Sources of country-sector productivity growth: public and private intangibles and capital reallocation in the EU15 and the US

C. Corrado, (The Conference Board), New York
J. Haskel, (Imperial College, CEPR and IZA), London
C. Jona-Lasinio, (LUISS Lab and ISTAT), Rome
M.Iommi, (LUISS Lab and ISTAT), Rome
M.O'Mahony (King's College), London

SPINTAN Final Conference - LUISS University
12-13 September 2016, Rome, Italy

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 612774

Aims and question, 1 of 2

- Aim: study productivity growth by
  - Country (12 countries, US, Northern Europe: DE, FR, UK; Scandinavian: DK FI, SE; Small Europe: AT, CZ, NL; Mediterranean: ES, IT)
  - Industry: 20 industries (A-U Nace Rev 2)
  - Institutional sector: Market and non-market within each of the 20 industries
  - Asset: Tangible and intangible assets (NA, INTAN Invest and SPINTAN)
- To do this we
  - Collect output and investment data by year-country-industry-institutional sector-asset from
    - national accounts (for output and tangibles) and
    - own-calculations (for non-national accounts intangibles plus splits by sector)
- Build capital stocks and consistent capital rental prices
- Link with EU-KLEMS labour composition data
- Calculate growth accounts

Aims and question, 2 of 2

- This builds integrated and harmonized measures of intangibles across countries and institutional sectors (INTAN-Invest and SPINTAN)
  - Corrado, Hulten and Sichel (2005) developed the measurement framework for intangibles in the market sector.
  - Corrado, Haskel and Jona-Lasinio (2014) proposed a framework to measure intangible investment in the nonmarket sector.
- Uses Jorgenson-Schreyer for capital returns in non-market sector
- Our major questions
  - Productivity accounts before and after the Great Recession
    - What is the contribution of tangible and intangible capital by country-industry-sector with a complete accounting for intangible capital inputs?
  - Non-market intangible investment and productivity
  - Spillovers between non-market and market intangibles?
  - Has capital reallocation "gone wrong" since the financial crisis?

Ultimate aim: a full mapping of CHS assets to the nonmarket sector

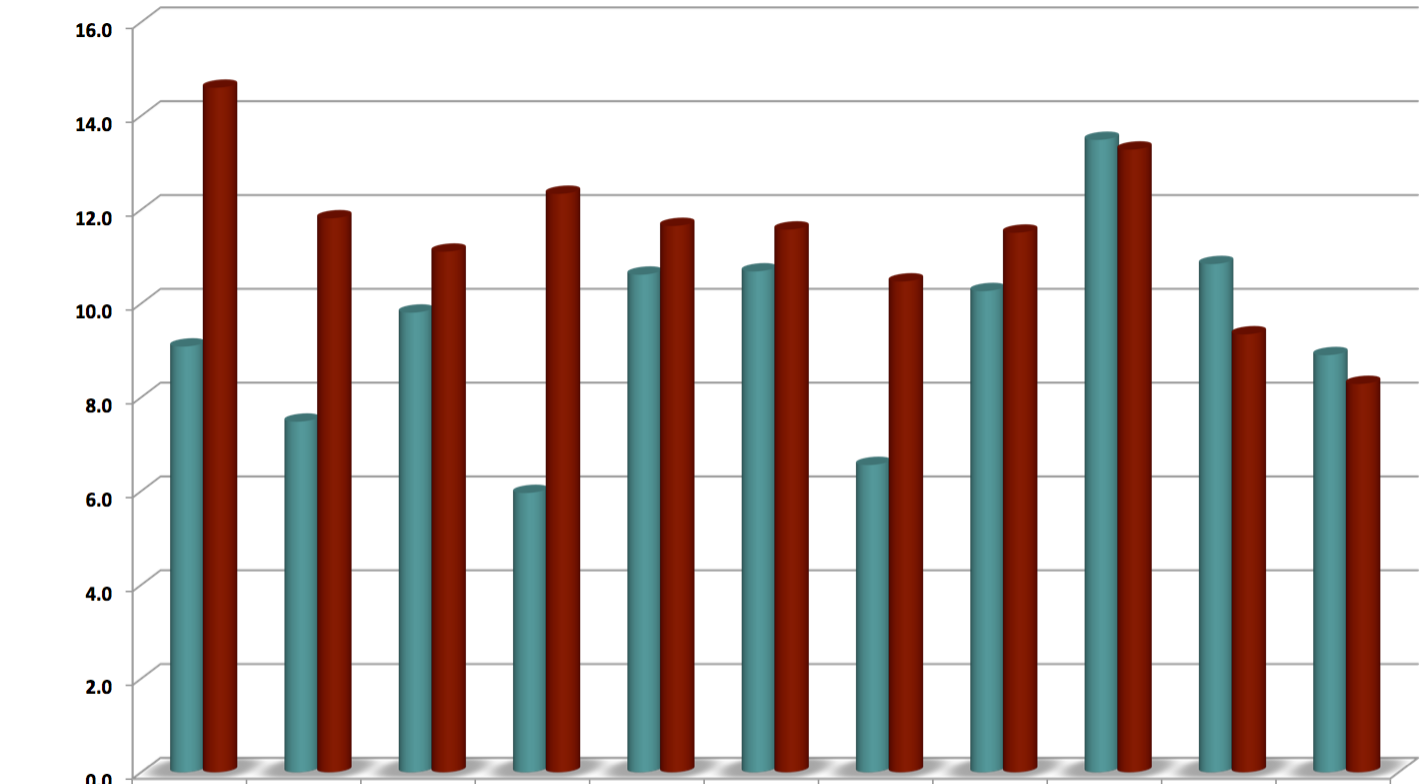
Market Sector		Nonmarket Sector	
Computerized Information		Information, Scientific, and Cultural Assets	
1	Software	1	Software
2	Databases	(2)	Open data
Innovative Property			
3	R&D, broadly defined to include all NPD costs	3	R&D, basic and applied science
4	Entertainment & artistic originals	(4)	Cultural and heritage, including arch. & eng. design
5	Design		
6	Mineral exploration	5	Mineral exploration
Economic Competencies		Societal Competencies	
7	Brands	6	Brands
8	Organizational capital	(7)	Organizational capital
	(a) Manager capital		(a) Professional and manager capital
	(b) Purchased organizational services		(b) Purchased organizational services
9	Firm-specific human capital (employer-provided training)	8	Function-specific human capital (employer-provided training)

NOTE—NPD=New Product Development, including testing and spending for new financial products and other services development not included in software or conventional science-based R&D.

Focus of work here: non-market R&D, software, organisational capital and design

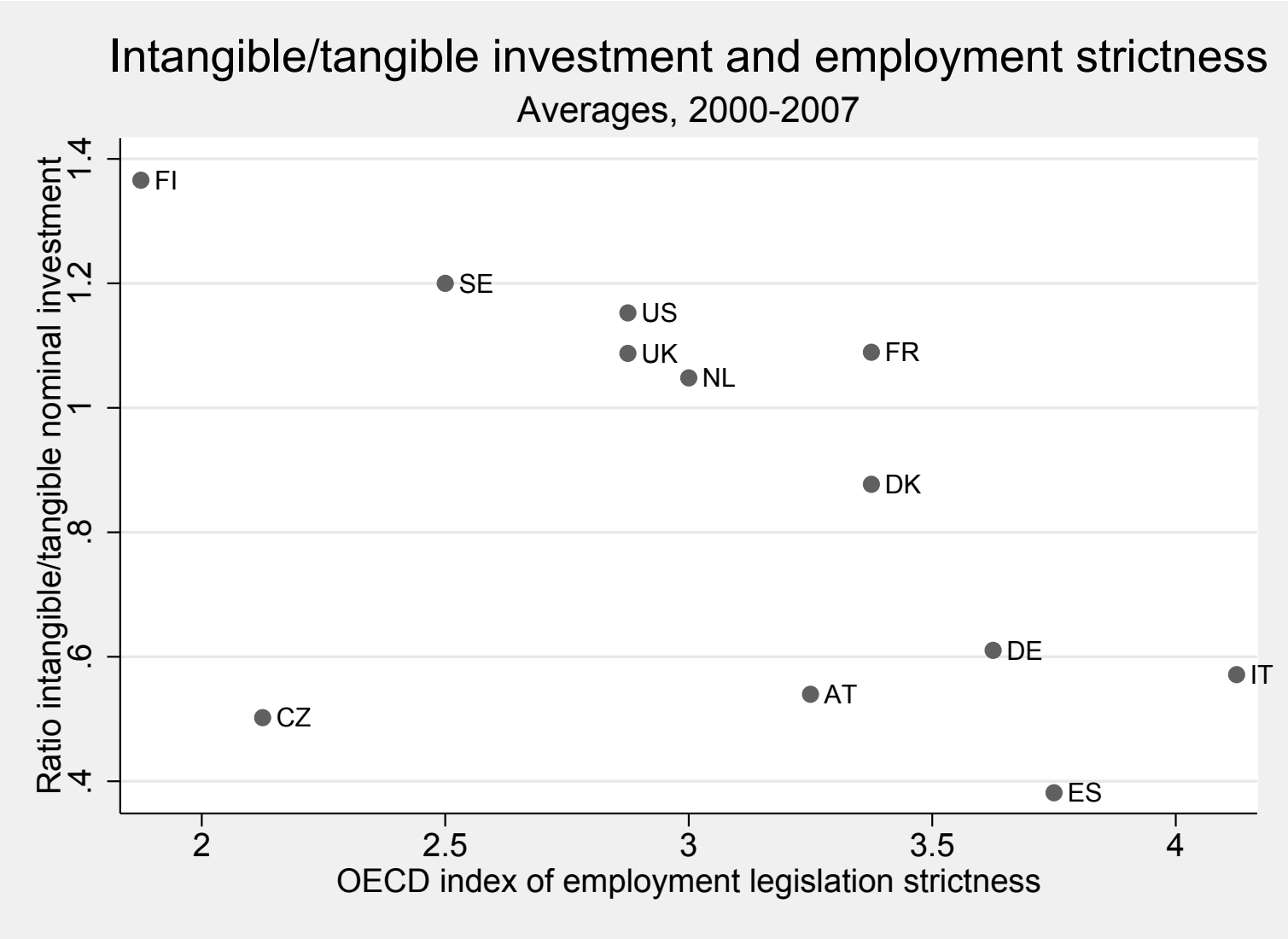
Tangible and intangible investment: (adjusted) value added shares (2013)

UK, US, SE: intangibles account for a larger value added share than tangibles. ES, IT opposite.



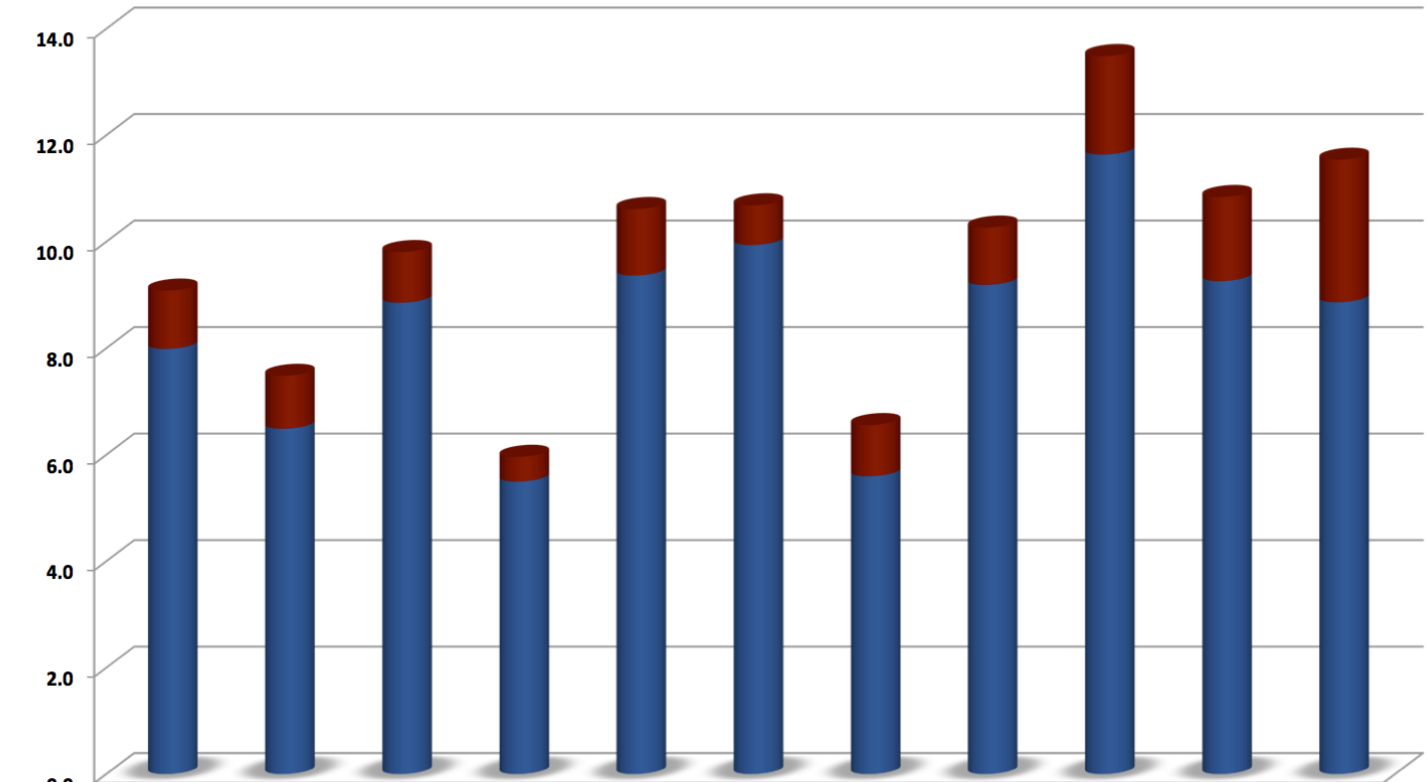
	AT	DE	DK	ES	FI	FR	IT	NL	SE	UK	US
Intangibles	9.1	7.5	9.8	6.0	10.6	10.7	6.6	10.3	13.5	10.8	8.9
Tangibles	14.6	11.8	11.1	12.3	11.7	11.6	10.5	11.5	13.3	9.3	8.3

What drives differences in country intangible investment?



Market and nonmarket intangibles: adjusted value added shares (2013)

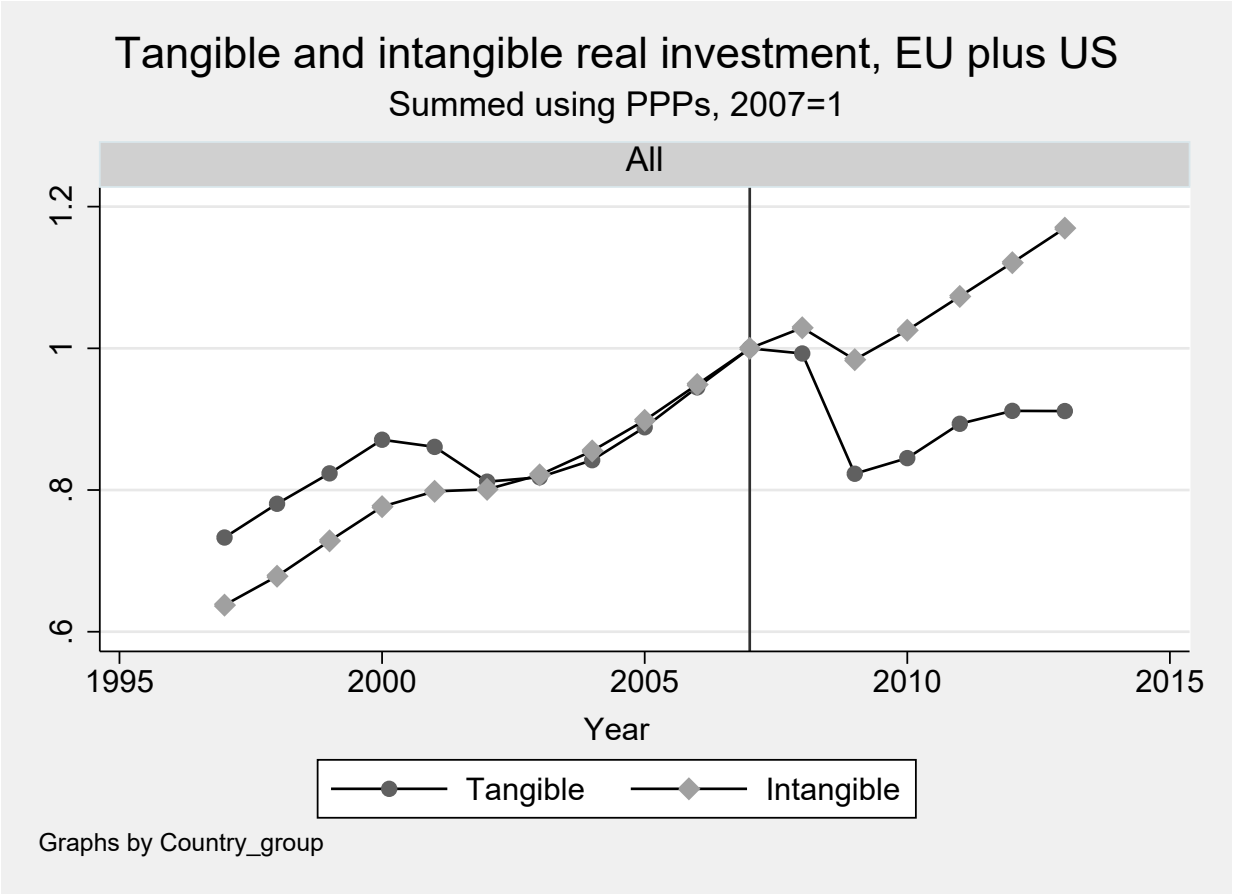
Non-market intangible investment (on this measure) is small. Overall (market and nonmarket) intangible investments account for 14% to 6% of value added with market and nonmarket sectors accounting on average for 8% and 1.5% respectively.



	AT	DE	DK	ES	FI	FR	IT	NL	SE	UK	US
NMKT	1.1	1.0	1.0	0.5	1.2	0.7	1.0	1.1	1.9	1.6	2.7
MKT	8.0	6.5	8.9	5.5	9.4	9.9	5.6	9.2	11.6	9.3	8.9

Tangible and intangible investment before and after the crisis: EU+US

Post crisis, tangible investment experienced a prolonged slowdown while intangible investment recovered.

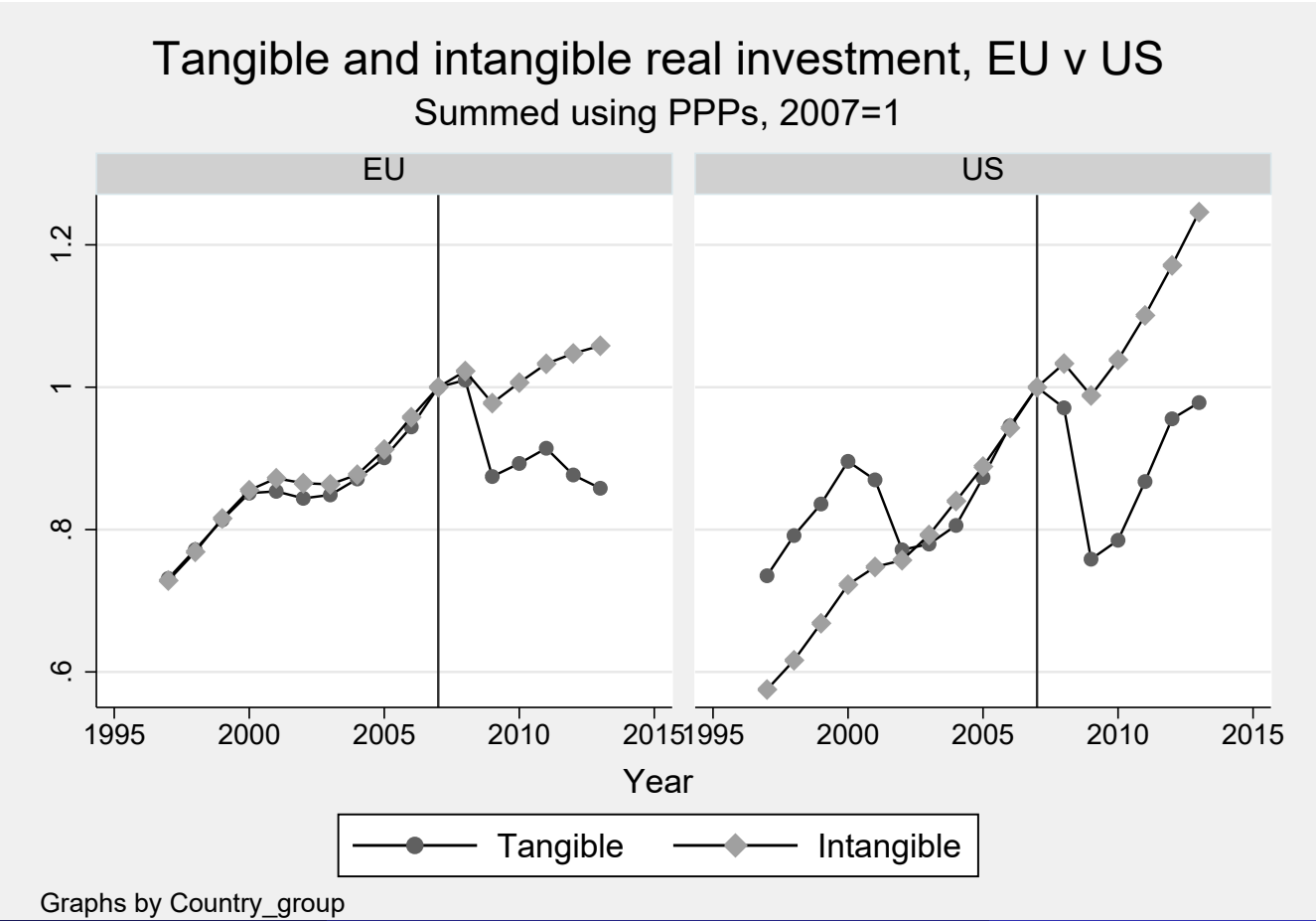


But this turns out to vary by country....

Tangible and intangible investment before and after the crisis: EU vs US

Intangibles were relatively resilient during the crisis: but...

- US: Intangibles recovered fast
- EU: Intangibles recovered more slowly and current growth is slower



Model

$$\Delta ln(Q/H)^{(a)}_{c,i,t} = s^{L(a)}_{c,i,m,t}\Delta ln(L/H)_{c,i,m,t} + s^{K(a)}_{c,i,m,t}\Delta ln(K/H)_{c,i,m,t}$$
$$\rightarrow + s^{R(a)}_{c,i,m,t}\Delta ln(R/H)_{c,i,m,t} + \Delta lnA_{c,i,m,t}$$

where:

- c=country, i=industry, m=market-nonmarket sector, t=time, (a)=assets
- $s = (P_x X/P_q Q)$: Q and shares consistent with (a) capitalized assets
- L is labor services, K is tangible capital, R is intangible capital, H is person-hours
- $\Delta lnA_{c,i,m,t}$ measured as a residual
- non-market sector return on capital is SRTP
- currently missing labour services data for CZ and DK

With countries-industry-sectors-asset-years we have many results...so concentrate here on EU and US, where EU is weighted average of AT, DE, DK, ES, FI, FR, IT, NL, SE, UK.

Sources of growth (1998-2013): Non-farm business sector (i.e. excluding Agri, Ed, Health, PA)

Non-farm business						
1998-2013						
Country						
	DlnQH	ConDlnLH	ConDlnKH NonICT	ConDlnKH ICT	ConDlnKH intan	DlnTFP
AT	1.8%	0.2%	0.3%	0.2%	0.5%	0.6%
CZ	3.2%		1.3%	0.4%	0.3%	
DE	1.2%	0.1%	0.3%	0.2%	0.2%	0.4%
DK	1.0%		0.3%	0.3%	0.4%	
ES	0.6%	0.1%	0.9%	0.2%	0.3%	-0.9%
FI	2.0%	0.1%	0.1%	0.1%	0.5%	1.2%
FR	1.6%	0.5%	0.2%	0.1%	0.5%	0.3%
IT	0.2%	0.2%	0.2%	0.2%	0.2%	-0.5%
NL	1.7%	0.4%	0.4%	0.1%	0.4%	0.1%
SE	2.6%	-0.1%	0.4%	0.4%	0.5%	1.5%
UK	1.6%	0.4%	0.2%	0.1%	0.4%	0.6%
US	**2.4%**	**0.2%**	**0.3%**	**0.3%**	**0.8%**	**0.8%**
_EU	***1.2%***	***0.2%***	***0.4%***	***0.2%***	***0.3%***	***0.1%***

Sources of growth (1998-2007): Non-farm business sector (i.e. excluding Agri, Ed, Health, PA)

1998-2007						
Country	Mean	Mean	Mean	Mean	Mean	Mean
	DlnQH	ConDlnLH	ConDlnKH NonICT	ConDlnKH ICT	ConDlnKH intan	DlnTFP
AT	2.5%	0.2%	0.4%	0.3%	0.5%	1.2%
CZ	5.0%		1.6%	0.5%	0.5%	
DE	1.8%	0.0%	0.4%	0.2%	0.3%	1.0%
DK	1.6%		0.3%	0.4%	0.4%	
ES	-0.2%	0.0%	0.6%	0.3%	0.1%	-1.2%
FI	3.6%	0.1%	0.0%	0.2%	0.5%	2.8%
FR	2.2%	0.4%	0.3%	0.2%	0.5%	0.9%
IT	0.4%	0.2%	0.1%	0.2%	0.2%	-0.2%
NL	2.6%	0.3%	0.5%	0.1%	0.4%	0.9%
SE	3.8%	-0.2%	0.4%	0.6%	0.5%	2.6%
UK	2.7%	0.5%	0.4%	0.2%	0.5%	1.5%
US	**3.1%**	**0.2%**	**0.4%**	**0.5%**	**0.9%**	**1.2%**
_EU	**1.8%**	**0.2%**	**0.4%**	**0.2%**	**0.3%**	**0.7%**

Sources of growth (2008-2013): Non-farm business sector (i.e. excluding Agri, Ed, Health, PA)

2008-2013						
Country	Mean	Mean	Mean	Mean	Mean	Mean
	DlnQH	ConDlnLH	ConDlnKH NonICT	ConDlnKH ICT	ConDlnKH intan	DlnTFP
AT	0.5%	0.2%	0.2%	0.1%	0.4%	-0.4%
CZ	0.3%		0.7%	0.3%	0.0%	
DE	0.1%	0.3%	0.2%	0.1%	0.1%	-0.7%
DK	0.1%		0.3%	0.1%	0.4%	
ES	1.9%	0.4%	1.4%	0.1%	0.5%	-0.5%
FI	-0.6%	0.3%	0.2%	0.1%	0.4%	-1.5%
FR	0.6%	0.6%	0.2%	0.1%	0.5%	-0.8%
IT	-0.1%	0.2%	0.4%	0.1%	0.2%	-0.9%
NL	0.3%	0.4%	0.2%	0.1%	0.4%	-0.8%
SE	0.7%	0.0%	0.4%	0.1%	0.5%	-0.3%
UK	-0.2%	0.3%	0.0%	0.1%	0.3%	-0.8%
US	**1.2%**	**0.2%**	**0.1%**	**0.2%**	**0.6%**	**0.1%**
_EU	**0.3%**	**0.3%**	**0.3%**	**0.1%**	**0.3%**	**-0.7%**

Sources of growth (1998-2013): Public (i.e. Ed, Health, PA)

Public						
1998-2013						
Country	Mean	Mean	Mean	Mean	Mean	Mean
	DlnQH	ConDlnLH	ConDlnKH NonICT	ConDlnKH ICT	ConDlnKH intan	DlnTFP
AT	0.5%	0.1%	0.2%	0.3%	0.0%	-0.1%
CZ	0.6%		1.2%	0.3%	0.1%	
DE	1.0%	0.4%	0.5%	0.1%	0.2%	-0.3%
DK	0.0%		0.4%	0.1%	0.1%	
ES	0.6%	0.3%	0.7%	0.2%	0.2%	-0.5%
FI	-0.3%	0.1%	0.4%	0.1%	0.0%	-0.9%
FR	0.9%	0.2%	0.3%	0.0%	0.1%	0.3%
IT	0.4%	0.4%	0.4%	0.1%	0.2%	-0.6%
NL	0.6%	0.1%	0.2%	0.1%	0.2%	0.1%
SE	-0.1%	3.4%	0.2%	0.2%	0.0%	-3.9%
UK	0.3%	0.1%	0.3%	0.0%	0.4%	-0.3%
US	**0.1%**	**0.1%**	**0.1%**	**0.0%**	**0.4%**	**-0.5%**
_EU	**0.6%**	**0.4%**	**0.4%**	**0.1%**	**0.2%**	**-0.4%**

Sources of growth (1998-2007): Public (i.e. Ed, Health, PA)

1998-2007						
Country	Mean	Mean	Mean	Mean	Mean	Mean
	DlnQH	ConDlnLH	ConDlnKH NonICT	ConDlnKH ICT	ConDlnKH intan	DlnTFP
AT	0.7%	0.2%	0.2%	0.4%	0.1%	-0.2%
CZ	1.5%		1.4%	0.4%	0.1%	
DE	0.8%	0.3%	0.7%	0.2%	0.2%	-0.7%
DK	0.0%		0.4%	0.2%	0.1%	
ES	1.0%	0.2%	0.5%	0.3%	0.2%	0.2%
FI	0.2%	0.2%	0.5%	0.1%	0.0%	-0.4%
FR	1.0%	0.2%	0.4%	0.0%	0.1%	0.3%
IT	0.6%	0.5%	0.5%	0.1%	0.2%	-0.7%
NL	0.6%	0.1%	0.2%	0.2%	0.2%	0.0%
SE	-0.1%	4.6%	0.3%	0.3%	0.0%	-5.2%
UK	0.7%	0.1%	0.4%	0.0%	0.4%	-0.1%
US	**0.0%**	**0.1%**	**0.1%**	**0.0%**	**0.5%**	**-0.6%**
_EU	**0.8%**	**0.4%**	**0.5%**	**0.1%**	**0.2%**	**-0.4%**

Sources of growth (2008-2013): Public (i.e. Ed, Health, PA)

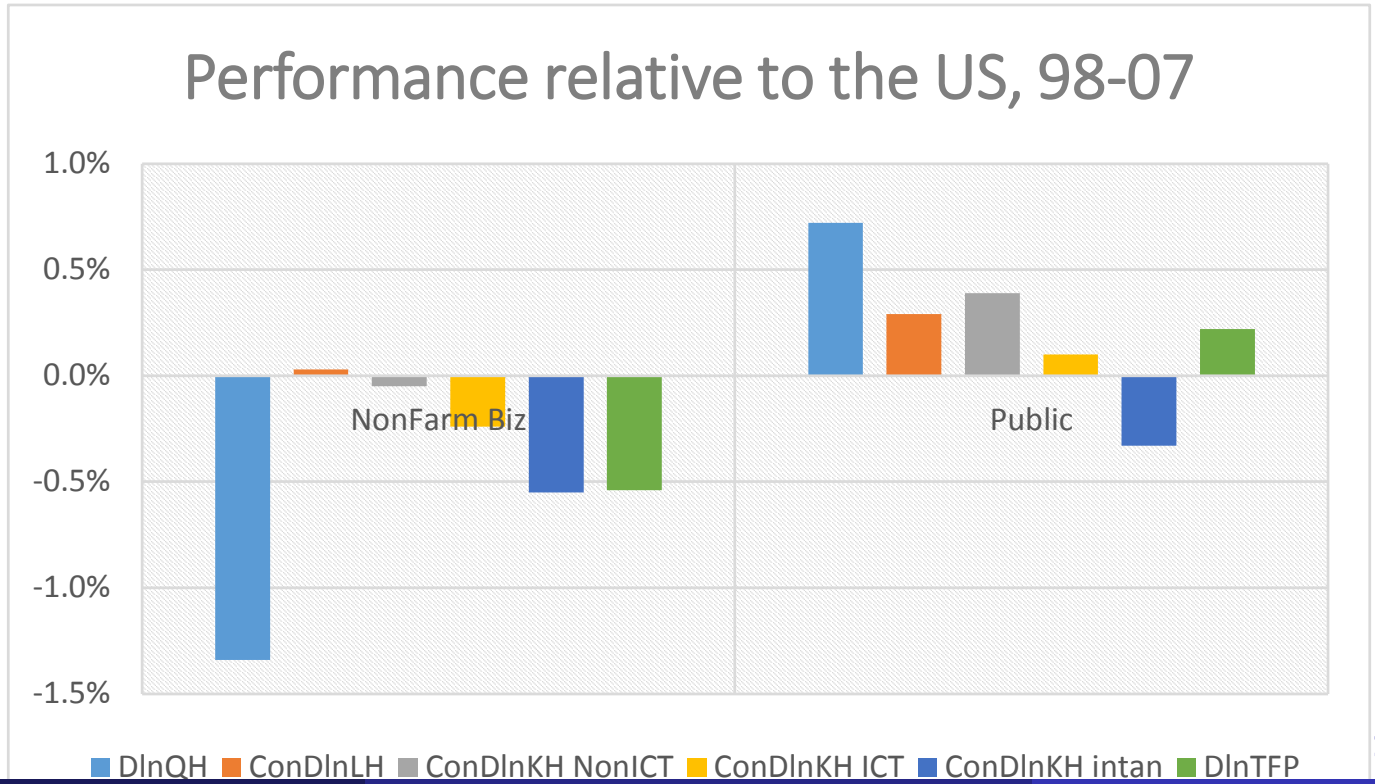
2008-2013						
Country	Mean	Mean	Mean	Mean	Mean	Mean
	DlnQH	ConDlnLH	ConDlnKH NonICT	ConDlnKH ICT	ConDlnKH intan	DlnTFP
AT	0.0%	-0.1%	0.1%	0.3%	-0.1%	-0.1%
CZ	-1.0%		0.8%	0.0%	0.0%	
DE	1.3%	0.4%	0.3%	0.1%	0.2%	0.3%
DK	0.1%		0.3%	0.1%	0.1%	
ES	-0.1%	0.4%	0.9%	0.1%	0.1%	-1.6%
FI	-1.0%	0.1%	0.3%	0.0%	0.1%	-1.6%
FR	0.9%	0.2%	0.3%	0.0%	0.1%	0.3%
IT	0.0%	0.2%	0.2%	0.1%	0.0%	-0.5%
NL	0.6%	0.1%	0.2%	0.1%	0.1%	0.2%
SE	-0.1%	1.3%	0.1%	0.0%	0.1%	-1.6%
UK	-0.4%	0.1%	0.1%	0.0%	0.3%	-0.8%
US	**0.3%**	**0.1%**	**0.0%**	**0.0%**	**0.3%**	**-0.2%**
_EU	**0.4%**	**0.3%**	**0.3%**	**0.1%**	**0.1%**	**-0.3%**

Before 2008: sources of growth (1998-2007): GDP-weighted average of EU countries minus US

Before the recession

- US NFBiz ΔlnQ=3.1%pa, $\Delta lnTFP$ = 1.2%pa; EU =1.8%pa, 0.7%pa
- US Public ΔlnQ=0.0%pa, $\Delta lnTFP$ = -0.6%pa; EU =0.8%pa, -0.4%pa
- EU lagged US in NFBiz, Ahead in public

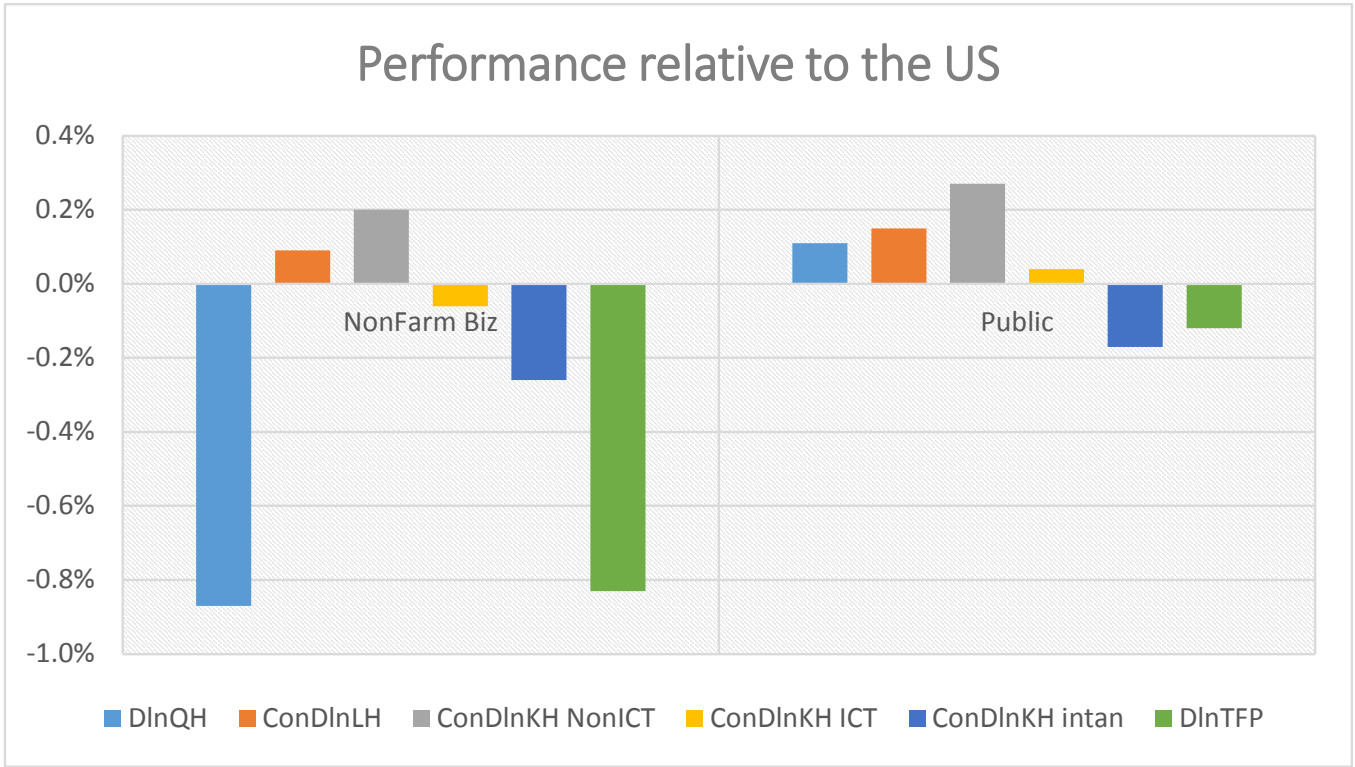
rel to US 98-07.pdf



After 2008: Sources of growth (2008-2013): GDP-weighted average of EU countries minus US

After recesssion

- MFBiz:EU TFP lag got worse
- Public: Public advantage fell



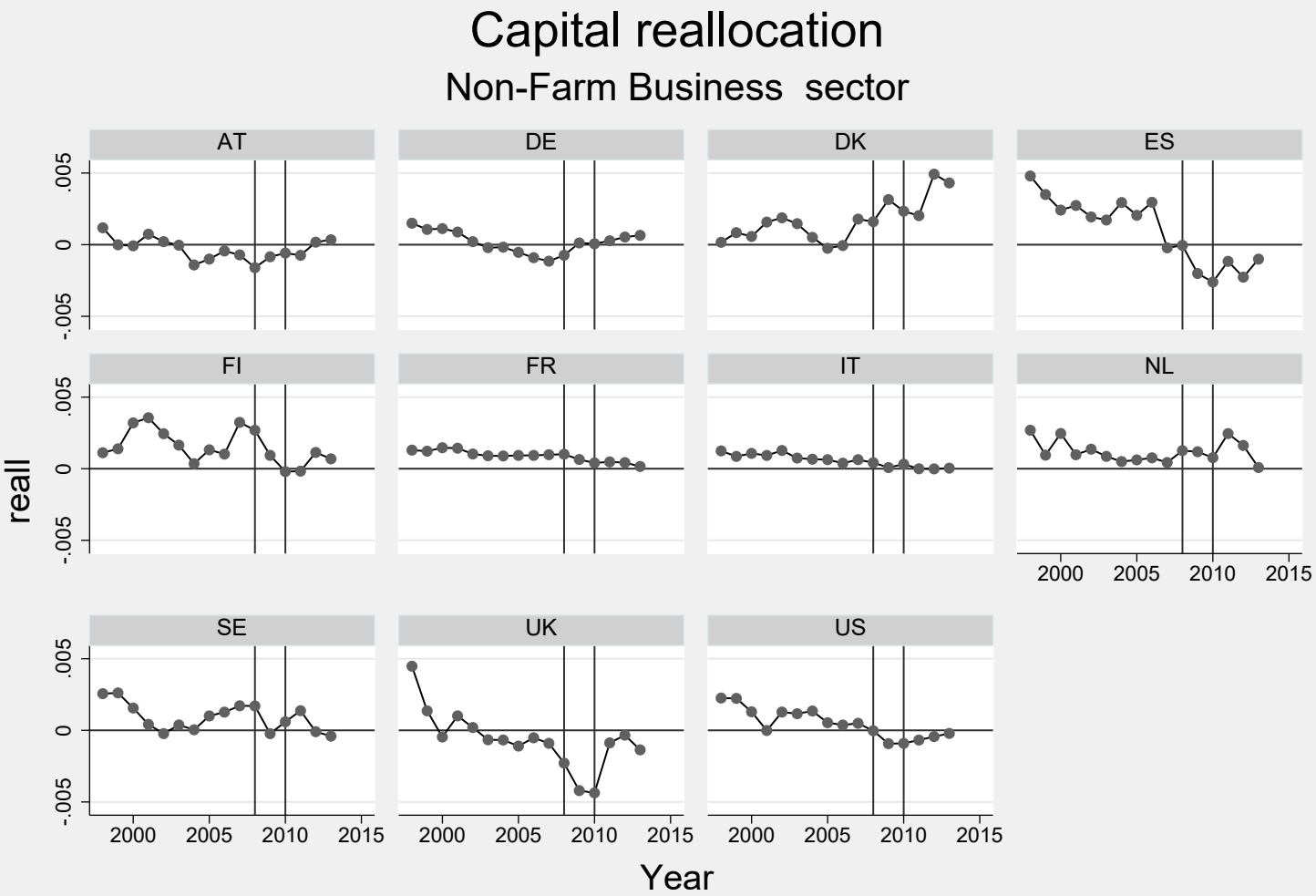
rel to US.pdf

Capital reallocation: Jorgenson and Schreyer (2013)

- Is capital is somehow not being allocated to the "right" sectors? And this is impeding productivity growth?
- To evaluate the degree of misallocation, need to compare relative to "benchmark" for productivity growth with no misallocation
- We follow Jorgenson and Schreyer and use their accounting framework, that directly links the reallocation of capital between industries and (total factor) productivity growth. Data from 11 countries, 1997-2013

- Jorgenson: calculate capital contributions to TFP when capital gets the same price in all industries = $ConK_{\rho_i=\rho}$
- Do same when capital gets different prices = $ConK_{\rho_i}$
- If the markets working, capital flows from low to high return industries
- => $ConK_{\rho_i}$ is relatively high, since ΔlnK_i is high in industries with high ρ_i
- => $ConK_{\rho_i} > ConK_{\rho_i=\rho}$
- We study $REALL_K = ConK_{\rho_i} - ConK_{\rho_i=\rho}$
- Test: if misallocation has got worse then this falls

Capital reallocation: only NA intangibles are capitalised



Compare SE, DE and UK. ES? IT?

We investigate possible drivers of capital reallocation estimating the following specification:

$$REALLK_{c,t} = \alpha_1 \Delta ln(Intrate)_{c,t} + \alpha_2 Crisis + \alpha_3 Exp^j_{c,t} + \alpha_4 Z^i_{c,t} + \gamma_c + \epsilon$$

where

- Intrate is long term interest rate,
- Crisis is a dummy variable for 2008,
- Exp^j are indicators of economic sentiment, with j=ESI, Factors influencing investments (demand (Dem) and financial (Fin) ,
- Z^i are other controls for government support to investment and
- γ_c are country dummies.

Capital reallocation: empirical results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1997-2013	1997-2007	1997-2013	1997-2007	1997-2007			1997-2013		
VARIABLES	Include the US		Exclude the US							
Interest rate	-0.0016***	0.0003	-0.0019***	-0.0036	-0.0018***	-0.0013**	-0.0008*	-0.0032***	-0.0025***	-0.0010
	(0.0005)	(0.0016)	(0.0005)	(0.0024)	(0.0005)	(0.0006)	(0.0005)	(0.0007)	(0.0007)	(0.0009)
ESI	0.0026***	0.0025	0.0032***	0.0034*	0.0032***	0.0036***	0.0037***	0.0063***	0.0075***	0.0052***
	(0.0009)	(0.0016)	(0.0009)	(0.0018)	(0.0009)	(0.0009)	(0.0009)	(0.0013)	(0.0012)	(0.0015)
GOS_GDP	-0.0058**	-0.0072**	-0.0078***	-0.0102***	-0.0069**	-0.0110***	-0.0127***	-0.0080*	-0.0158***	-0.0166***
	(0.0023)	(0.0030)	(0.0026)	(0.0035)	(0.0027)	(0.0024)	(0.0025)	(0.0042)	(0.0038)	(0.0039)
Crisis	-0.0007***		-0.0006***		-0.0006***	-0.0005***	-0.0005***			
	(0.0001)		(0.0002)		(0.0002)	(0.0002)	(0.0002)			
I grants_GDP					0.0003*	0.0003	0.0002	0.0008***	0.0004*	0.0002
					(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0004)
Demand conditions						0.0002*			0.0007***	
						(0.0001)			(0.0002)	
Financial conditions							0.0001*			0.0002*
							(0.0001)			(0.0001)
Observations	187	121	170	110	169	129	116	109	79	70

ndard errors in parentheses
* p<0.01, ** p<0.05, * p<0.1

Summary: REALL gets worse when:

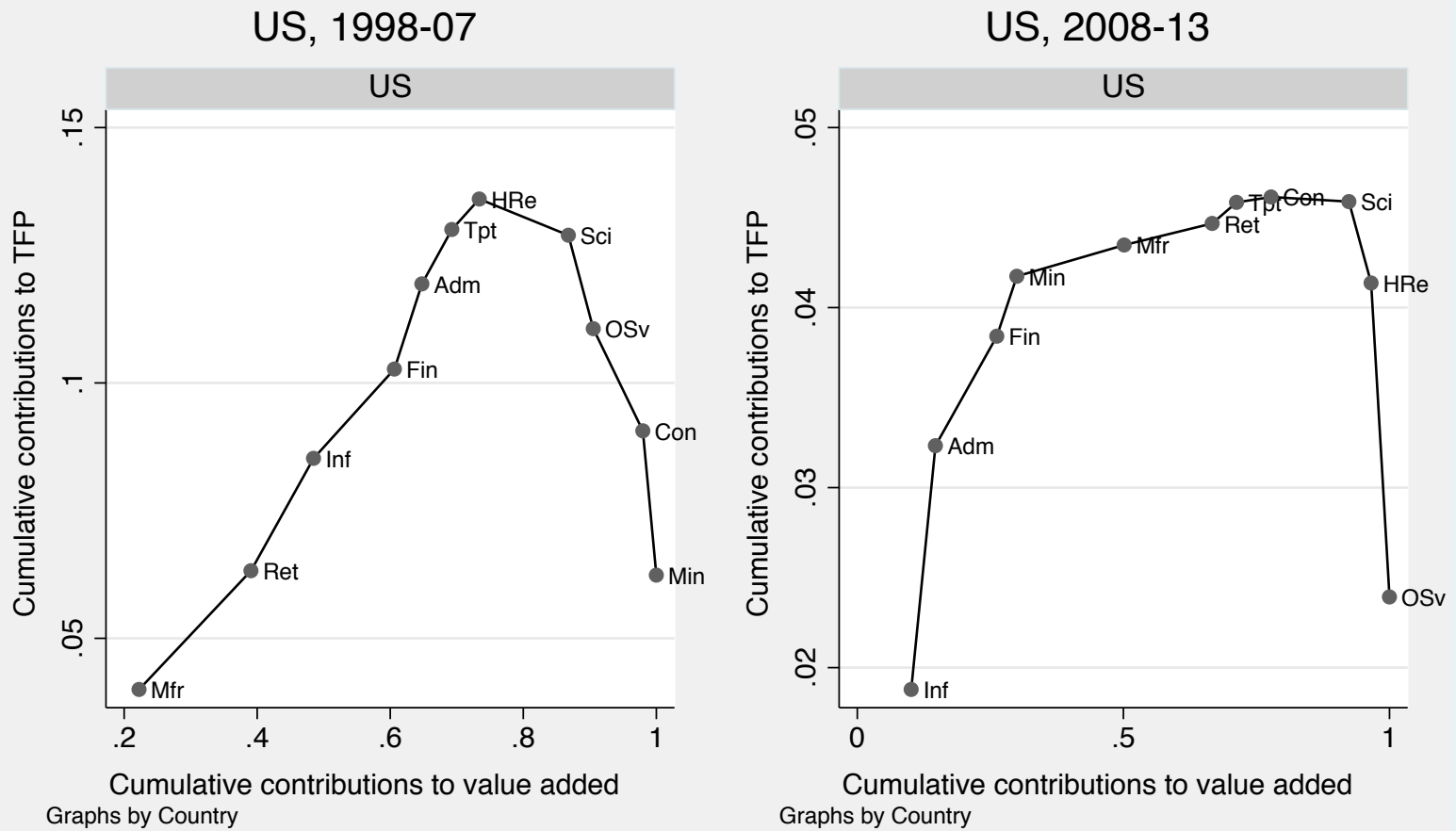
- Crisis
- poor sentiment/ low expectations
- rising interest rates
- high profits

Contributions

- Creation of a country-industry-sector database for productivity analysis that accounts for the role of tangible and intangible capital in the total economy (private and public).
- Intangible and tangible investment show different sensitivity to the business cycle across countries
- Still comparatively low intangible investment in EU countries relative to US: correlated with more employment strictness. Policy opportunity?
- Post-crisis:
  - lag in EU $\Delta lnTFP$ has got worse
  - Capital reallocation fell strongly in crisis in most countries, but not in e.g. SE. Trending down in ES and IT. Falls with low sentiment. Policy opportunity?

US: Cumulative contributions to TFP and value added

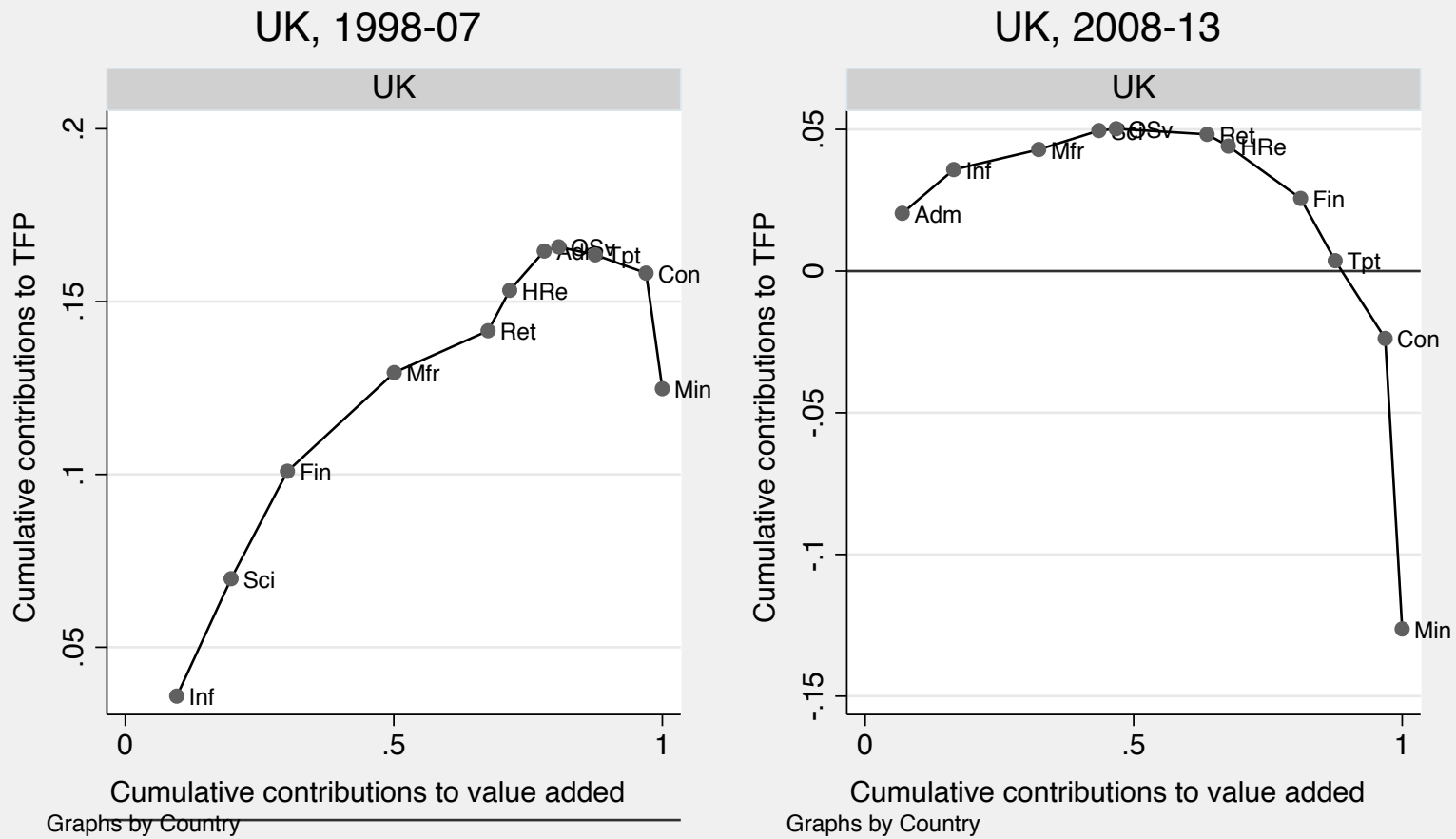
Ordered left to right by DlnTFP



Note: All intangibles capitalised

UK: Cumulative contributions to TFP and value added

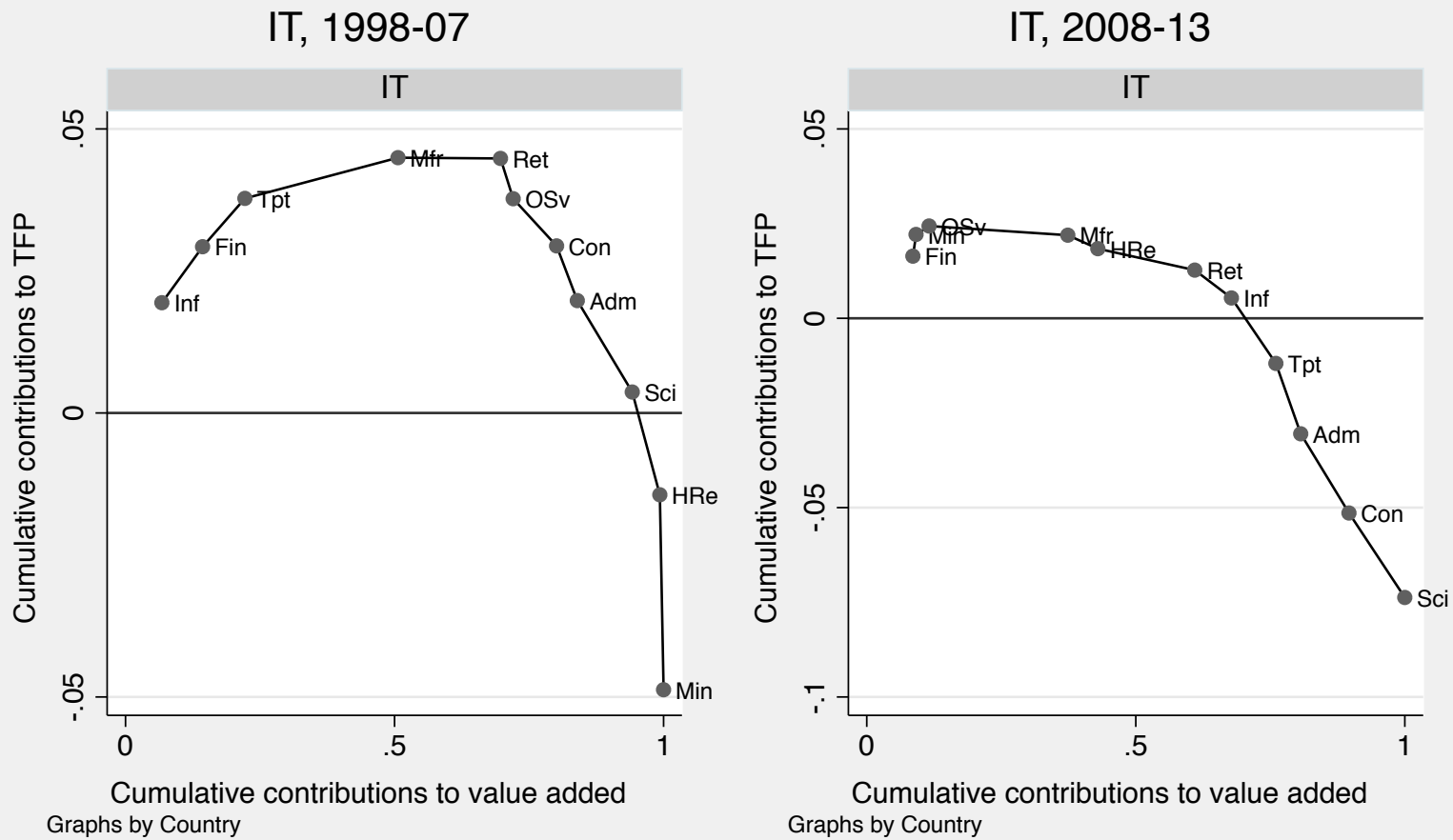
Ordered left to right by DlnTFP



Note: All intangibles capitalised

IT: Cumulative contributions to TFP and value added

Ordered left to right by DlnTFP



Note: All intangibles capitalised