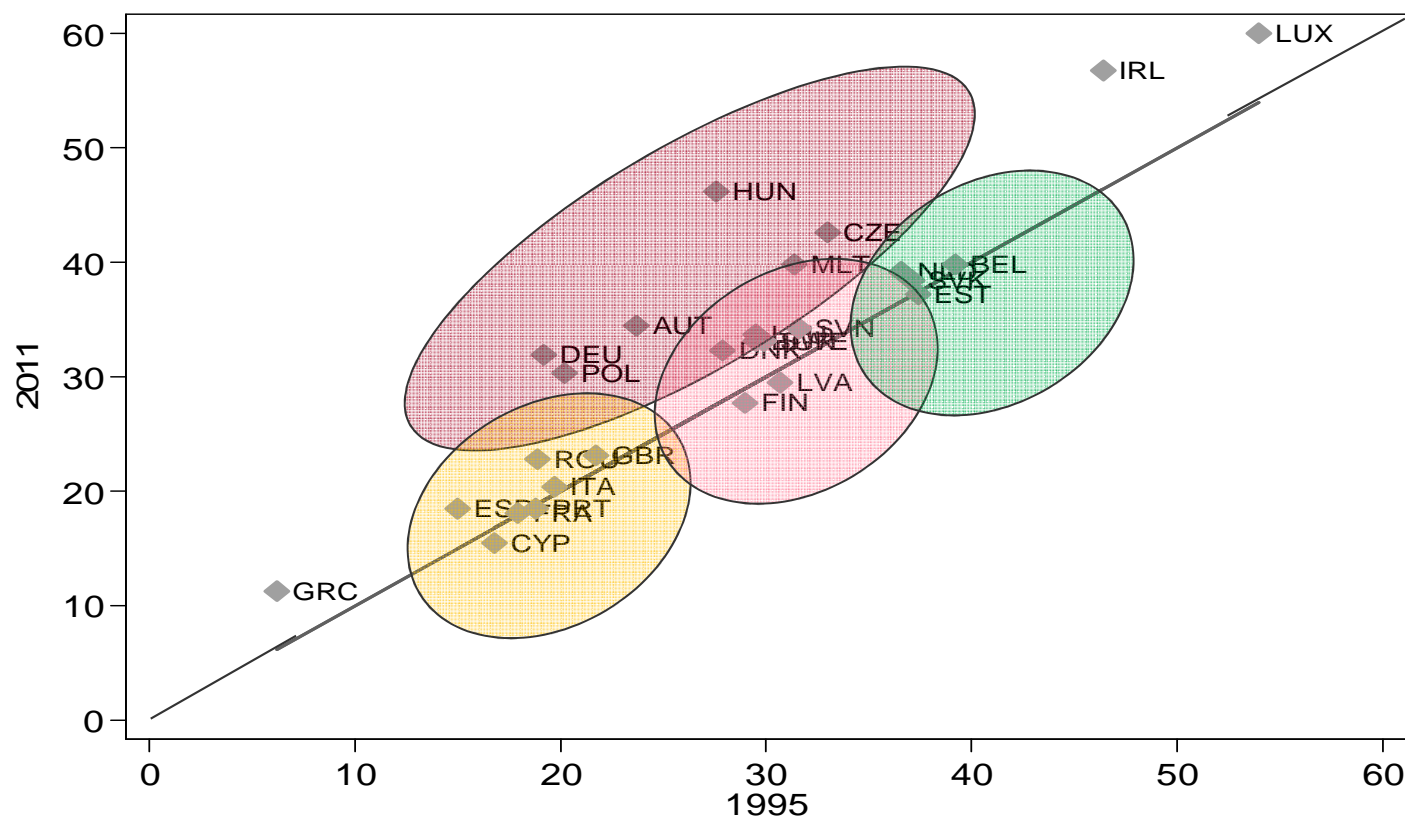
Source: WIOD database, own calculations.

## Differences across EU member states



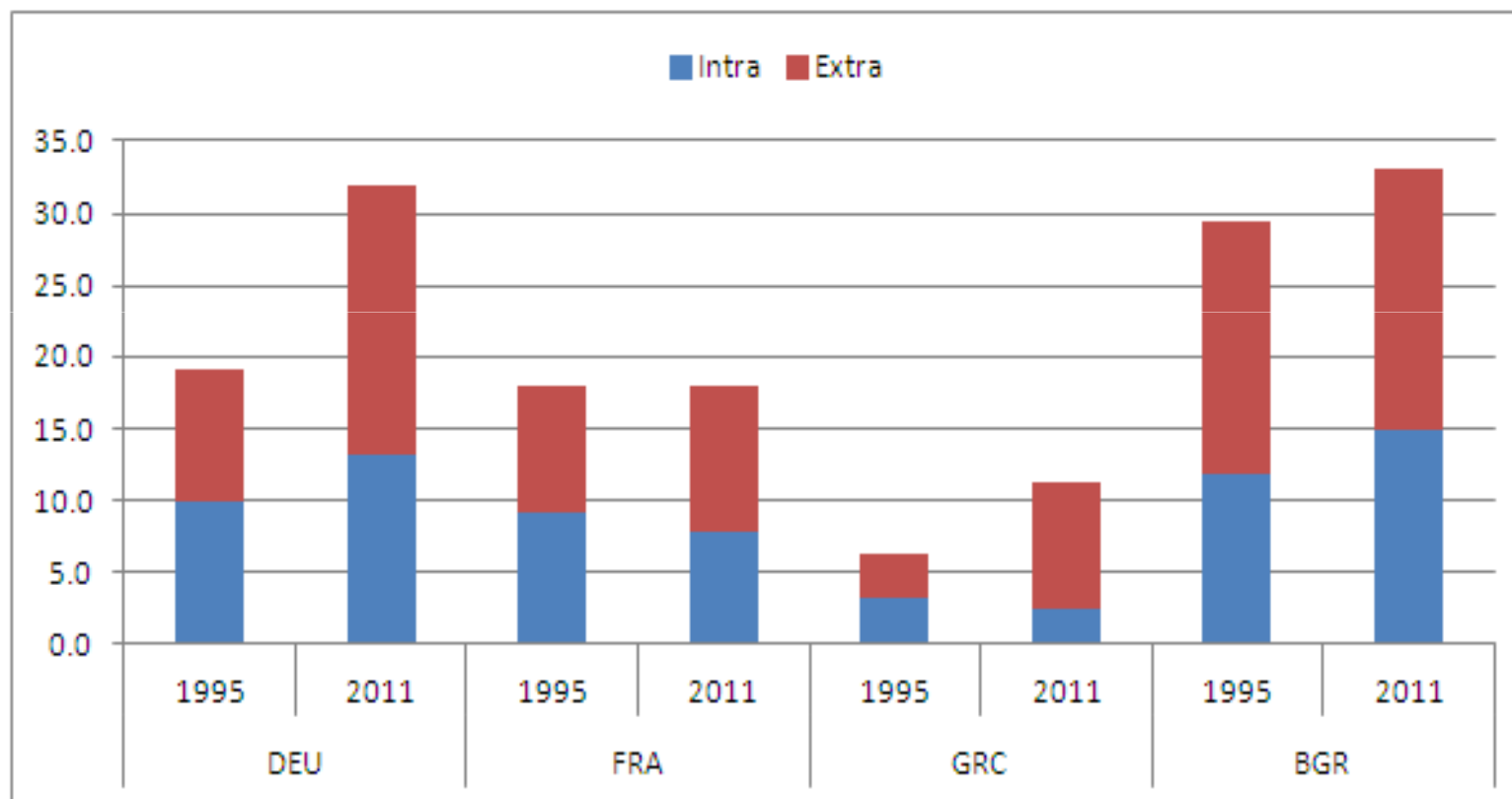
## EU members have differently engaged in external markets

Value added due to foreign demand (in % of total GDP), 1995 and 2011



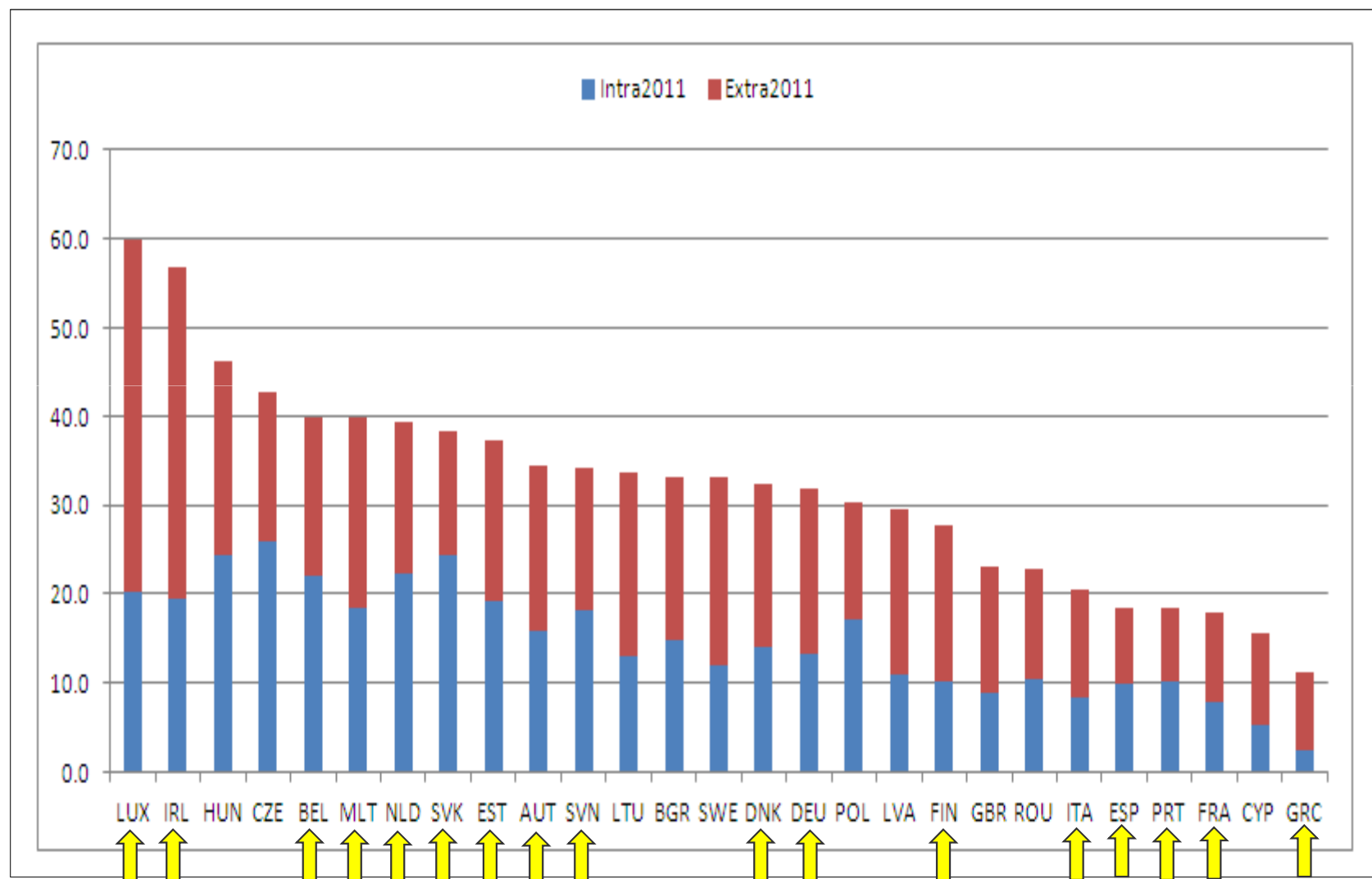
Source: WIOD database, own calculations.

## Importance of extra- and intra-EU final demand effects, 1995 and 2011



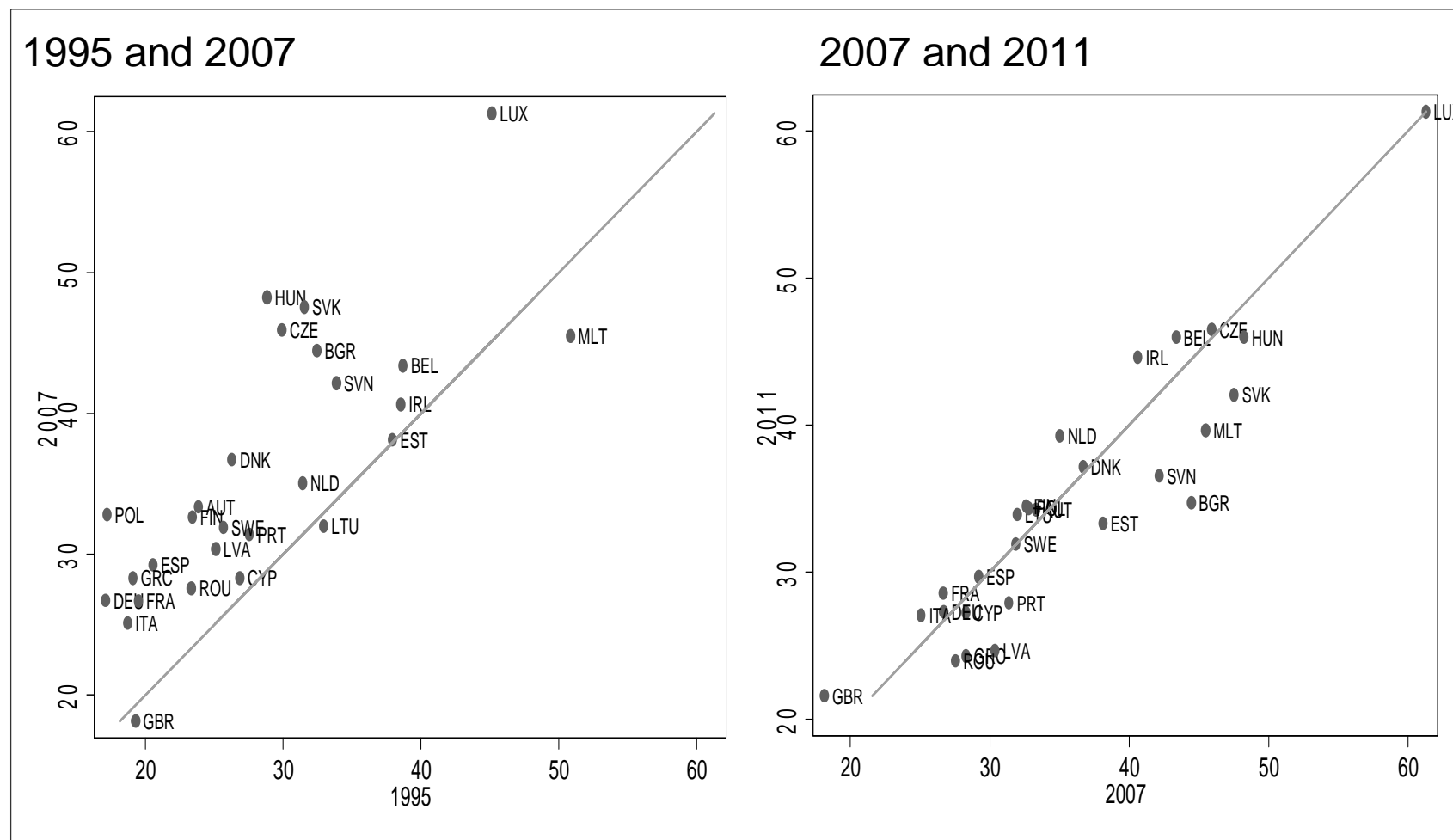
Source: WIOD database, own calculations.

## Extra-EU and intra-EU demand importance, 2011



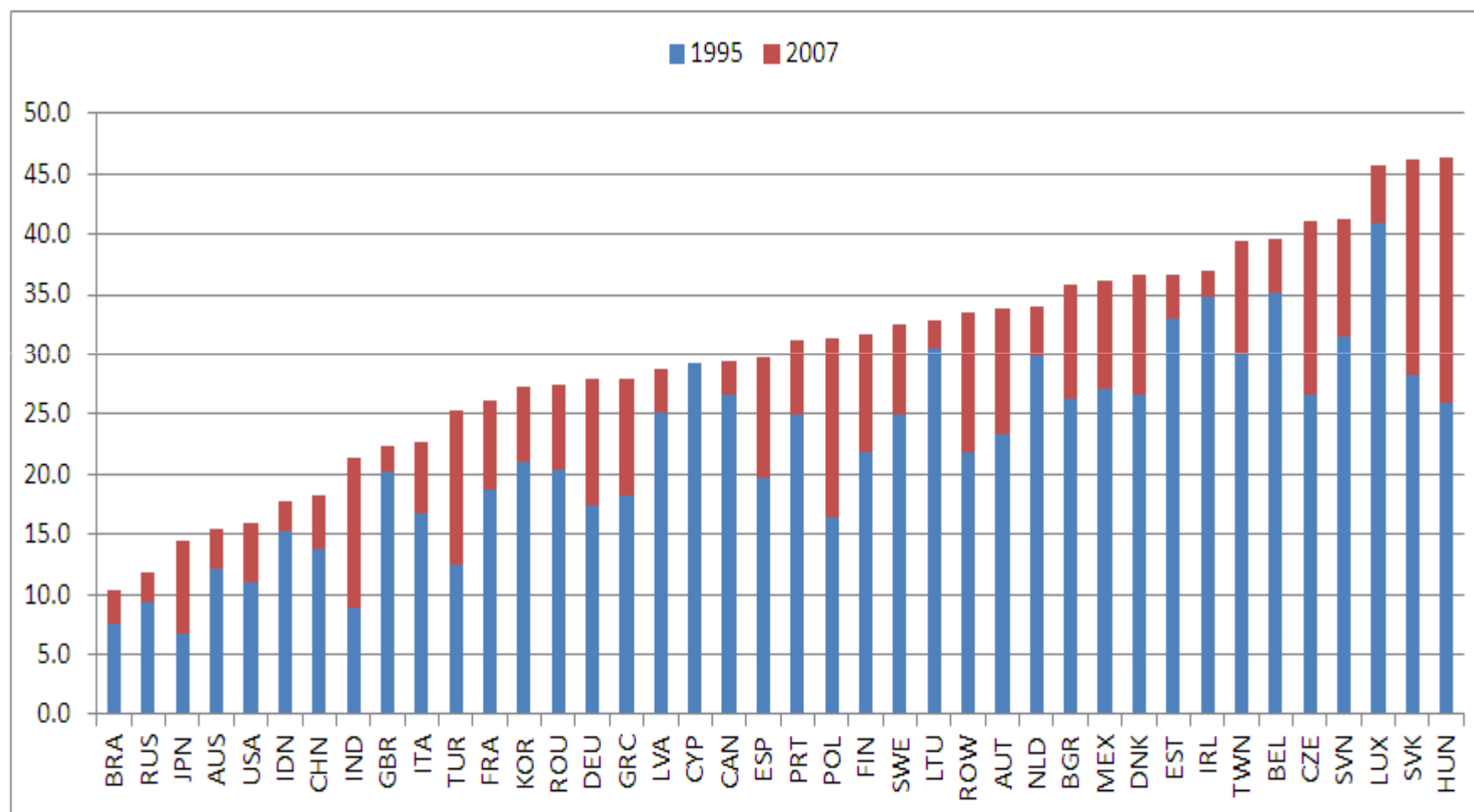
Source: WIOD database, own calculations.

# Supply side: Increasing importance of foreign sourcing (Vertical specialization)



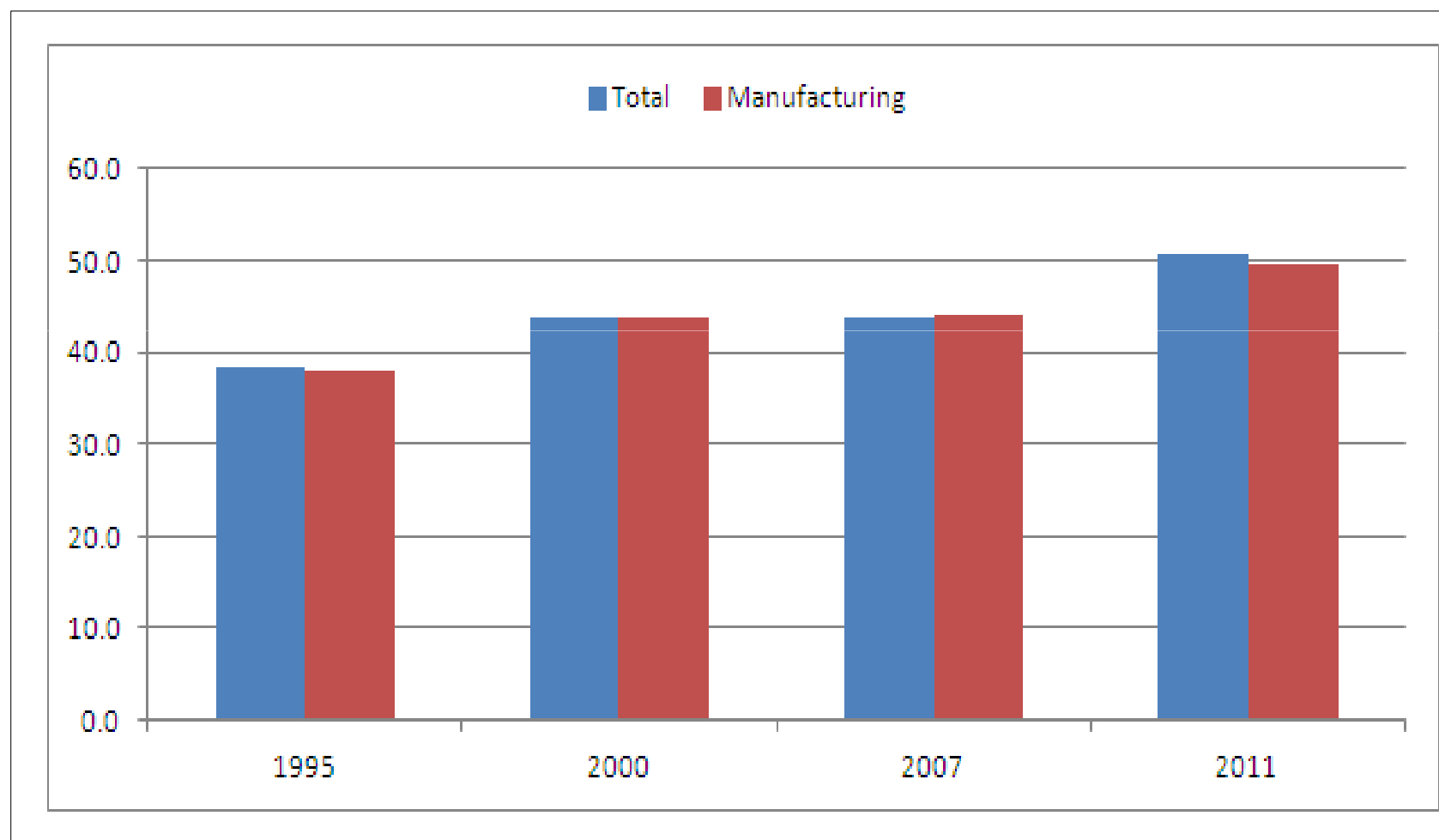
Source: WIOD database, own calculations.

## Foreign content of exports, 1995-2007



Source: WIOD database, own calculations.

## Share of 'farshoring' in total offshoring increased over crisis



Source: WIOD database, own calculations.

## Summary of descriptive results

- Increasing importance of foreign demand
  - Tends to be stronger in higher-tech manufacturing sectors
- Increasing vertical specialization (foreign content)
  - Tends to be stronger in higher-tech manufacturing sectors
- Significant differences across EU member states
  - in levels
  - in trends (increasing importance of non-EU markets)
  - driven by (initial) specialization (?)
- Countries which are more open and specialized in med and high-tech manufacturing
  - Real exchange rate (intra-EU and increasingly extra-EU) matters more
  - Different views on monetary policy (inflation) and wage policies

## Econometric evidence before crisis (1995-2007)

(preliminary results)

- Looking at overall GO, VA and employment growth
  - What are effects of VA trade
  - Controlling for standard growth variables and other macro-variables
  - NOTE: results based on pre-crisis period
- Productivity growth
  - Fostering gross output and value added growth
  - But negatively related to employment growth
- Positive effect of capacity variables
  - Capital accumulation (less so for employment due to labour saving technologies)
  - High-skill employment (needs some additional controls); particularly strong in EU
- Openness
  - Results not robust



- Vertical specialisation
  - Only effect on gross output, not on value added or employment growth
  - For employment growth: Productivity effect of offshoring is counteracted by scale effect
- Real wage growth is negatively related to value added and (even stronger) employment growth

## Offshoring and employment

## Evidence on Offshoring and the Demand for Skilled Labour

- A number of empirical studies examine the impact of production offshoring on the demand for skilled labour in developed countries (usually concentrating on specific countries)
- Examples: Feenstra and Hanson (1996; US), Falk and Koebel (2002; Germany); Strauss-Kahn (2003; France), Hijzen et al (2005; UK)
  - Results tend to suggest that offshoring impacts negatively upon the demand for unskilled labour (exception Falk and Koebel, 2002)
  - Despite such results the 'consensus view' is that trade was not the major reason for rising wage inequality in the 80s and 90s, with skill biased technological change cited as the major reason
    - The results of Feenstra and Hanson (1996) for example suggest that trade contributed around 31 percent of the increase in non-production wages

# Offshoring and employment levels

(Foster, Pöschl and Stehrer, 2012)

- Offshoring has
  - **Productivity effect** which tends to have negative effect on labour demand
  - **Scale effect** which tends to have positive effect on labour demand

- Estimation strategy

- Conditional labour demand equation (for productivity effect)

$$\ln L_{ict} = \alpha_0 + \sum_j \alpha_j \ln w_{ict} + \beta_k \ln k_{ict} + \beta_y \ln y_{ict} + \sum_l \gamma_l z_{ilct}$$

- Unconditional labour demand equation (for total effect)

$$\ln L_{ict} = \alpha_0 + \sum_j \alpha_j \ln w_{ict} + \beta_k \ln k_{ict} + \beta_p \ln p_{ict} + \sum_l \gamma_l z_{ilct}$$

- Scale effect is difference between total and productivity effect

## Offshoring and employment levels

	Conditional	Unconditional
	All	All
Wage/Materials Price	-0.137*** (0.00886)	-0.0834*** (0.00937)
Log Capital Stock	0.550*** (0.0133)	0.669*** (0.0137)
Log Output	0.184*** (0.0112)	
Log Price		0.0892*** (0.0117)
Log ICT Share	-0.159*** (0.00966)	-0.178*** (0.0107)
Intra-Ind. Offshoring	<b>-0.0417***</b> <b>(0.014)</b>	<b>0.00169</b> <b>(0.0148)</b>
Inter-Ind. Offshoring	<b>-0.0431**</b> <b>(0.0182)</b>	<b>-0.0138</b> <b>(0.0207)</b>
Year Dummies	Yes	Yes
Observations	7,922	7,922
R-squared	0.688	0.653
F	261.4***	283.8***

- **Productivity effect is negative**
- **Total effect is insignificant**
- **Scale effect compensates productivity**

## Offshoring and employment levels

(using long-differences)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>EMP_ALL</i>	<i>EMP_LS</i>	<i>EMP_MS</i>	<i>EMP_HS</i>	<i>EMP_ALL</i>	<i>EMP_LS</i>	<i>EMP_MS</i>	<i>EMP_HS</i>
<i>ALL COUNTRIES</i>								
$\Delta w$	-0.397*** (0.0168)	-0.354*** (0.0167)	-0.291*** (0.0450)	-0.407*** (0.0174)	-0.332*** (0.0170)	-0.295*** (0.0169)	-0.249*** (0.0380)	-0.346*** (0.0175)
$\Delta w_{II}$	0.357*** (0.0195)	0.359*** (0.0201)	0.293*** (0.0410)	0.338*** (0.0197)	0.244*** (0.0188)	0.251*** (0.0193)	0.206*** (0.0339)	0.230*** (0.0192)
$\Delta K$	0.00258 (0.00578)	0.00371 (0.00669)	0.000837 (0.00637)	0.00439 (0.00740)	0.0918*** (0.00663)	0.0925*** (0.00725)	0.0814*** (0.00719)	0.0936*** (0.00799)
$\Delta GO$	0.371*** (0.0106)	0.369*** (0.0127)	0.331*** (0.0152)	0.373*** (0.0127)				
$\Delta IIM^N$	0.00563 (0.00399)	0.0102** (0.00513)	-0.000463 (0.00469)	0.0182*** (0.00499)	0.0164*** (0.00445)	0.0212*** (0.00547)	0.00926* (0.00494)	0.0289*** (0.00535)
Observations	9,854	9,854	9,854	9,854	9,854	9,854	9,854	9,854
R-squared	0.374	0.227	0.254	0.247	0.199	0.124	0.142	0.146
F-Test	140.4***	107.7***	78.55***	105.6***	47.13***	45.62***	22.97***	48.88***

# Offshoring and employment levels

(using long-differences)

	Conditional model				Unconditional model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>EMP_ALL</i>	<i>EMP_LS</i>	<i>EMP_MS</i>	<i>EMP_HS</i>	<i>EMP_ALL</i>	<i>EMP_LS</i>	<i>EMP_MS</i>	<i>EMP_HS</i>
Narrow offshoring – all countries								
$\Delta IIM^N$	0.00563 (0.00399)	0.0102** (0.00513)	-0.000463 (0.00469)	0.0182*** (0.00499)	0.0164*** (0.00445)	0.0212*** (0.00547)	0.00926* (0.00494)	0.0289*** (0.00535)
Narrow offshoring – developed countries								
$\Delta IIM^N$	-0.00134 (0.00355)	0.0107 (0.00765)	-0.0102** (0.00457)	0.00304 (0.00598)	0.0306*** (0.00494)	0.0426*** (0.00841)	0.0211*** (0.00555)	0.0344*** (0.00696)
Narrow offshoring – developing countries								
$\Delta IIM^N$	0.00386 (0.00536)	0.00623 (0.00649)	-0.00170 (0.00626)	0.0206*** (0.00644)	0.00988* (0.00578)	0.0124* (0.00679)	0.00326 (0.00650)	0.0258*** (0.00675)
Broad offshoring – all countries								
$\Delta IIM^B$	0.0165 (0.0117)	0.0227 (0.0143)	0.0158 (0.0122)	0.0728*** (0.0141)	0.0256** (0.0125)	0.0328** (0.0150)	0.0243* (0.0128)	0.0825*** (0.0146)
Broad offshoring – developed countries								
$\Delta IIM^B$	-0.0628*** (0.0118)	-0.00593 (0.0165)	-0.0609*** (0.0135)	-0.0378** (0.0167)	0.0404*** (0.0133)	0.0911*** (0.0176)	0.0364** (0.0147)	0.0609*** (0.0188)
Broad offshoring – developing countries								
$\Delta IIM^B$	0.0279* (0.0155)	0.0221 (0.0185)	0.0250 (0.0161)	0.0948*** (0.0183)	0.0287* (0.0161)	0.0235 (0.0190)	0.0261 (0.0165)	0.0961*** (0.0184)

## Further results (summary)

- Offshoring increased own-price elasticity of labour demand
  - More emphasized for medium- and high-skilled workers
  - Effects tend to be larger in developing countries
- Threshold regressions
  - More offshoring leads to stronger effect on elasticity
  - Leveling off for developed countries for large offshoring
- Accounting for skill-biased technical change
  - By using IV approach (lack of ICT capital stock data)
  - Results broadly supported (sometimes insignificant)



## Cost share equations

(Foster, Stehrer and deVries, 2012)

- Empirical model is based upon the estimation of a translog cost function (see Berman et al., 1994)
- Based on this framework the estimating equation is:

$$\Delta s_i = \sum_{j=1}^N \gamma_{ij} \Delta \ln w_j + \theta_K \Delta \ln K_i + \theta_{GO} \Delta \ln GO_i + \theta_{IID} \Delta \ln IID_i + \theta_{IIM} \Delta \ln IIM_i + \varepsilon_i, \quad i = 1, \dots, N$$

- Where:
  - s is the share of factor i in total variable costs (i.e. labour and intermediate inputs)
  - w are factor rewards
  - K is the capital stock (split into an ICT and non-ICT component)
  - GO is gross output
  - IID and IIM are measures of domestic and imported intermediate use respectively

## Regression Results - Elasticities

VARIABLES	(1) $\Delta s_{LS}$	(2) $\Delta s_{MS}$	(3) $\Delta s_{HS}$
<i>NARROW OFFSHORING</i>			
All Industries	-0.02068	-0.01323	-0.00485
Manufacturing – Low	0.00575	-0.04066	-0.03949
Manufacturing - Medium	-0.0155	-0.01655	-0.02303
Manufacturing - High	-0.02478	-0.06584	-0.04993
Services - Low	-0.02069	-0.00218	0.027761
Services – Medium	-0.02287	-0.00485	-0.00167
Services - High	0.009155	0.005731	-0.00396
<i>BROAD OFFSHORING</i>			
All Industries	-0.02096	-0.04336	-0.05654
Manufacturing – Low	-0.02536	-0.04147	-0.08177
Manufacturing - Medium	-0.02626	-0.04673	-0.0734
Manufacturing - High	0.040498	-0.0395	-0.07052
Services - Low	0.065918	-0.04666	-0.10937
Services – Medium	-0.07382	-0.04223	-0.02509
Services - High	0.092256	-0.02924	-0.00876

## Summary

- Narrow and Broad Offshoring have impacted (negatively) upon cost shares for all types of labour
  - The coefficients are often found to be larger in absolute value when considering the medium-skilled cost share
  - Due to the relatively large shares of medium-skilled workers however results when considering elasticities are less clear-cut, being larger for low-skilled workers when considering the full sample
  - Note: Share of high educated was rising, thus offshoring tends to dampen increases
- Considering differences across industry types:
  - Few significant effects are found in services industries (med-skill services)
  - Offshoring has particularly strong negative effects in high-tech manufacturing
  - Offshoring tends to impact more strongly on medium- and high-skilled cost shares in manufacturing industries

## Summary

- Offshoring impacts positively on employment
  - Scale effect is important
- Offshoring tends to lead to job polarization
- Offshoring tends to increase elasticities
  - Workers become more vulnerable
  - Bargaining power is reduced