Imperial College London BUSINESS SCHOOL

SPINTAN smartpublicintangibles

Productivity growth and intangibles: how does Finland compare?

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Features work from: SPINTAN (EU grant No. 612774) with Carol Corrado, Cecilia Jona-Lasinio, Massimiliano Iommi

The EU-financed SPINTAN project, www.spintan.net

- New country/industry/market-non-market productivity database
- With tangibles and intangible assets
- 20 industries, 1995-2013, 12 countries
  - US
  - Big Northern Europe: DE, FR, UK
  - Scand: DK FI, SE
  - Small Europe: AT, CZ, NL
  - Med: ES, IT
- Features
  - Bottom-up capital stocks from investment data
  - Ex-post rental rates so capital rental payments equal gross operating surplus
  - Public sector intangibles
  - Returns to capital in the non-market sector
  - Harmonised ICT prices

Sources of growth

Industry-level production function

$$\Delta \ln Q^{(a)}_{c,i,t} = s^{(a)L}_{c,i,m,t} \Delta \ln L_{c,i,m,t} + s^{(a)K}_{c,i,t} \Delta \ln K_{c,i,m,t} + s^{(a)R}_{c,i,t} \Delta \ln R_{c,i,m,t} + \Delta \ln TFP_{c,i,m,t}$$

- Country, c; Industry, i; time, t
- Market/non-market sector, m
- Asset capitalisation
  - Tangible assets, K; intangible assets R
  - Value added, $Q^{(a)}$, consistent with capitalised assets
  - Shares, $s=P_xX/P_qQ$ also consistent with capitalised assets
- Consistent aggregation to sectors and econ-wide level
- TFP a residual
    - Measures shift of production function, mismeasurement, spillovers

Capital inputs

Asset prices

$$P^{R(a)}_{c,i,m,t} = P^{N(a)}_{c,i,m,t}(r_{c,i,m,t} - \pi^{R(a)}_{c,i,m,t} + \delta^{R(a)}) \quad and \quad P^{K(a)}_{c,i,m,t} = P^{I(a)}_{c,i,m,t}(r_{c,i,m,t} - \pi^{K(a)}_{c,i,m,t} + \delta^{K(a)})$$

Asset accumulation

$$R^{(a)}_{c,i,m,t} = \frac{P^{N(a)*}_{c,i,m,t} N^{(a)}_{c,i,m,t}}{P^{N(a)}_{c,i,m,t}} + (1-\delta^{R(a)}) R^{(a)}_{c,i,m,t-1} \quad and \quad K^{(a)}_{c,i,m,t} = \frac{P^{I(a)*}_{c,i,m,t} I_{c,i,m,t}}{P^{I(a)}_{c,i,m,t}} + (1-\delta^{K(a)}) K^{(a)}_{c,i,m,t-1}$$

- "Conventional" issues
  - Asset deflators $P^{N(a)}$ and $P^{R(a)}$.
    - Country-specific except ICTEq =hardware +comms equip is harmonised to US nat accounts (OECD method, Scheyrer/Collecia).
    - Intang. R&D country-specific. Others are country-specific GDP deflator
  - δ. EUKLEMS for tang, CHS for intang. Equal for country-industry-time
  - r?
    - Baseline: Country-industry-time specific
    - Compare with country-time specific to get Jorgenson reallocation term
  - Starting K values
    - KLEMS. Allocated by employment across market and non-market sectors
    - Growth steady state for intangibles
- New issues from non-market sector
  - What to do with non-market returns? Set r=Soc rate time pref
  - Starting K values. For tangibles, take industry from KLEMS and allocated by employment across market and non-market sectors within the industry.

Industries

NACE_R2_a21	NACE_R2_a21(L)
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households
U	Activities of extraterritorial organisations and bodies

We exclude A, L, T, U

Asset list

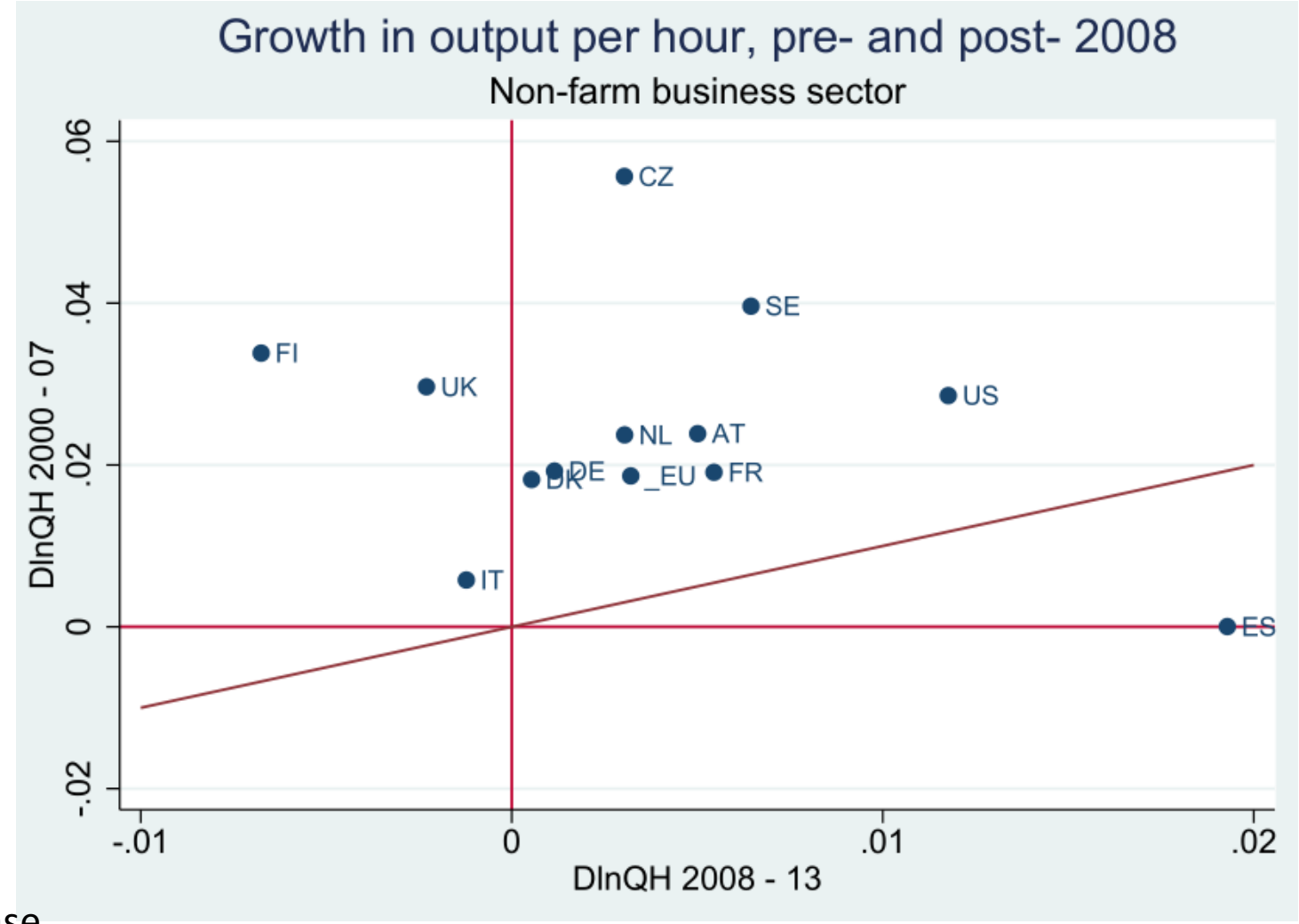
ASSET10	ASSET10(L)/TIME
N11	Total fixed assets - esa2010 definition
N11K	Total Construction
N111	Dwellings
N112	Other buildings and structures
N11M	Machinery and equipment and weapons systems
N1131	Transport equipment
N1132	ICT equipment
N11321	Computer hardware
N11322	Telecommunications equipment
N11O	Other machinery and equipment and weapons systems
N115	Cultivated biological resources
N117	Intellectual property products
N1171	Research and development
N1173	Computer software and databases
N1172_N1174	Mineral explorations and Entertainment, literary and artistic originals
N117x1173	IPP excluding software = R&D+MinArt
	New financial products
	Design
	Brand equity
	Organisational capital
	Firm specific human capital
	Total fixed assets - including new intangible assets

Table 3: **Knowledge Capital in a Total Economy**

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)

Source: Corrado , Haskel, Jona-Lasinio, 2014. SPINTAN working paper

Productivity growth compared…



Source: SPINTAN database

Sources of growth, pre-2008

1998-2007, Non-farm business						***Of which:***		
	DlnQH	**ConDlnLH**	**ConDlnKH NonICT**	**ConDlnKH ICT**	**ConDlnKH intan**	***ConDlnKH rd***	***ConDlnKH intan xrd***	**DlnTFP**
AT	2.53%	0.19%	0.31%	0.29%	0.52%	*0.15%*	*0.37%*	1.22%
DE	1.81%	-0.01%	0.34%	0.22%	0.25%	*0.09%*	*0.17%*	1.00%
ES	-0.18%	-0.04%	0.57%	0.27%	0.13%	*0.02%*	*0.11%*	-1.12%
FI	**3.58%**	**0.06%**	**-0.02%**	**0.15%**	**0.53%**	***0.36%***	***0.18%***	**2.86%**
FR	2.16%	0.39%	0.24%	0.15%	0.49%	*0.08%*	*0.41%*	0.89%
IT	0.40%	0.21%	0.03%	0.19%	0.16%	*0.03%*	*0.13%*	-0.19%
NL	2.58%	0.29%	0.48%	0.13%	0.44%	*0.05%*	*0.39%*	0.88%
SE	3.82%	0.01%	0.37%	0.56%	0.46%	*0.20%*	*0.25%*	2.42%
UK	2.65%	0.45%	0.35%	0.17%	0.42%	*0.04%*	*0.38%*	1.78%
US	3.01%	0.15%	0.42%	0.44%	0.88%	*0.18%*	*0.70%*	1.13%
_EU	**1.78%**	**0.19%**	**0.33%**	**0.21%**	**0.33%**	***0.07%***	***0.26%***	**0.73%**

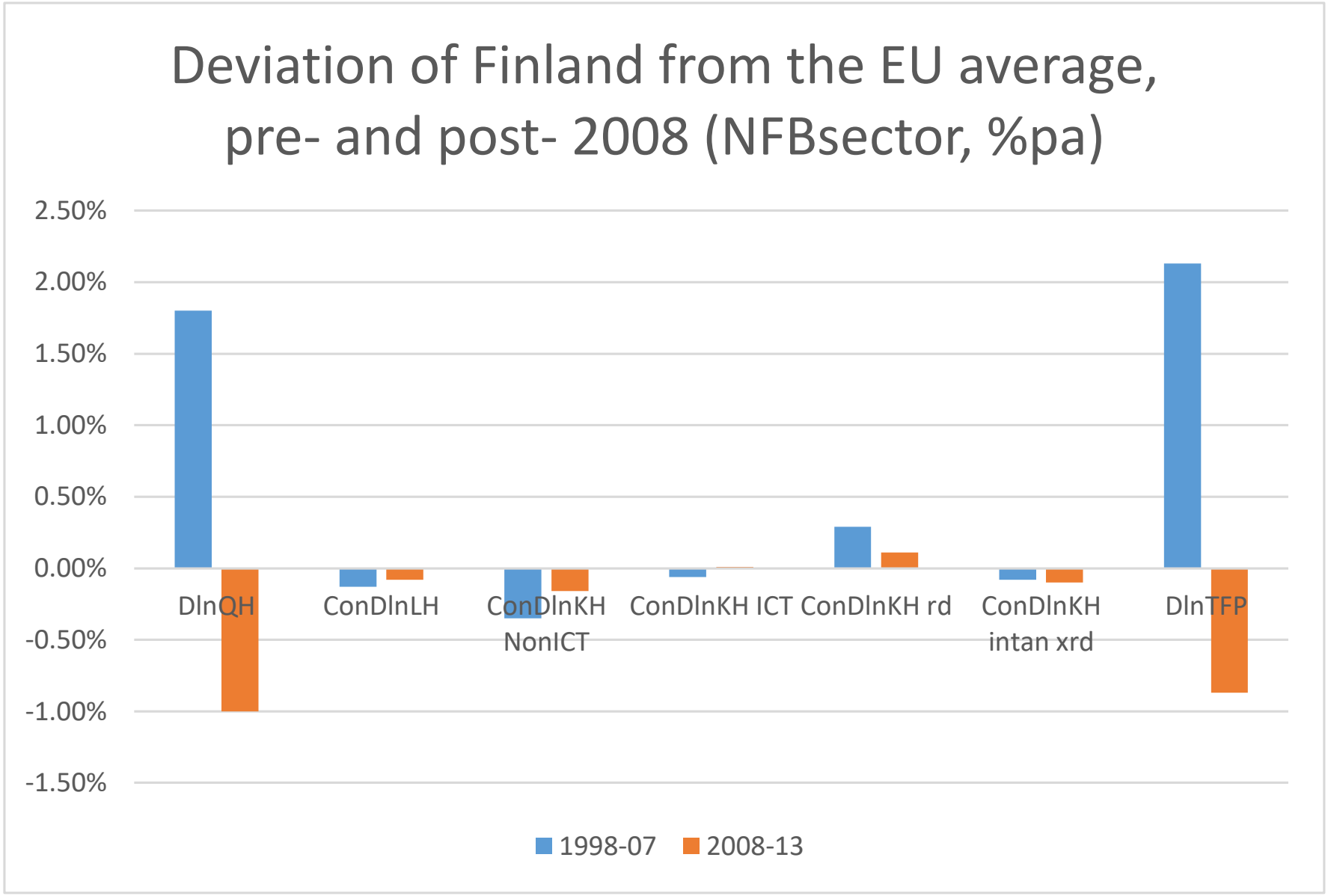
Source: SPINTAN database

Sources of growth, post-2008

2008-2013, Non-farm business						*Of which:*		
	DlnQH	ConDlnLH	ConDlnKH NonICT	ConDlnKH ICT	ConDlnKH intan	*ConDlnKH rd*	*ConDlnKH intan xrd*	DlnTFP
AT	0.50%	0.16%	0.19%	0.08%	0.44%	0.23%	0.21%	-0.37%
DE	0.12%	0.33%	0.19%	0.10%	0.14%	0.08%	0.06%	-0.64%
ES	1.93%	0.41%	1.33%	0.12%	0.52%	0.13%	0.39%	-0.45%
FI	**-0.68%**	**0.25%**	**0.15%**	**0.11%**	**0.32%**	**0.21%**	**0.11%**	**-1.51%**
FR	0.54%	0.55%	0.16%	0.06%	0.53%	0.14%	0.40%	-0.75%
IT	-0.12%	0.17%	0.38%	0.12%	0.13%	0.08%	0.05%	-0.92%
NL	0.30%	0.44%	0.17%	0.08%	0.42%	0.03%	0.40%	-0.81%
SE	0.64%	0.01%	0.41%	0.12%	0.49%	0.16%	0.33%	-0.38%
UK	-0.23%	0.28%	-0.05%	0.07%	0.26%	0.04%	0.23%	-0.43%
US	1.18%	0.24%	0.23%	0.14%	0.65%	0.16%	0.48%	-0.08%
_EU	**0.32%**	**0.33%**	**0.31%**	**0.10%**	**0.30%**	**0.10%**	**0.21%**	**-0.64%**

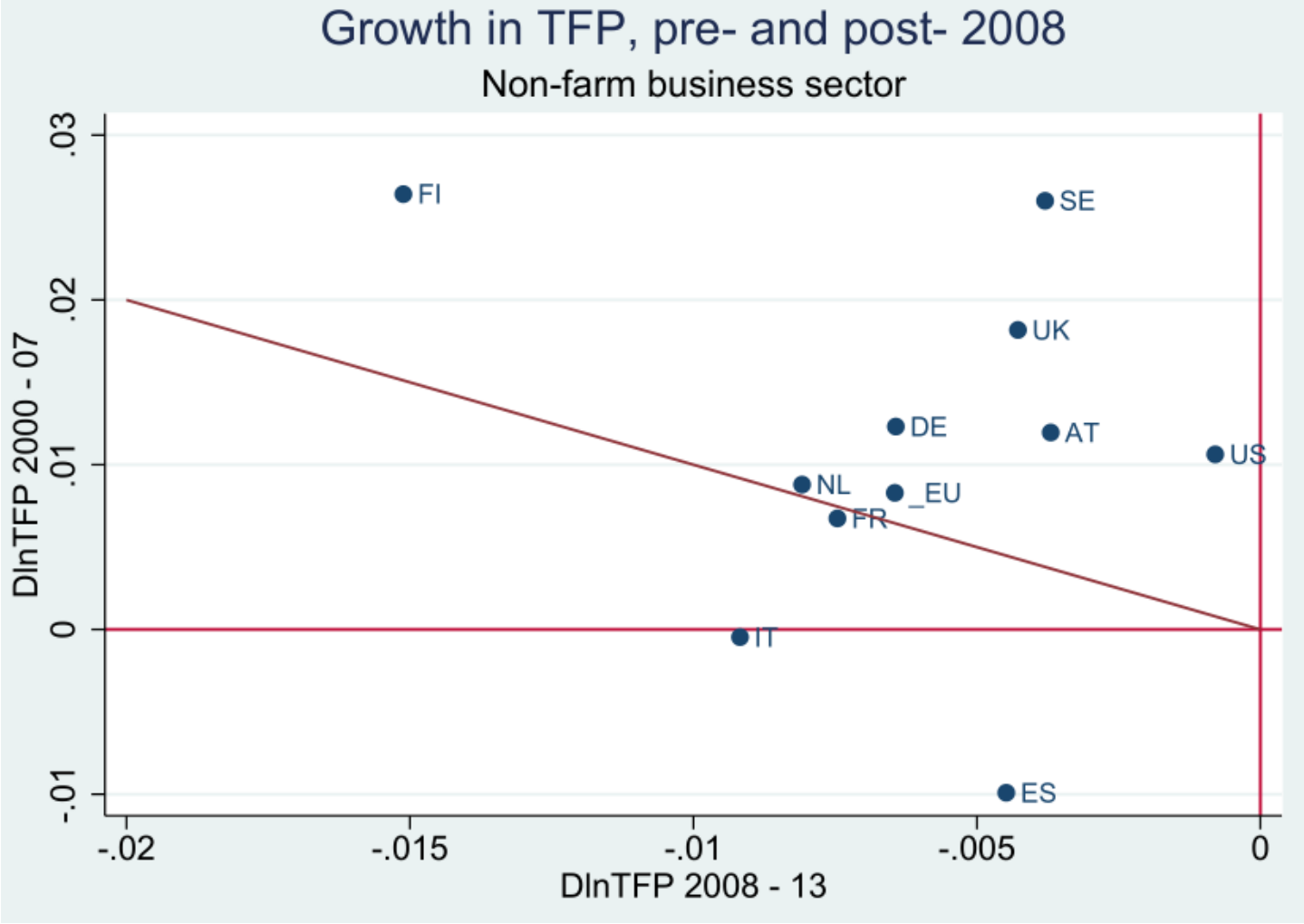
Source: SPINTAN database

Finland relative to the EU



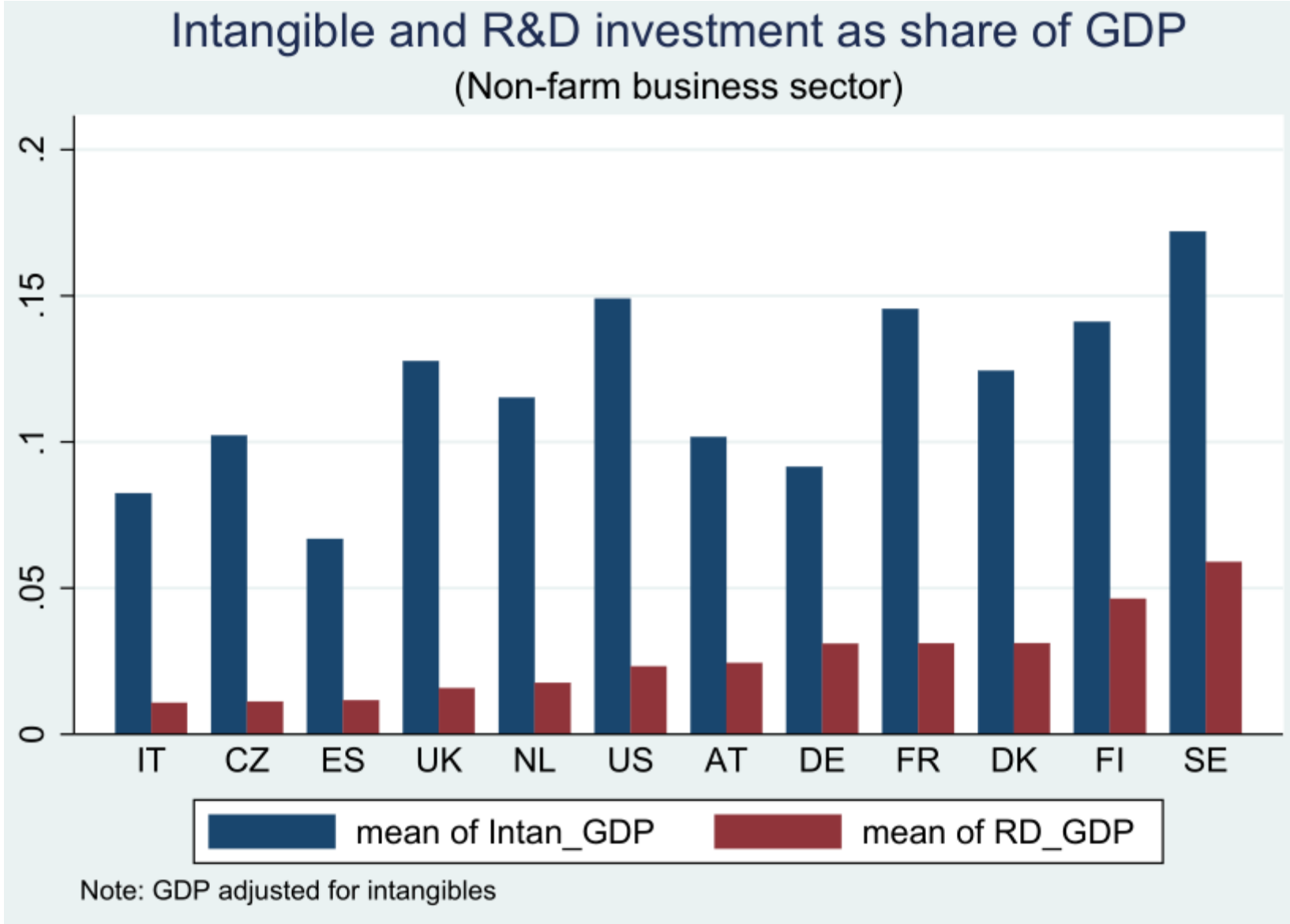
Source: SPINTAN database

TFP growth compared…



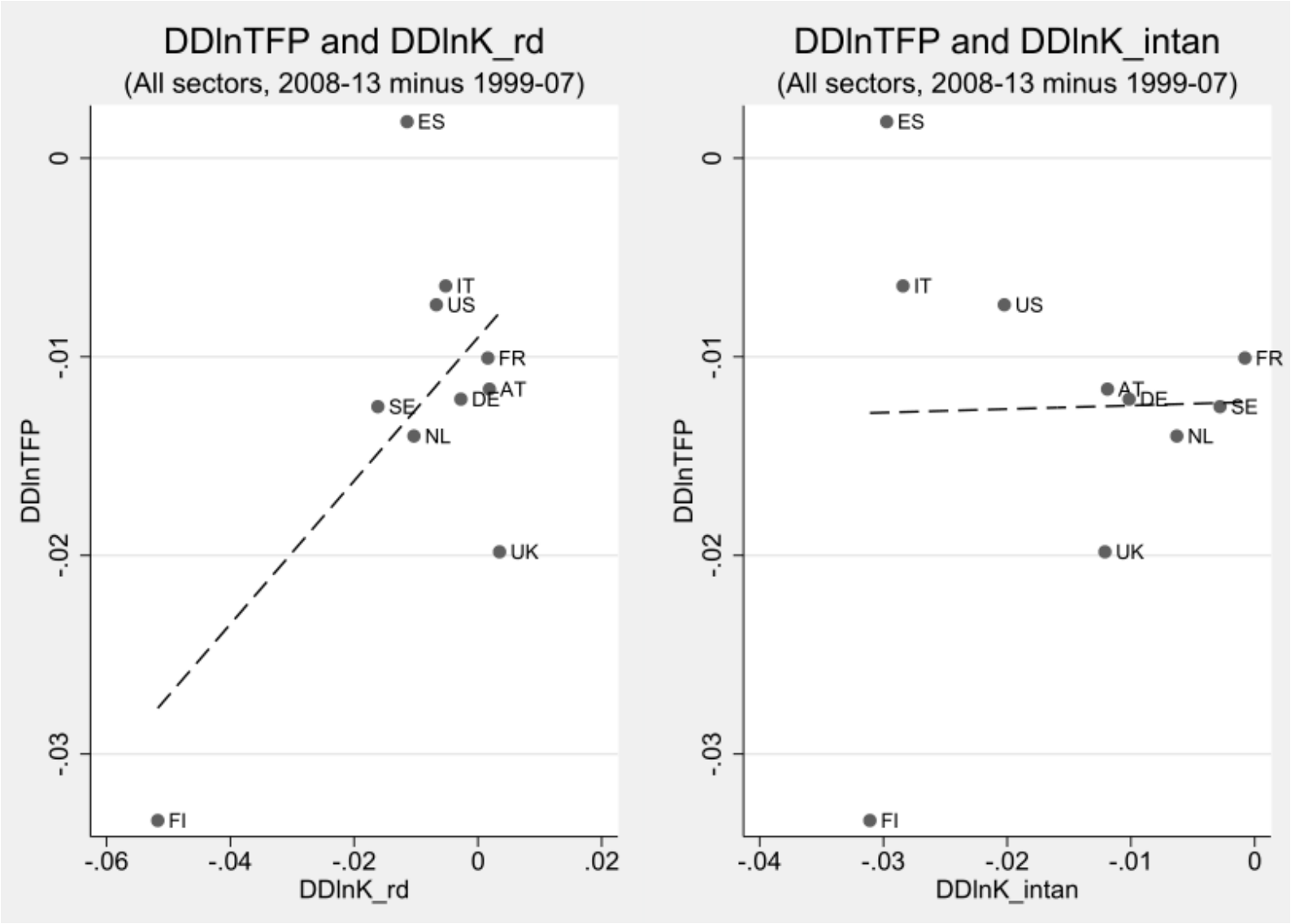
Source: SPINTAN database

Intangibles, 1995-2013



Source: SPINTAN database

The TFP and intangible slowdown?



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