The changing structure of Global Value Chains (GVCs): Are central hubs key for productivity?

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Based on joint work with Jonathan Timmis (OECD)

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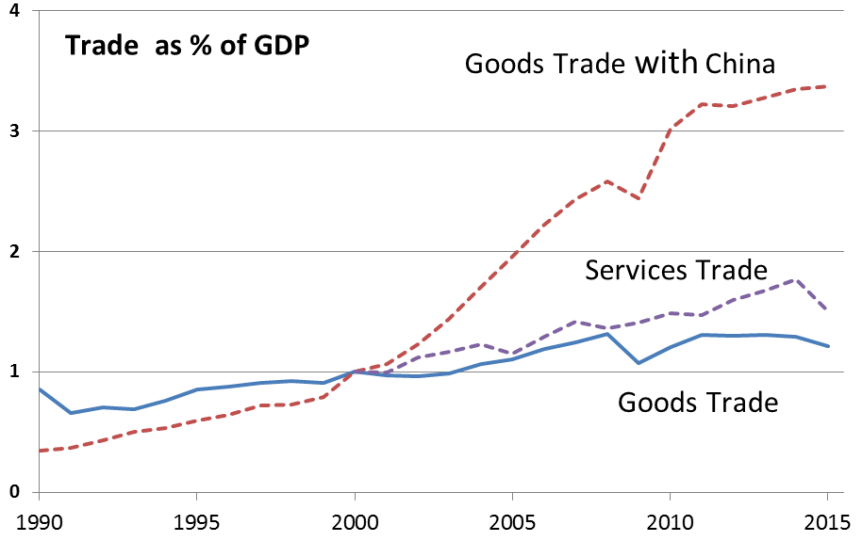
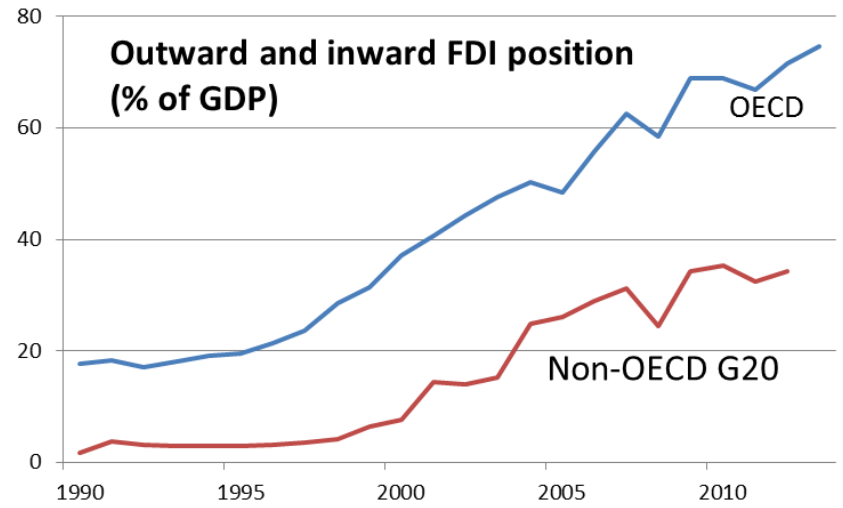
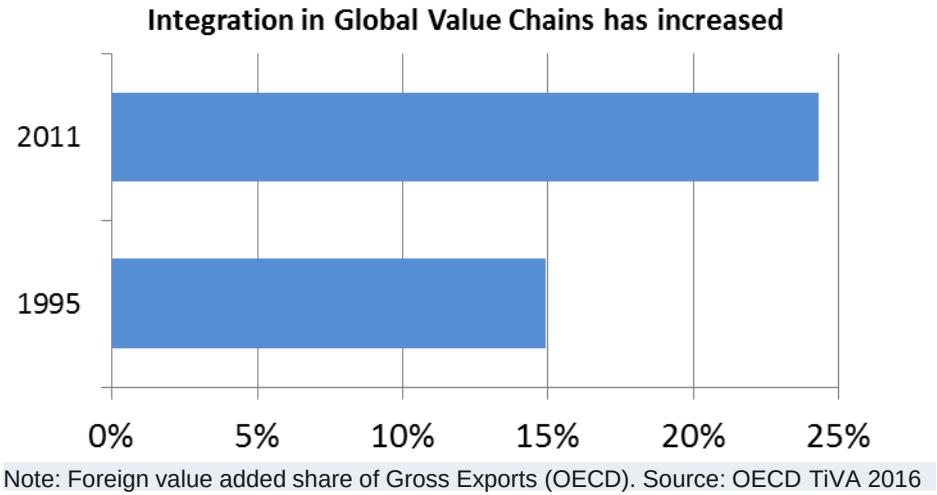
Globalisation has accelerated



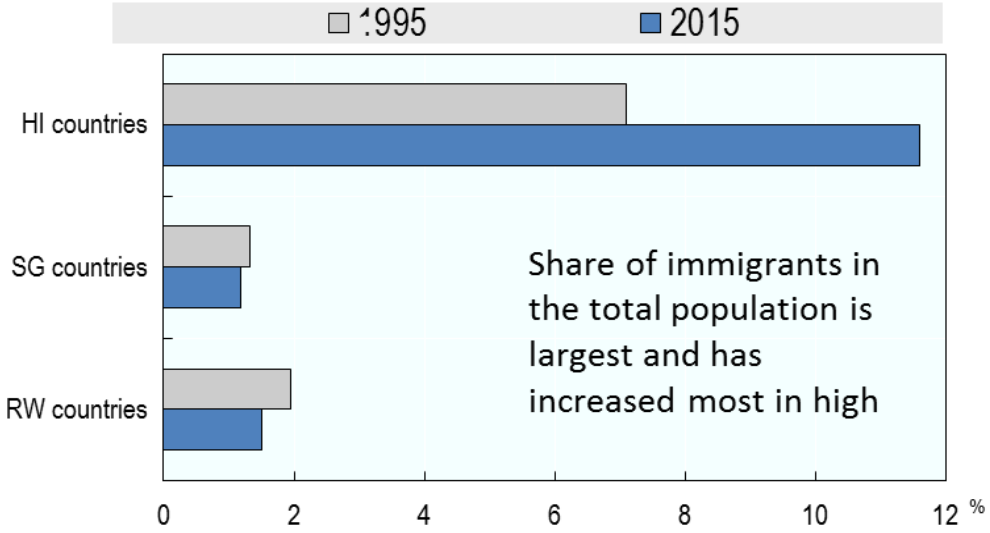
Source: Comtrade data



Source: OECD International direct investment database, IMF.



Note: Foreign value added share of Gross Exports (OECD). Source: OECD TiVA 2016

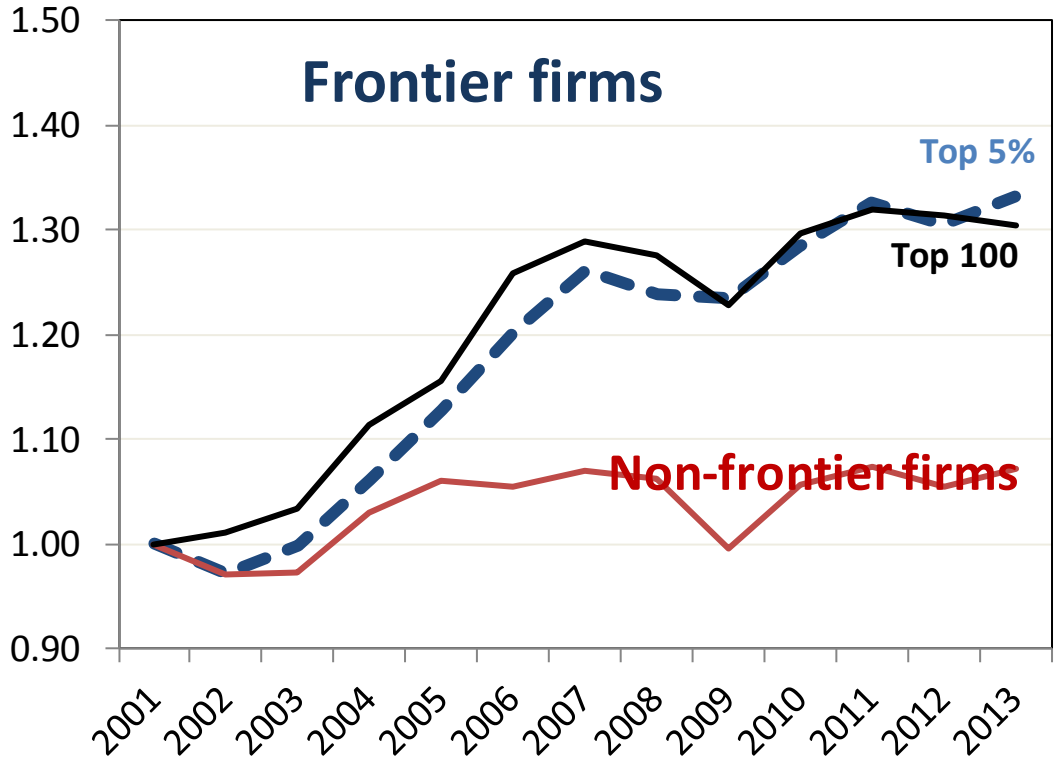


Source: Perspectives on Global Development 2017: International Migration in a Shifting World

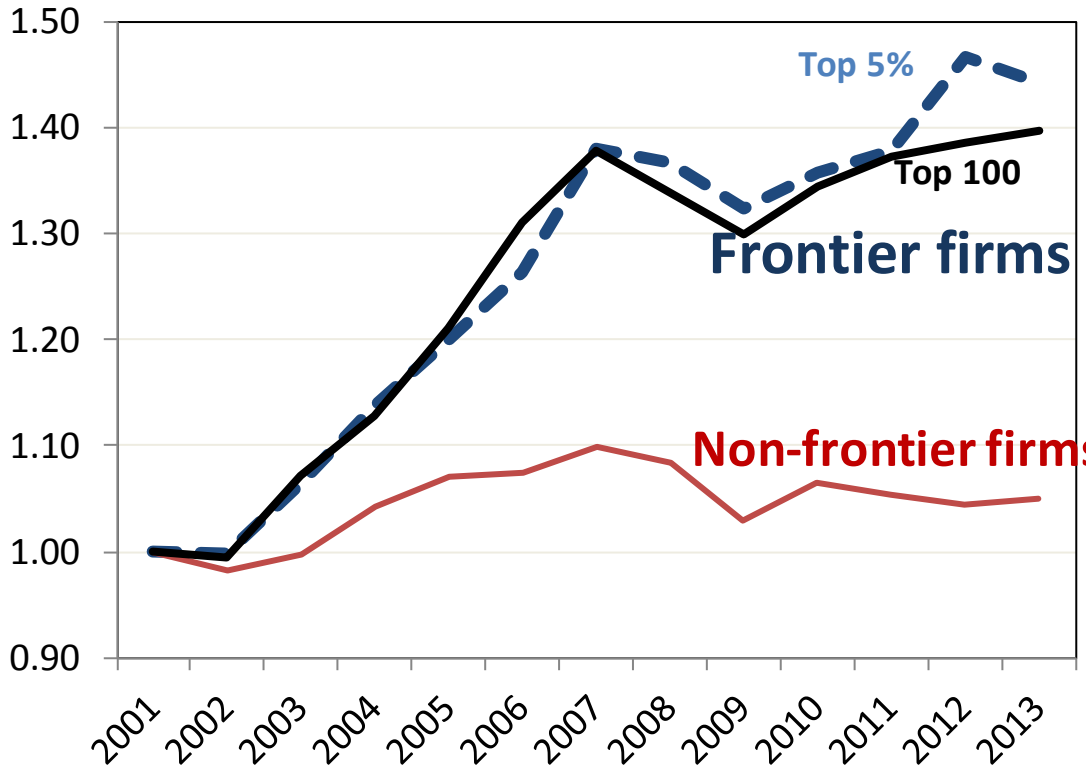
Rising productivity divergence between firms at global frontier and others

Average of labour productivity across each 2-digit sector (log, 2001=0)

Manufacturing

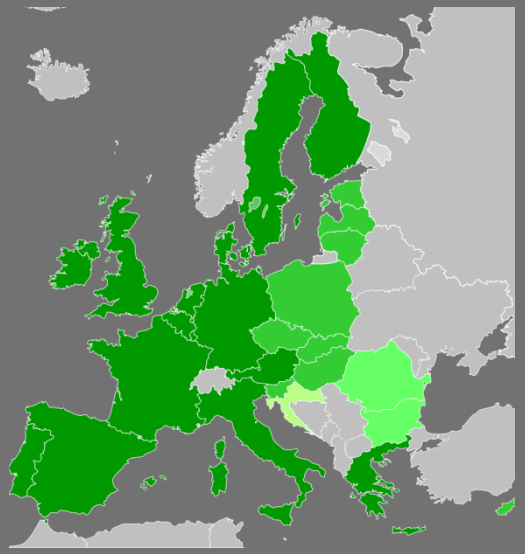


Business services



Source: Andrews, D. C. Criscuolo and P. Gal (2015), **"**Frontier firms, technology diffusion and public policy: micro evidence from OECD countries**",** OECD Productivity Working Papers No. 2.

But how are productivity trends related to changes in the structure of GVCs?



Trade as a web of networks

Extensive literature on how trade/Global Value Chain participation can impact productivity

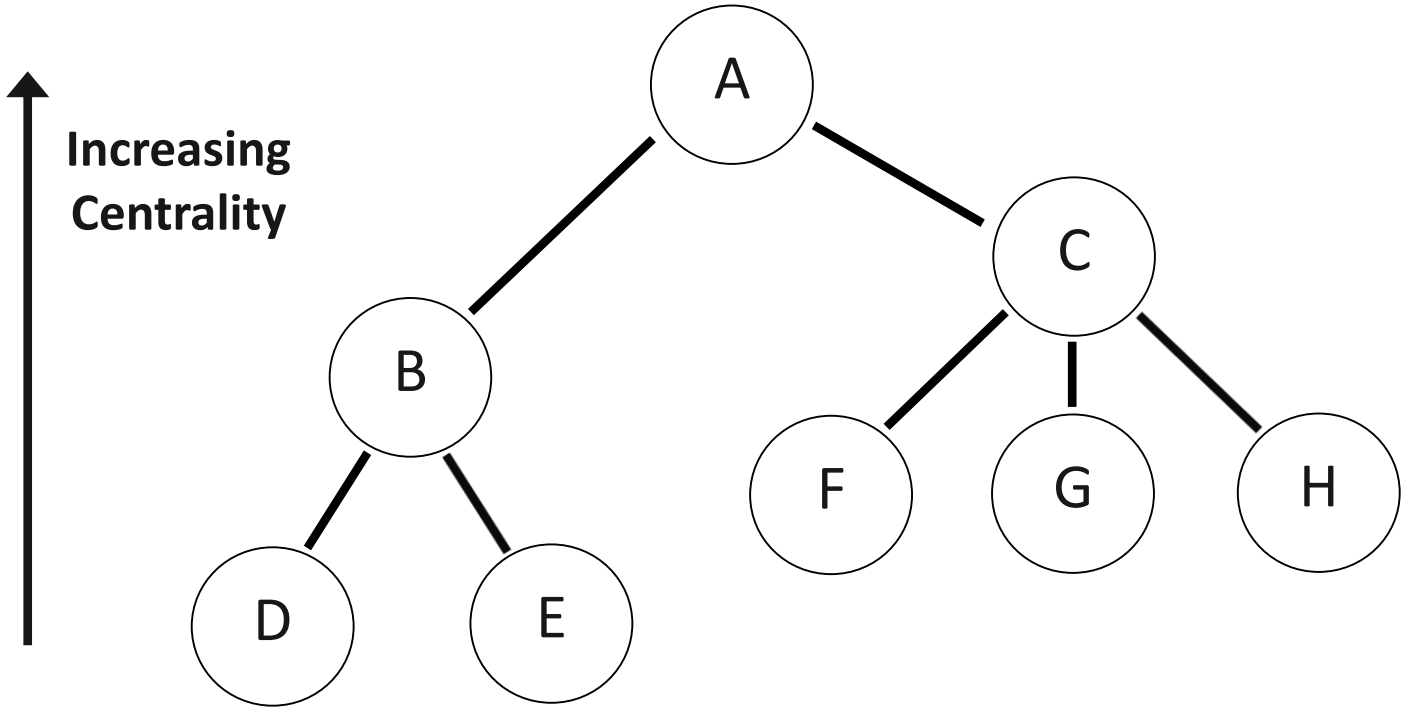
But we know much less about how effects differ by position within GVC networks (“central” hubs vs periphery) and the composition of buyers / suppliers networks

How do we measure “centrality”? Identifying key hubs

“Bonacich-Katz eigenvector” centrality

= Strength of direct **& indirect** connections

– measure of influence in network



“Centrality” as key feature of networks

a) Theoretically grounded measure of shock transmission:
   - 2% most central sectors explain 80% US output growth [1]
   - 100 most central firms explain 91% Belgian GDP volatility[2]
   - Fits with a broader literature looking at position within GVCs (e.g. upstreamness)

b) Role of social networks for knowledge diffusion amongst individuals:
   - “Central” individuals play key role in knowledge diffusion of new finance or insurance schemes, household wealth [3]

1 – Carvalho (2014); 2 - Maggerman et al. (2016);3 – Banerjee et al. (2013, 2016); Alatas et al. (2016)

Which data for measuring “centrality” and identifying key hubs?

Network is country-industry input flows from ICIO tables underlying TiVA 2015 edition

- 34 sectors (ISIC rev.3), 62 economies = 4.4million (potential) flows

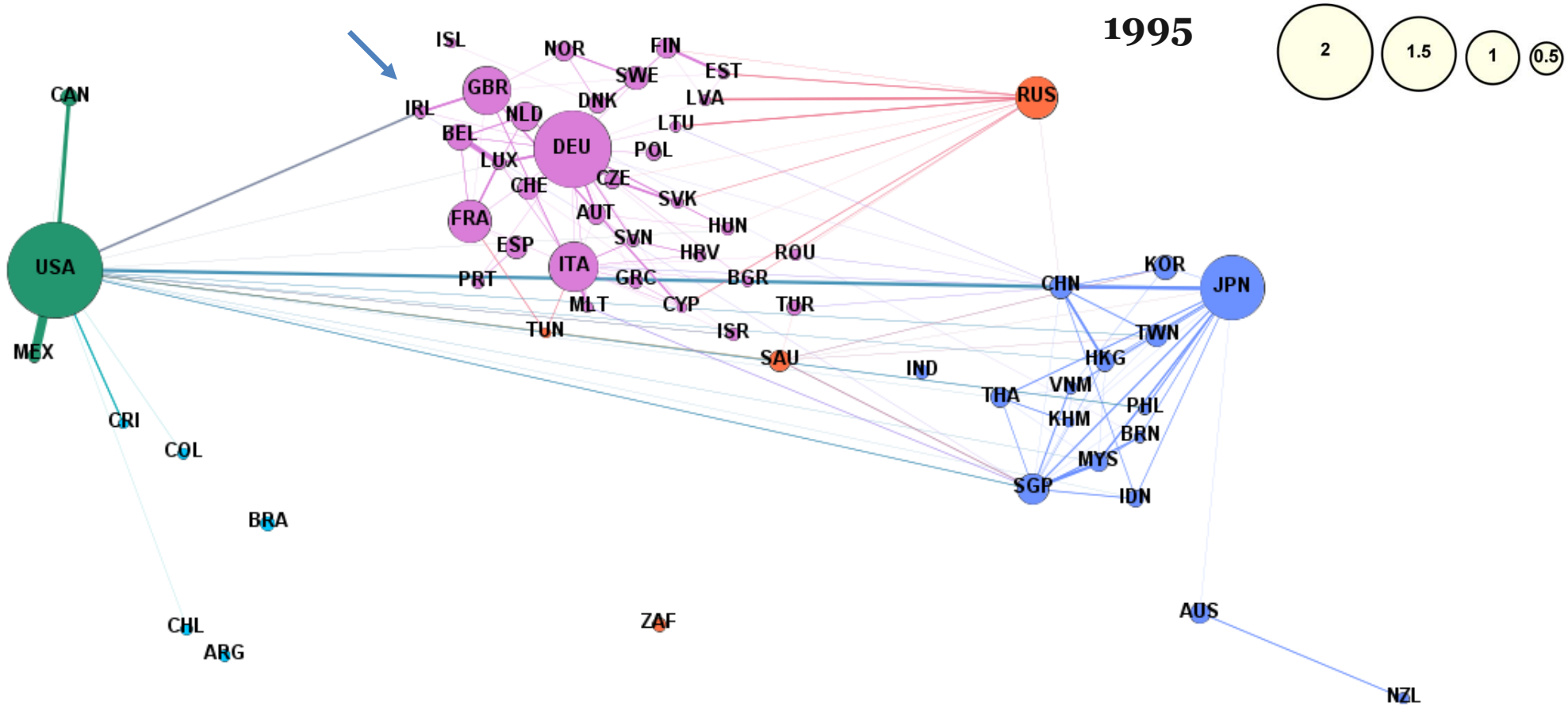
Input shares (rather than values) – relative measure

Focus on foreign sources of centrality

			Use by Countries						
			Country 1			….	Country 62		
			Sector 1	….	Sector 34	….	Sector 1	….	Sector 34
Supply from Countries	Country 1	Sector 1							
		….							
		Sector 34							
	….	….							
	Country 62	Sector 1							
		….							
		Sector 34							

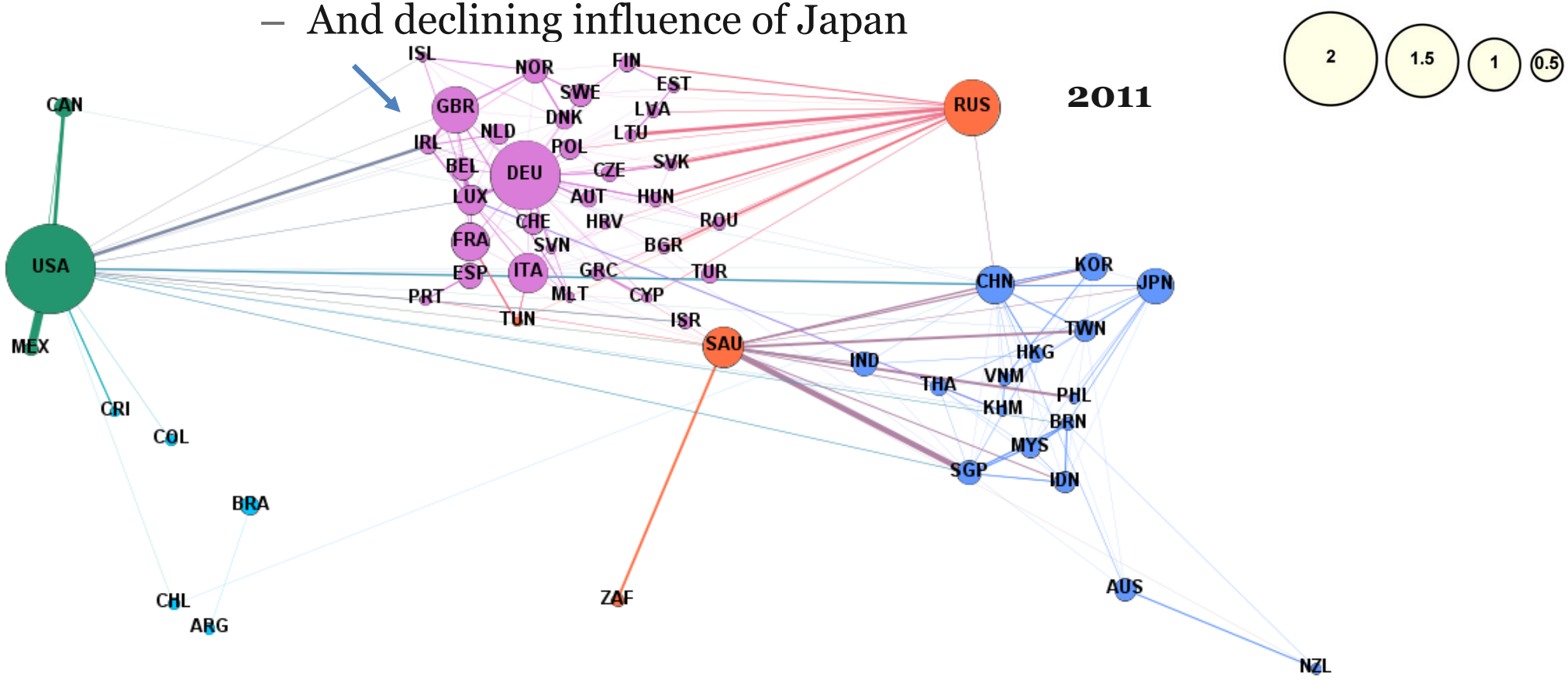
Changing GVC structure over time: the world in 1995

- Minority of key hubs dominate regional value chains in 1995 e.g. USA, Japan, Germany
  - Limited role of Latin America



Changing GVC structure over time: the world in 2011

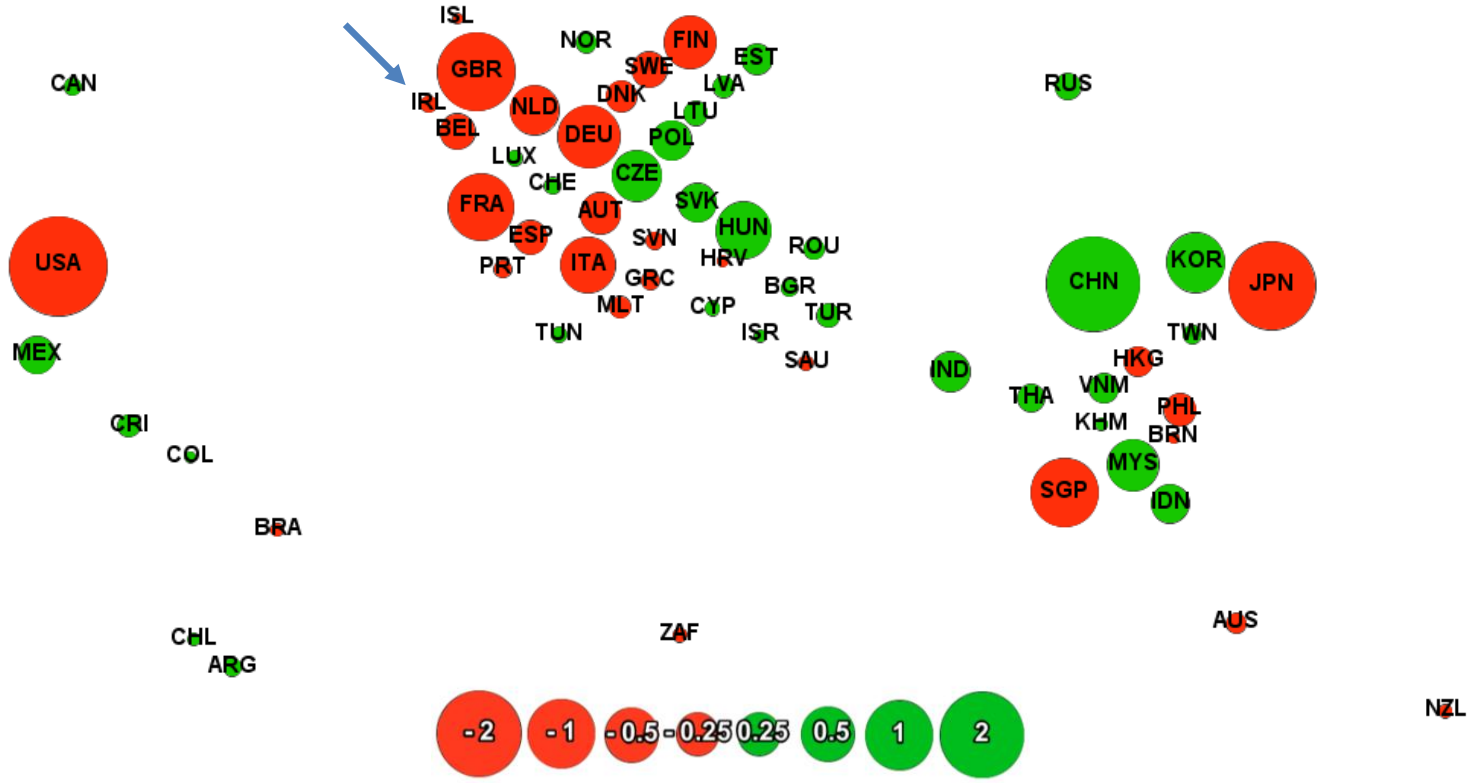
- Many key hubs persist in 2011…but….
  - Rising importance of services e.g. Luxembourg, UK, Ireland
  - Increasing influence of emerging economies
  - And declining influence of Japan



A Shift eastwards in IT Manufacturing

- Large shifts in IT manufacturing over 1995-2011….
  - Rising importance of E. Europe & E. Asia
  - Declining centrality of old centres of production

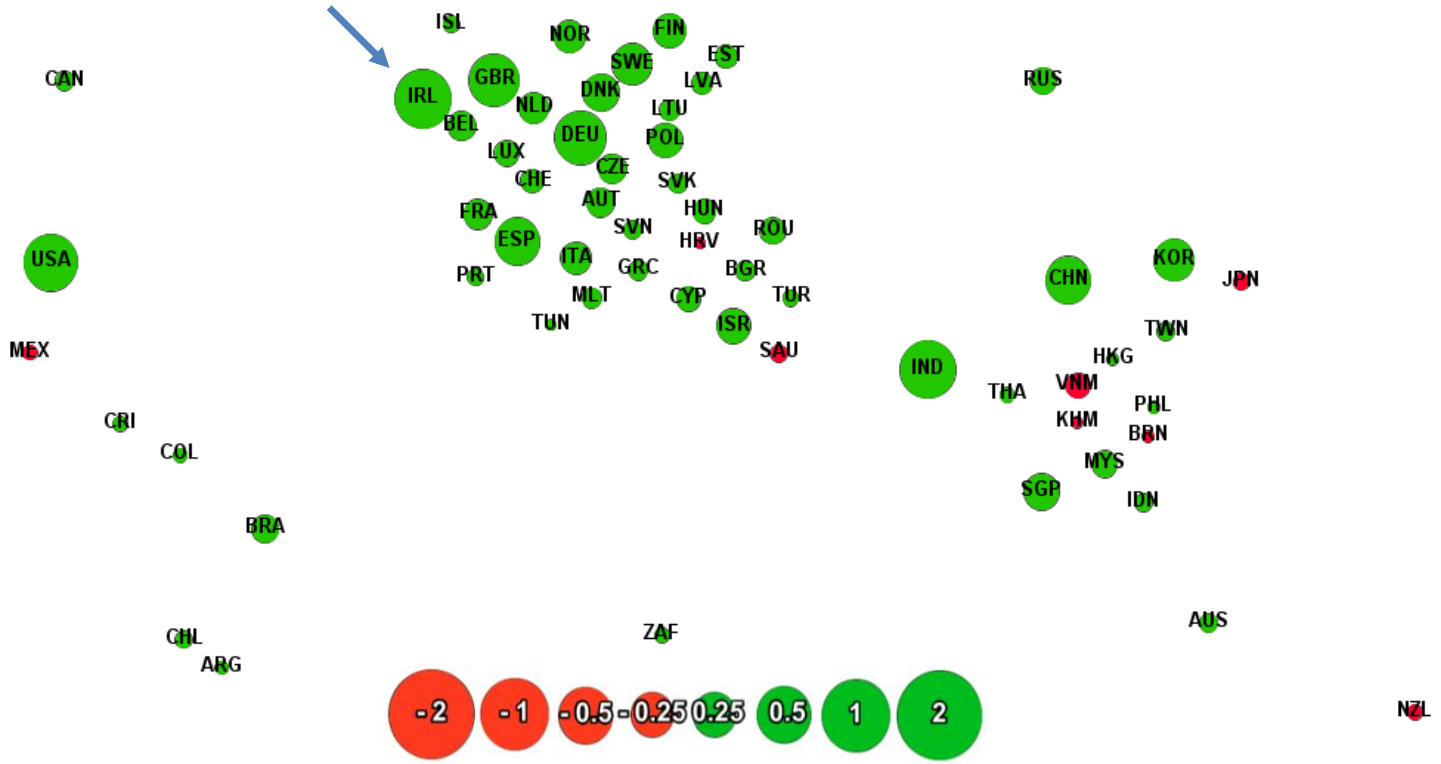
Computing & electronics manufacturing – Δ1995-2011



IT services: increasingly central everywhere

- IT services are increasingly central to GVCs everywhere
  - Not just in developed economies
  - But also, many emerging economies, e.g. India, China

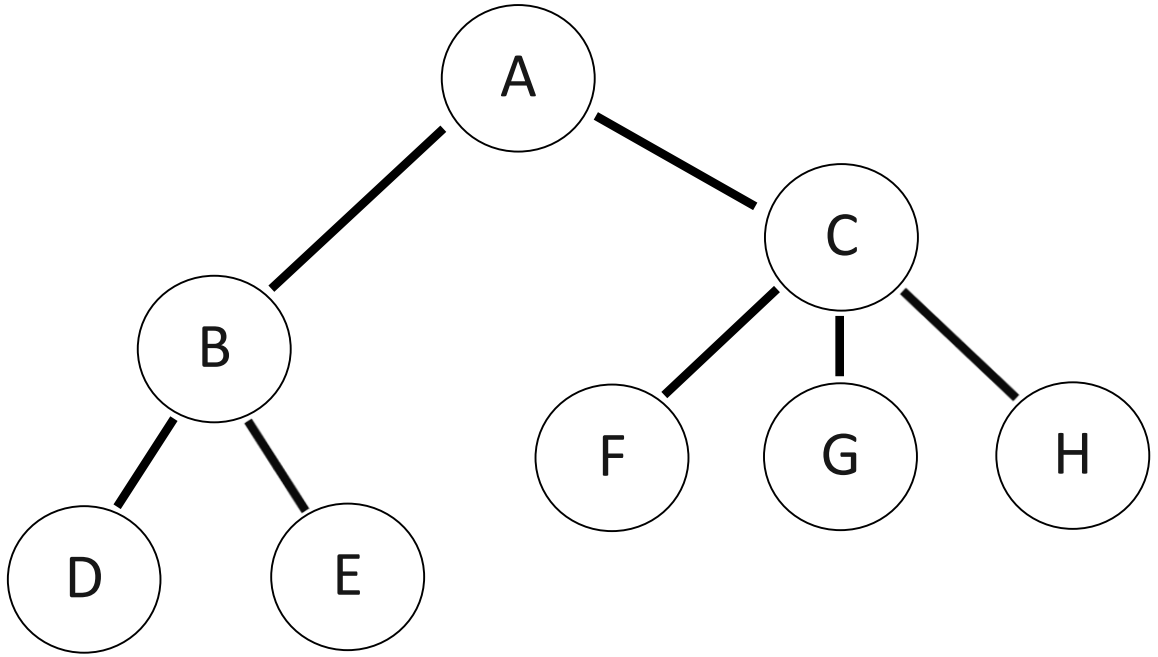
IT services – Δ1995-2011



How does centrality correlate with firm productivity?

Changes in Firm Productivity (Difference-in-Differences) from ORBIS, related to:

1. Centrality "*c*" (regardless who is connected)
2. Composition of buyers / supplier networks (regardless of centrality)
   - Average productivity (centrality weighted) of buyers / suppliers



Baseline results – all firms & countries

Over all firms in our data:

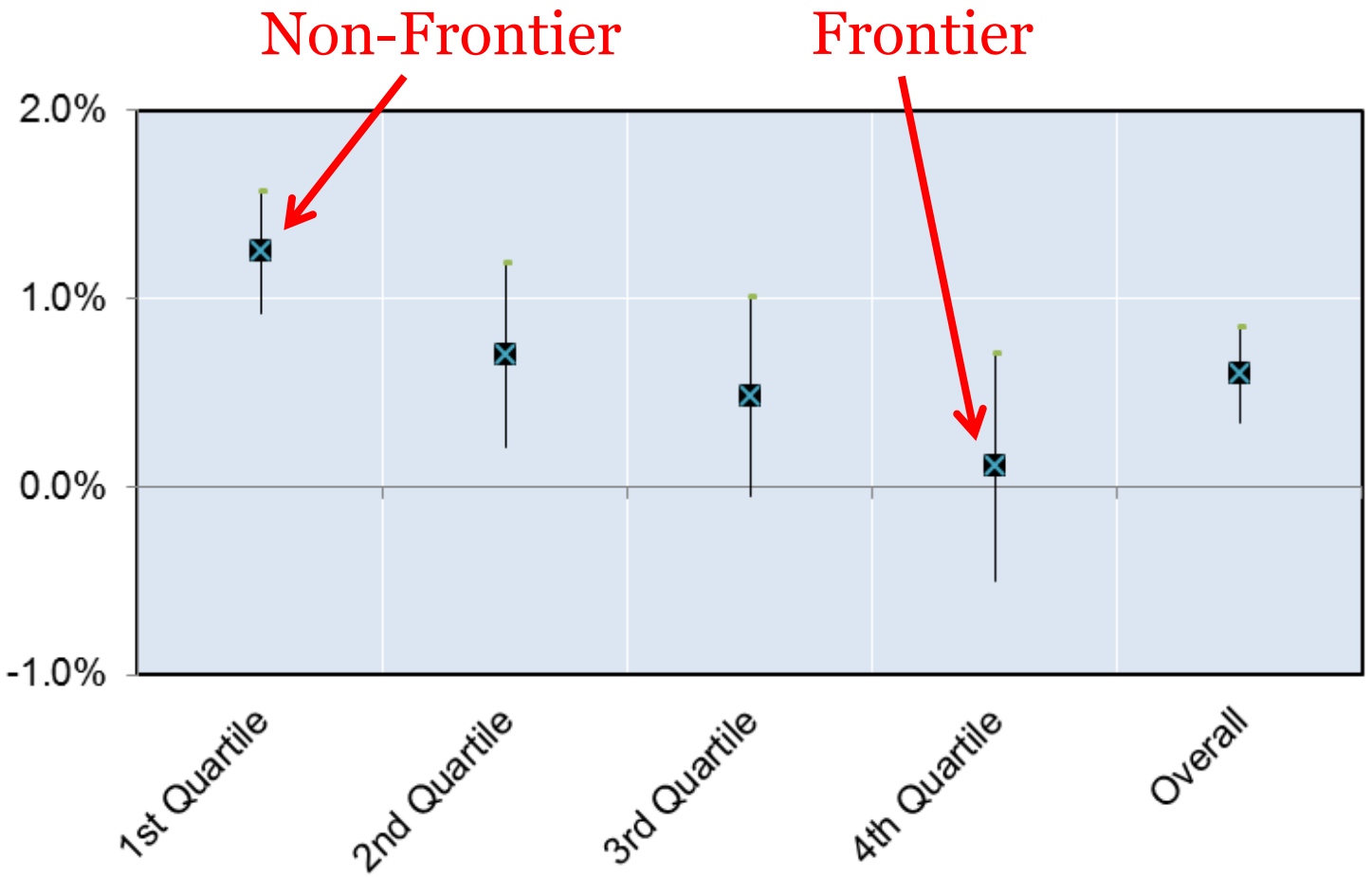
- GVC centrality is uncorrelated with firm productivity
- But average (centrality weighted) productivity growth of buyer networks (via forward linkages) is correlated with firm productivity growth

	Total	Forward	Backward
Centrality	0.237	0.046	0.144
	(0.148)	(0.090)	(0.089)
Average Productivity (Centrality Weighted) of Buyers / Suppliers	0.637***	0.888***	0.092
	(0.139)	(0.204)	(0.164)
Observations	2,446,048	2,446,048	2,446,048

All regressions include Year Fixed Effects, Firm Fixed Effects, Firm Size and Industry Controls

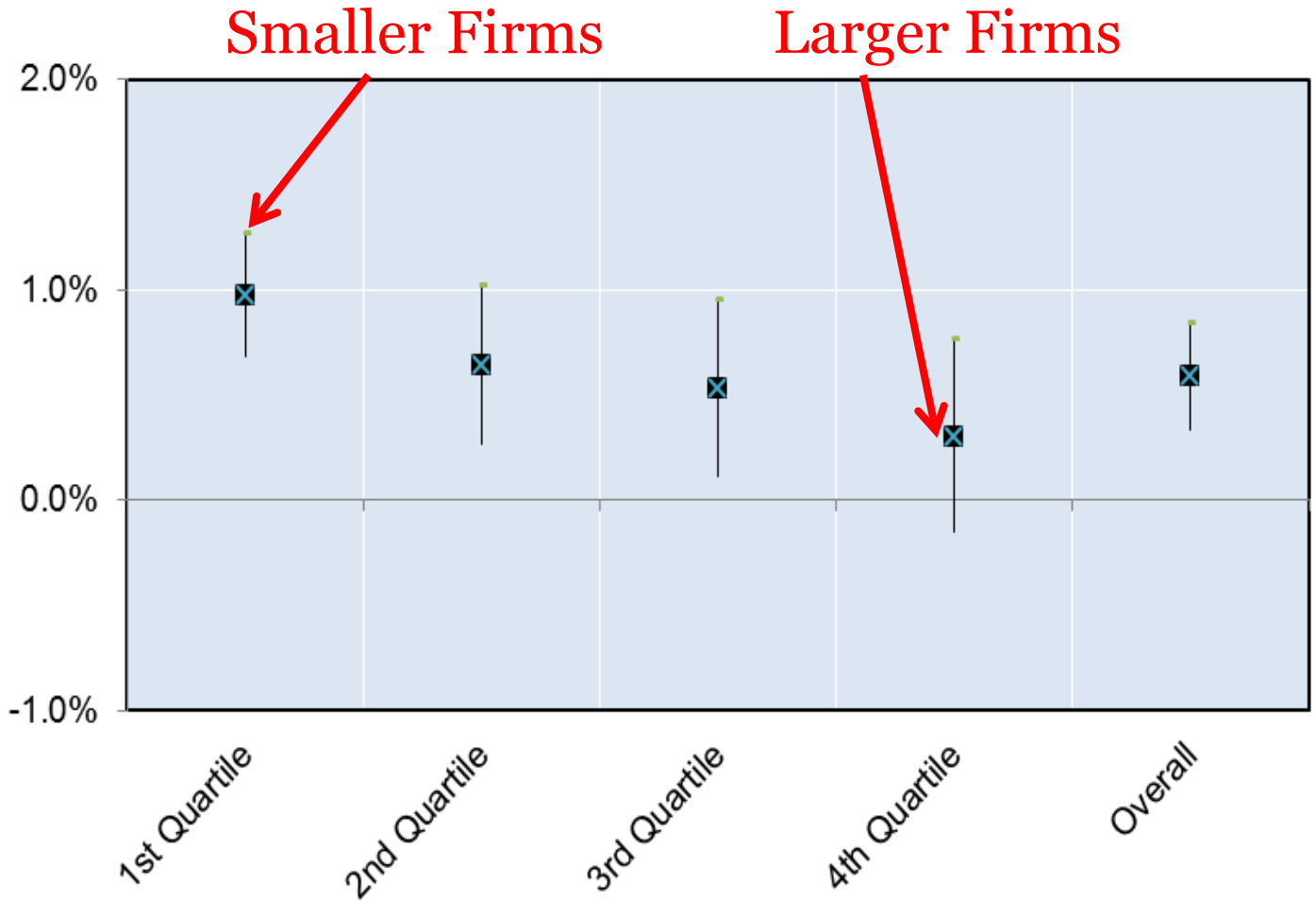
But, potential catch-up of non-frontier firms

- Approx. 1% non-frontier firm MFP growth per annum for mean productivity growth foreign buyers / suppliers



Potential catch up of smaller firms

- Approx. 1% smaller firm MFP growth per annum for mean productivity growth foreign buyers / suppliers



Potential role in the catch-up of economies

- Becoming more influential/central in GVCs matters for catch-up of Post-04 EU members (or smaller) countries
- But for other European (or larger) countries it is the composition of buyer/supplier networks that matter

	Other Factory Europe			Post-04 EU Members		
	Total	Forward	Backward	Total	Forward	Backward
Centrality	0.157	0.205***	-0.057	5.310***	3.503**	3.930***
	(0.097)	(0.071)	(0.055)	(1.491)	(1.540)	(1.190)
Average Productivity (Centrality Weighted) of Buyers / Suppliers	0.456***	0.407***	0.206**	0.769**	0.816*	0.106
	(0.121)	(0.111)	(0.087)	(0.333)	(0.427)	(0.240)
Observations	245,124	245,124	245,124	2,019,522	2,019,522	2,019,522

All regressions include Year Fixed Effects, Firm Fixed Effects, Firm Size and Industry Controls

A broad range of policies matter for productivity spillovers

- Flexible Employment Regulations
- Trade facilitation
  - Customs complexity
- Contracting environment
  - Contract enforcement, protection of intellectual property
- Removing barriers to upgrading
  - Barriers to entrepreneurship , access to finance

Key findings & policy implications

- Large changes in the structure of GVCs (e.g. computer & electronics, IT services)
- Potential for policy to influence centrality – EU accession
- Centrality & composition of buyer/supplier networks play a role in catch-up of non-frontier or smaller firms
- Centrality in GVCs matters for smaller/post-04 EU countries vs composition of networks for other countries.
- Suggesting there is no one-size-fits-all policy
  - Policies that support GVC integration are important for smaller / non-frontier firms or smaller / EU accession economies.
  - But for firms overall in larger/higher income economies, what matters is formation of highly productive foreign buyer/supplier networks
    - Skills & upgrading, but also information barriers & matching

Thank you!

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Backlash against globalisation

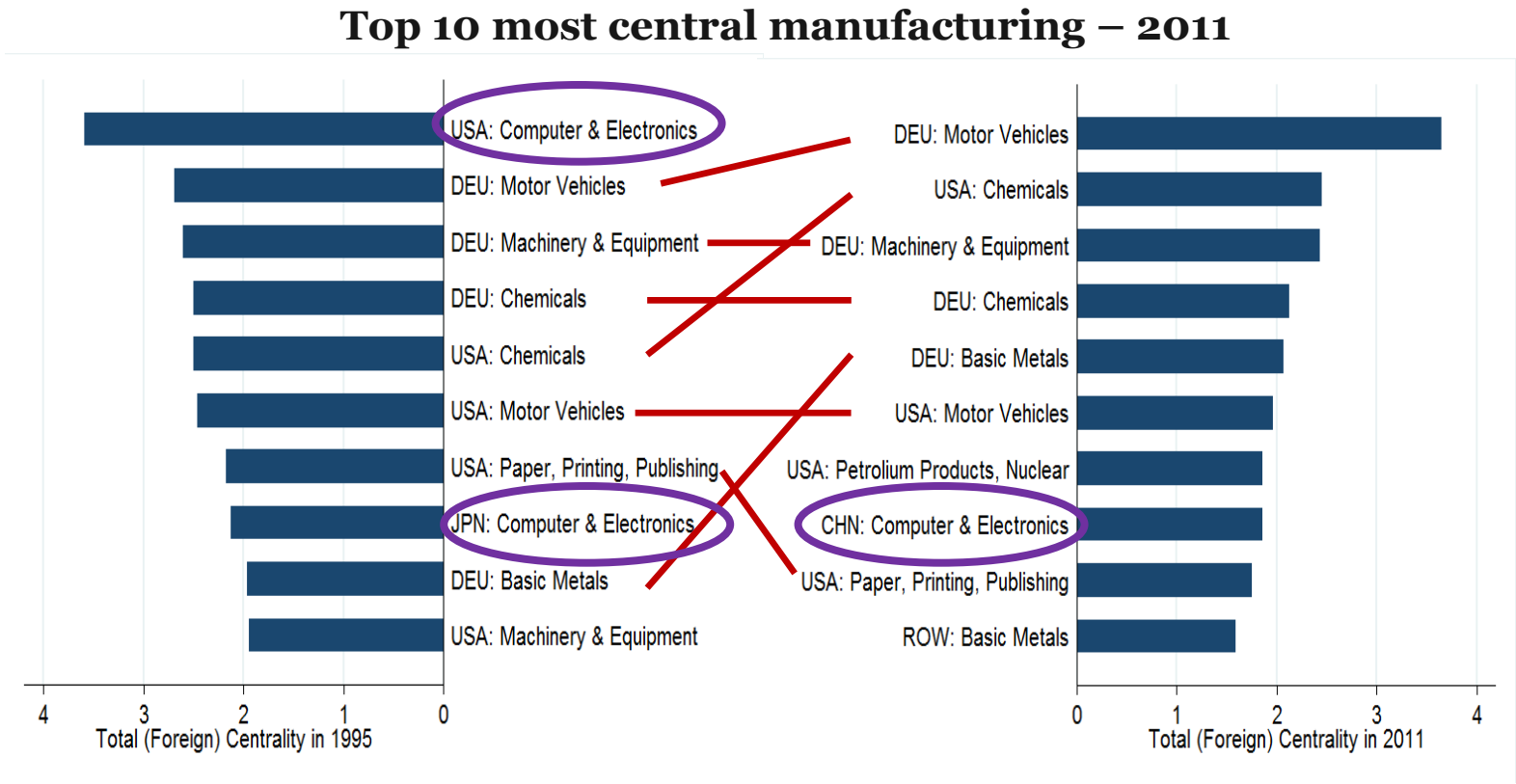
- Majority feel that benefits accrue disproportionately to a small segment of the population.

…while they have been left behind:

- **Increased income inequality**
- **Job polarisation / squeeze of the middle class**
- **Job insecurity and job displacement**
- **Exposure to global shocks**

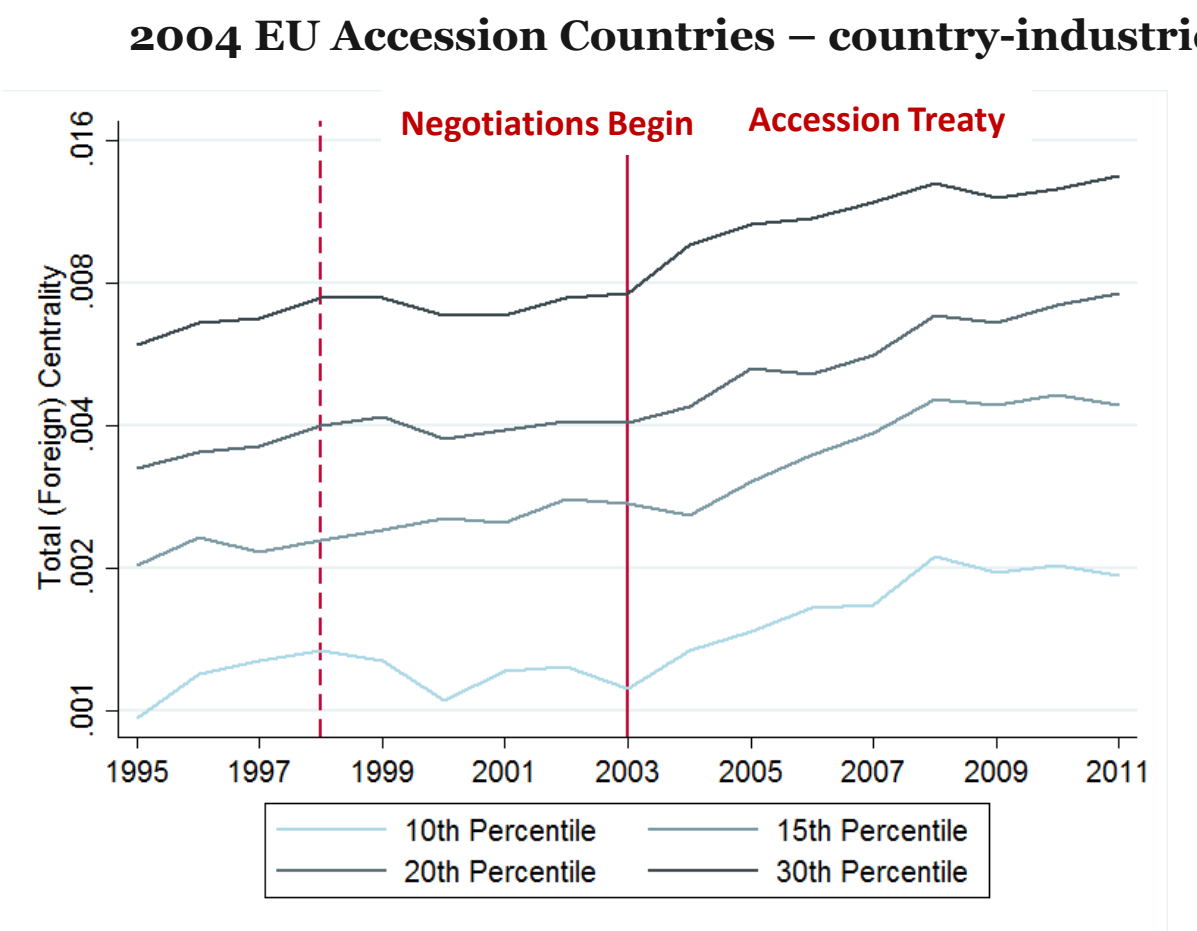
Key Hubs: those who stay and those who go…

- At sector level many key hubs persist over time….
  - E.g. German and American motor vehicles
  - But large shifts in computer & electronics

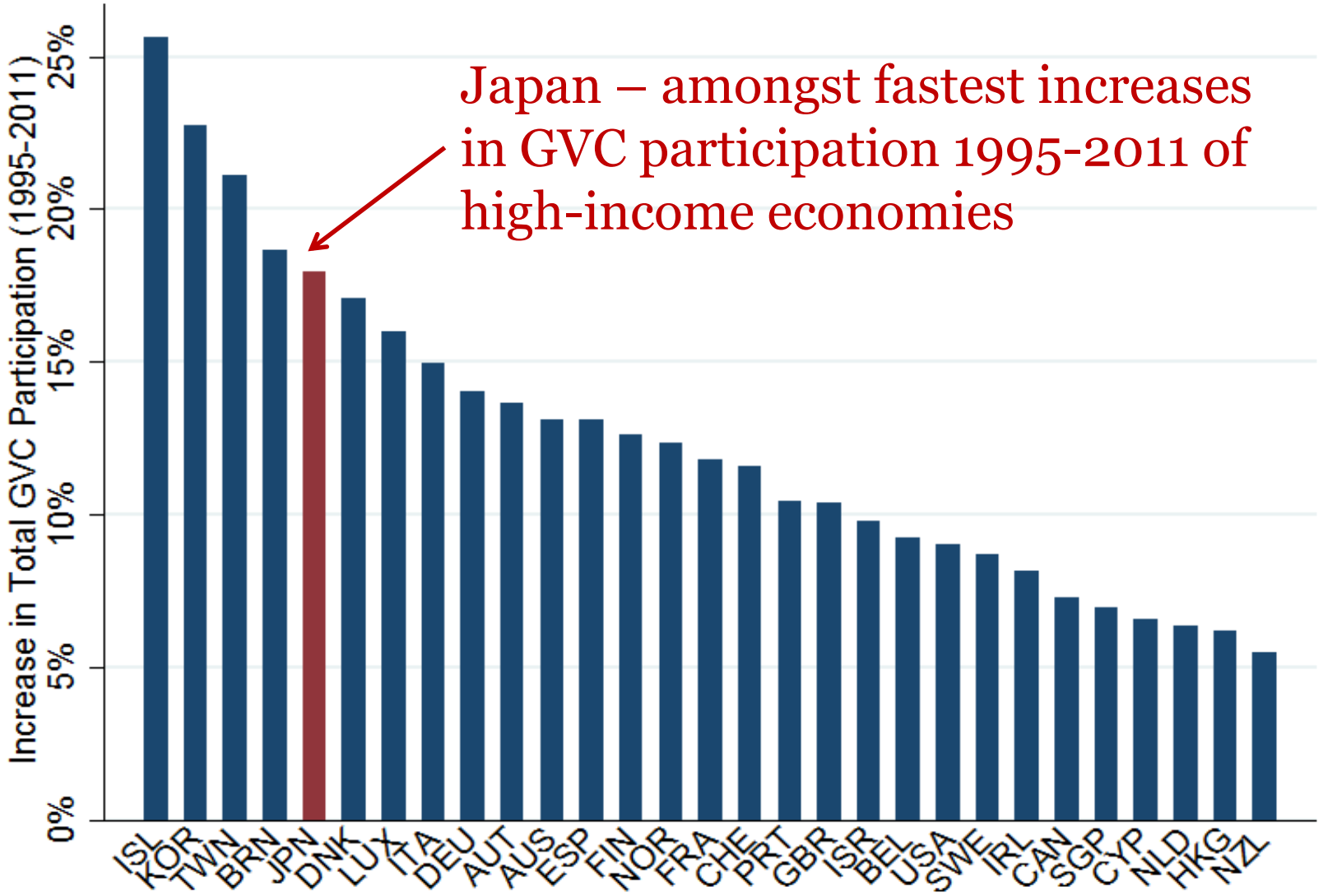


…is this because of EU enlargement?...maybe…

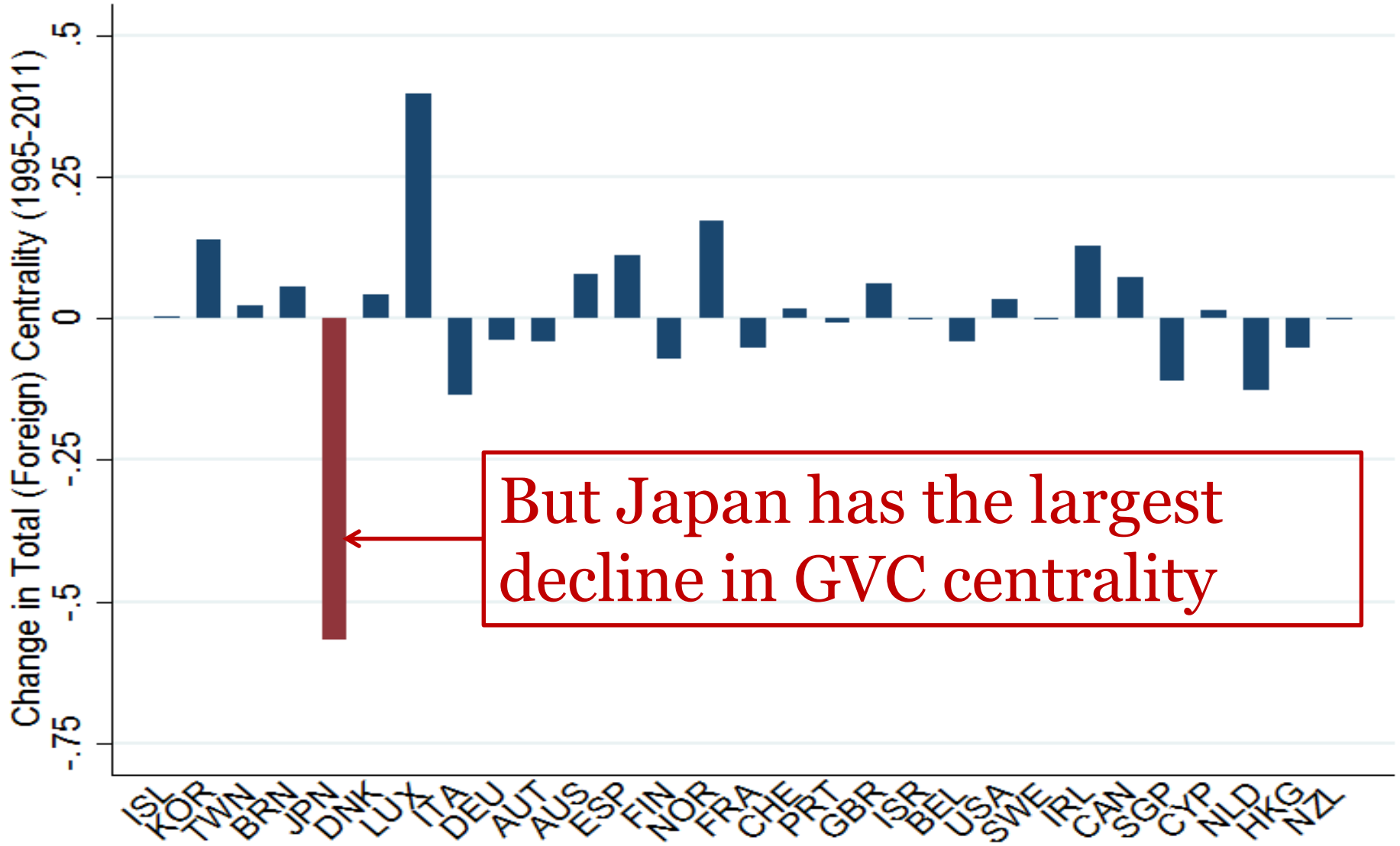
- Increasing centrality of periphery is driven by post-2004 EU Accession Countries



Is this evidence really new?
Centrality is more than participation



GVC centrality is more than participation



Identifying key hubs: “centrality”

How do we measure eigenvector centrality?

- Forwards (outflows) & Backwards (inflows) & Total (avg forwards & backwards)
- Recursive metric:
  - Centrality is weighted avg. of neighbour’s centrality
  - Weights = intermediate inflows w_{ji} or outflows w_{ij}

λ = Rate of decay of higher order linkages

$$c^{back}{}_i = \sum_j w_{ji} \cdot \lambda \cdot c_j^{back} + \eta$$

$$c^{fwd}{}_i = \sum_j w_{ij} \cdot \lambda \cdot c_j^{fwd} + \eta$$

η = Minimum centrality scaling factor

(But solved via matrix algebra)

Firm-level Data

Difference in difference specification:

$$MFP_{ist} = \beta_1 c_{st-1} + \beta_2 \overline{PROD}_{st-1} + \beta_3 Industry\ Controls_{st-1} + \beta_4 Firm\ Size_{st-1} + \delta_i + \delta_t + \varepsilon_{ist}$$

Firm Data: Productivity (MFP Wooldridge) from cross-country ORBIS

- Mainly medium and large firms (mean=260 employees)
- Mainly high income economies (90% of firms)
- Keep firms > 20 employees

But "average" firm results mask role in firm catch-up

- Centrality & productivity growth of buyers/supplier networks correlated with productivity growth of non-frontier or smaller firms
- But weakens with proximity to the frontier or firm size

	Frontier vs Non-Frontier		
	Total	Forward	Backward
Centrality	1.336**	0.541*	1.690**
	(0.641)	(0.318)	(0.654)
Centrality * Initial Productivity	-0.108**	-0.045	-0.144***
	(0.053)	(0.029)	(0.053)
Average Productivity (Centrality Weighted) of Buyers / Suppliers	6.173***	6.312***	4.994***
	(0.656)	(0.570)	(0.617)
Average Productivity of Buyers / Suppliers * Initial Productivity	-0.507***	-0.498***	-0.447***
	(0.057)	(0.052)	(0.054)
Observations	2,446,048	2,446,048	2,446,048

All regressions include Year Fixed Effects, Firm Fixed Effects, Firm Size and Industry Controls