LAGGARDS OR LEADERS? WHAT IS HOLDING BACK PRODUCTIVITY GROWTH?

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Based on joint work with Dan Andrews and Chiara Criscuolo and on further work by Giuseppe Berlingieri, Patrick Blanchenay, Sara Calligaris, Rudy Verlhac

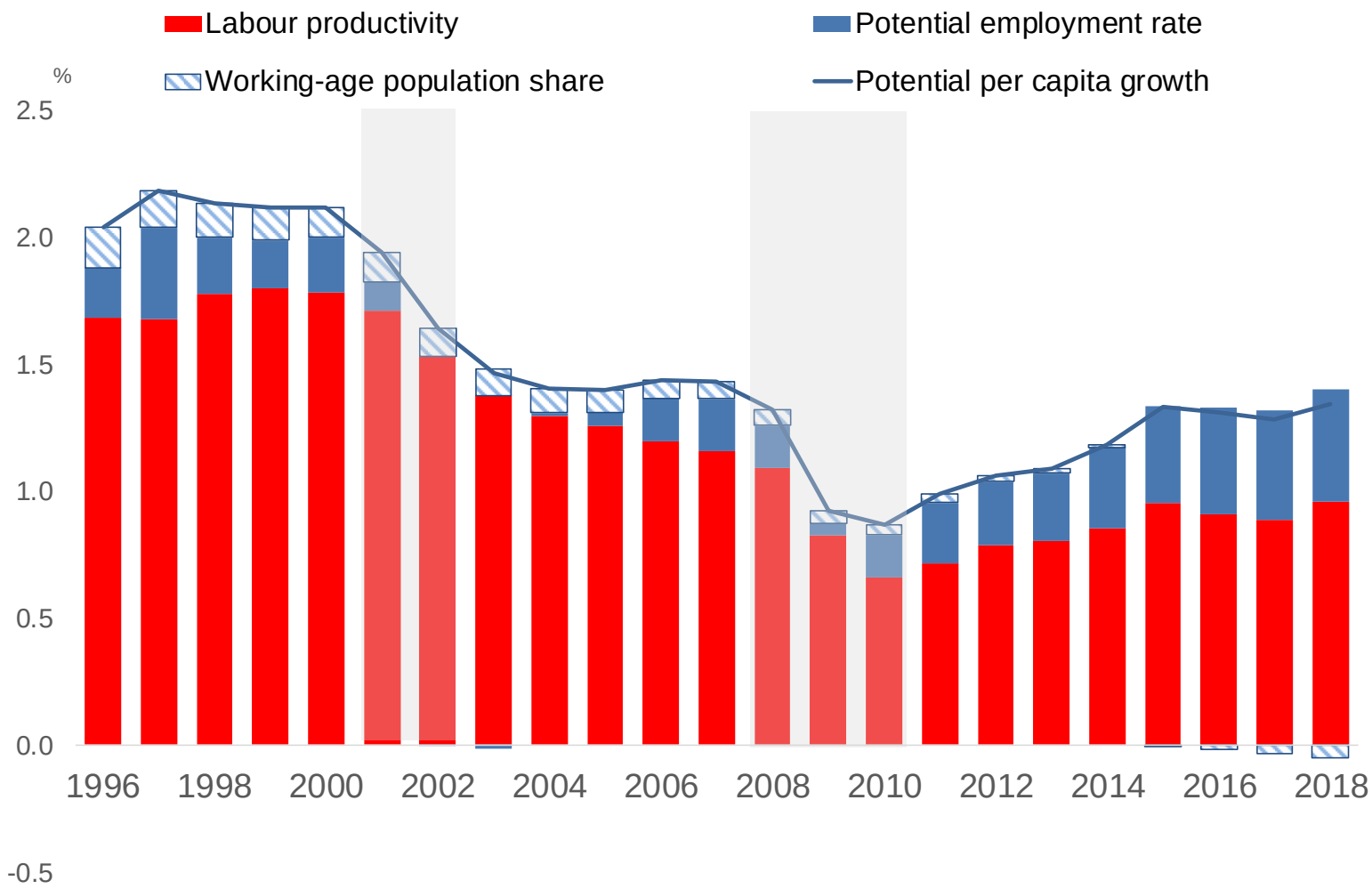
ERSA - OECD Winter School | Trento
January 2019

GLOBAL FORUM ON PRODUCTIVITY

OECD
BETTER POLICIES FOR BETTER LIVES

Weak labour productivity underpinning slow potential growth

Contribution to potential per capita output growth, OECD average

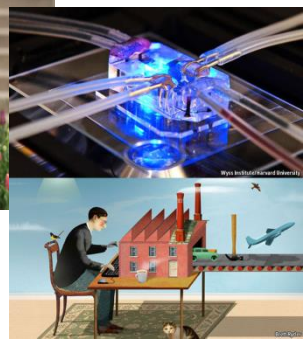


Source: OECD Economic Outlook, November 2018. Note: 2018 is nowcast.

The slowdown has ignited a spirited debate …

Pessimists:

- Gordon
- Cowen
- Thiel
- …



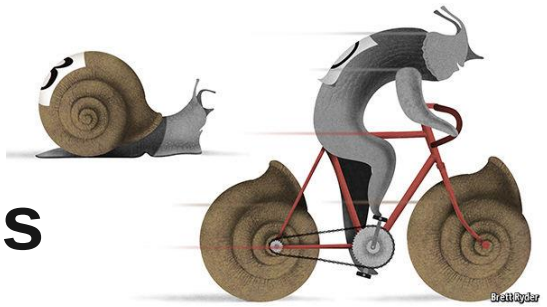
Optimists:

- Brynjolfsson
- McAfee
- Mokyr
- Jovanovic
- …

OECD contribution: bring more micro evidence to a largely macro debate

1. Productivity at Global Frontier remained robust but **laggard** firms increasingly **fell behind**

   "The great divergence" ***in*** The Economist



2. This holds also **within countries**
3. Some **explanations**:
   1. "Winner takes all" dynamics
   2. Stalling diffusion of technologies

   Capabilities?

   3. Market dynamism fell
   4. Policy reforms lacking

   Incentives?

Outline

1. Literature and conceptual background
2. Data and measurement
3. Productivity divergence across firms
   - Globally
   - Within countries
   - Further implications on wages
4. Potential explanations
   - Problems at the bottom?
   - … at the top?
   - Role of policies in creating the right incentives (competition)

Views on the causes of the aggregate productivity slowdown

1. Technological factors
   - Adoption and diffusion of **general purpose technologies** (Griliches, 1957; Brynjolfsson, Rock, Syverson, 2018)
   - A “return to normal” after a decade of exceptional IT-fueled gains (Fernald, 2014)
2. Rising resource misallocation (Gopinath et al., 2017) or less efficient reallocation (Barnett et al, 2014)
3. Cyclical factors
   - Demand conditions and monetary policy (Anzoategui et al., 2016)
   - Weak credit post crisis (Riley, Bondibene and Young, 2015)
4. Measurement (Byrne, et al., 2016; Syverson, 2016)

Conceptual background: What drives productivity growth?

- Widespread **heterogeneity** in firm productivity
  (Bartelsman and Doms, 2000)

  → need to look beyond averages / aggregates

1. Neo-Schumpeterian growth (Aghion and Howitt, 2006)

   a) The best ("global frontier") firms **innovate**.

   b) These technologies **diffuse** to other firms
      This raises *within-firm* productivity through **catching-up**

2. **Reallocation** via growth of productive firms and the downsizing / **exit** of less productive ones
   (Caballero and Hammour, 1994)

DATA AND MEASUREMENT

TWO APPROACHES

I. Global Database
Cross-country firm-level data Orbis

- **Wide coverage**
  - 24 OECD countries, 1997-2014
  - Both manufacturing and services
  - Large and small firms
  - Balance sheets and income statements
    - Collected and harmonized by Bureau van Dijk

- **Limitation**: coverage varies across countries and over time
  - Developed EU countries generally more complete

  → 20+ employees subsample to alleviate this

  → Extensive robustness checks (sample, measurement, etc.)

  → Descriptive charts limited to 2001-2013

II. National Databases

MultiProd project: distributed micro-data analysis

- **Complete coverage of the whole market economy**
  - Based on production surveys and business registers of national statistical offices
    → more tailored for economic analysis
  - Micro-aggregation circumvents confidentiality issues (Bartelsman, 2004)
- **Limitation**:
  - More costly to set up access
  - Not possible to pool the underlying micro data

Measurement
Cross-country comparability is key

- **Productivity measures**
  - Labour productivity
  - Several measures of multi-factor productivity
    - Correct for endogeneity of inputs (Wooldridge, 2009)
    - No firm-level prices → revenue productivity
    - Correction for mark-ups (De Loecker & Warzynski, 2012)

- **Deflation & currency conversion**
  - industry level deflators from OECD National Accounts
  - industry-level PPP in 2005. Inklaar and Timmer (2014)

- **Frontier measures**
  - Top 5% of firms, separately by each industry
  - **Set** of firms can change so that new ones can “push” the frontier

- **Sectors:** Non-farm, non-financial business sector

GLOBAL PRODUCTIVITY DIVERGENCE

THE FINDINGS

The global frontier: Who are they?
Basic descriptives

Frontier firms have
- larger market shares
- higher capital intensity
- higher wages
- higher mark-ups
- more patents

… More so in services than in manuf.

Productivity gap is also higher in services

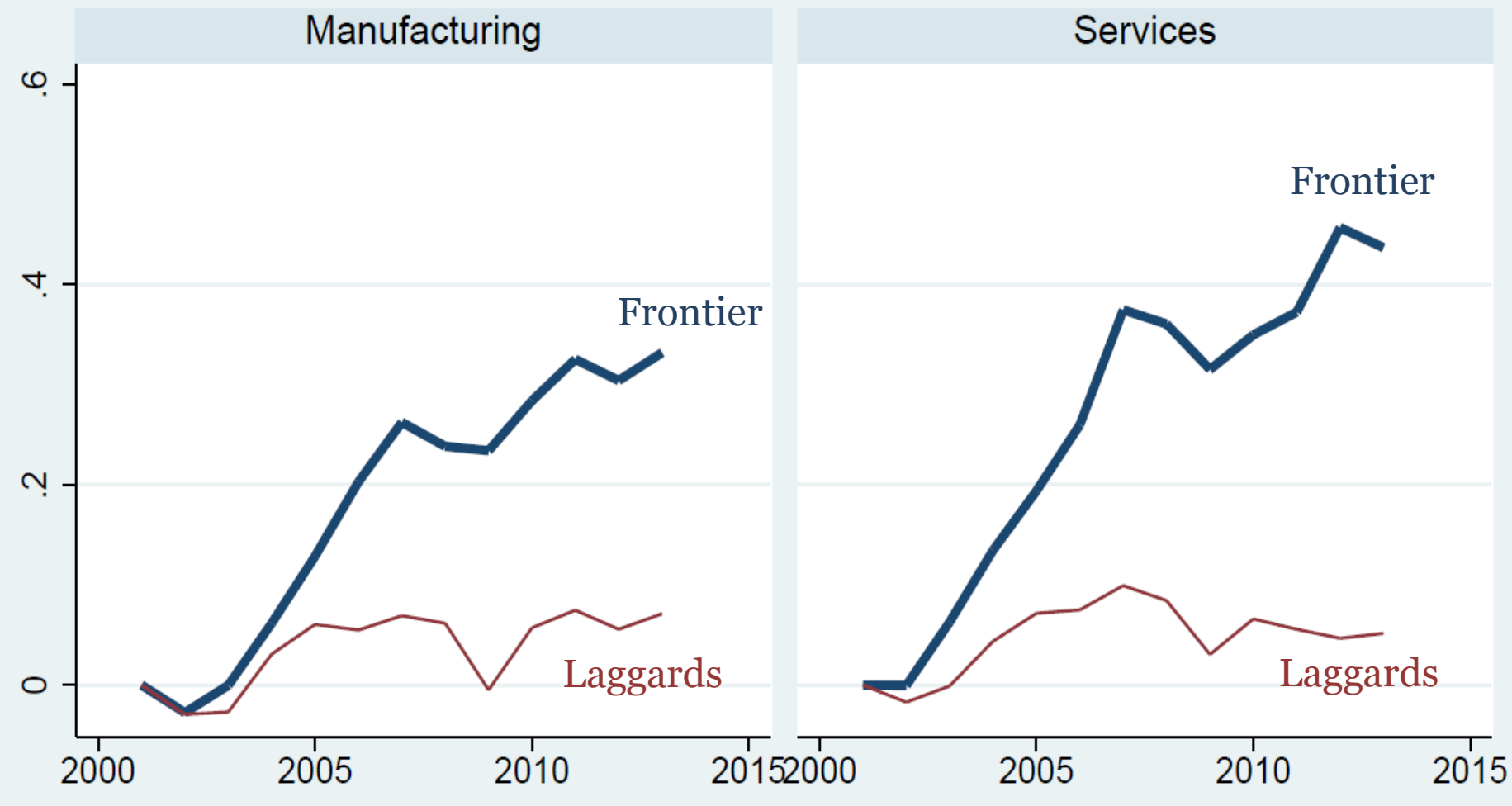
Frontier is composed of various countries

Sector	Manufacturing			Services		
Frontier status	Below frontier	At the frontier		Below frontier	At the frontier	
Variable	Mean st.dev.	Mean st.dev.	Sign. diff.	Mean st.dev.	Mean st.dev.	Sign. diff.
Productivity	10.7 *(0.6)*	12.0 *(0.4)*	***	12.0 *(0.7)*	11.9 *(0.7)*	***
Employees	49.3 *(52.1)*	45.1 *(33.8)*	***	59.5 *(156.6)*	38.0 *(24.8)*	***
Capital-labour ratio [1]	86.1 *(115.3)*	274.5 *(425.5)*	***	12.5 *(32)*	49.4 *(169.2)*	***
Revenues [2]	11.8 *(21.6)*	39.0 *(58.8)*	***	1.1 *(2.2)*	3.8 *(9.2)*	***
Markup (log)	0.05 *(0.4)*	0.10 *(0.4)*	***	0.07 *(0.4)*	0.26 *(0.5)*	***
Wages [1]	31.0 *(15.1)*	49.4 *(18.2)*	***	12.3 *(20)*	27.1 *(37.9)*	***
Number of firms	21,191	825		22,053	627	

"The Best vs. the Rest"

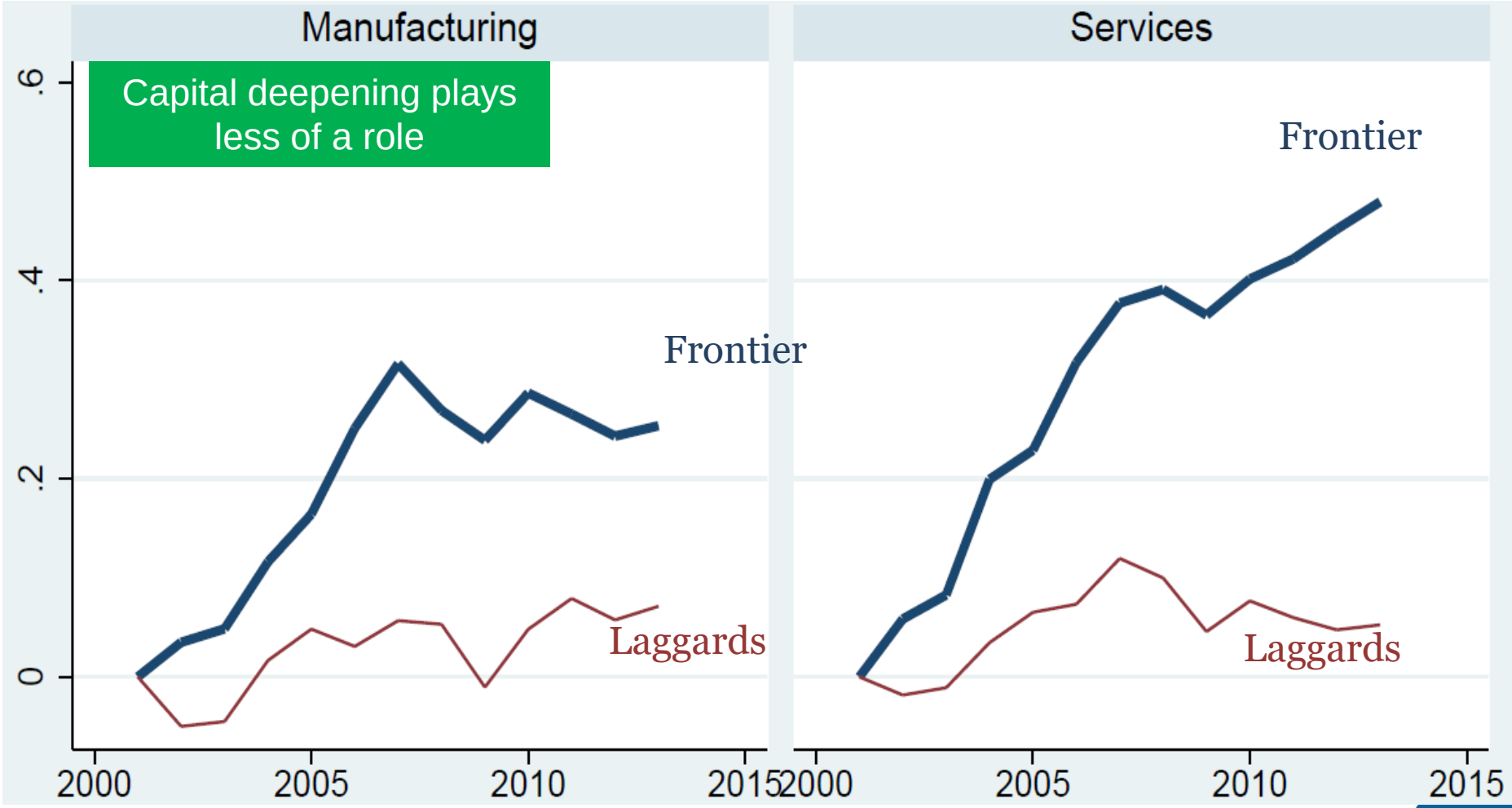
Rising labour productivity gap between global frontier and laggards

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



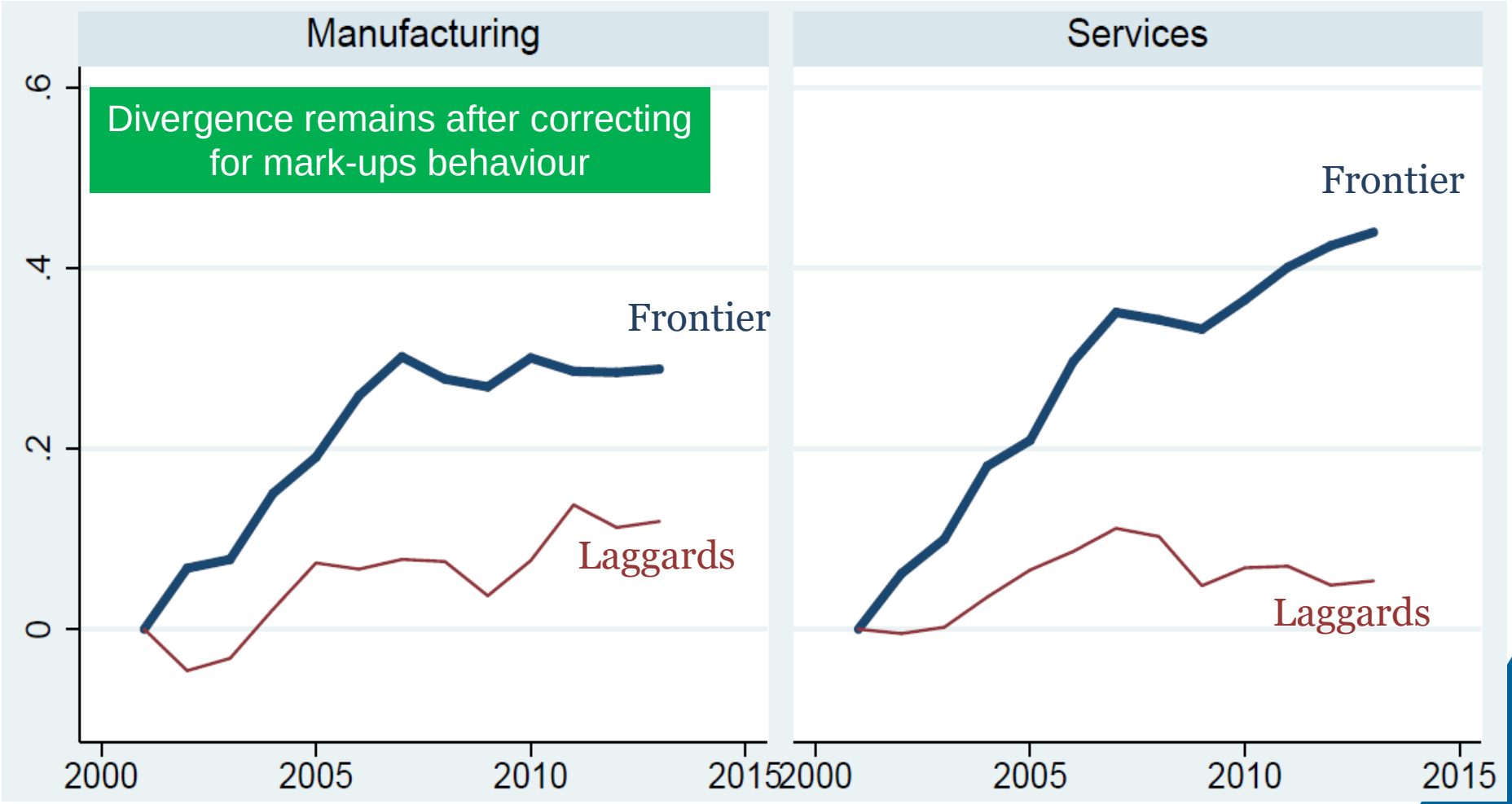
... largely reflects MFPR divergence

Average of MFPR (Wooldridge) across each 2-digit sector (log, 2001=0)



… which may reflect "technological" divergence

Average of mark-up adjusted MFPR across each 2-digit sector (log, 2001=0)



Productivity divergence robust to…

- Different MFP measures and mark-up corrections
- Frontier definition (Top 100, Top 10%)
- More **narrowly defined** industries (3 and 4 digit)
- Retaining only **groups** (consolidated) and **standalone** firms
- Comparing frontier with official **industry aggregates**
- Longer period using industry-level data: increased divergence from the early 2000s compared to 1985-2000

PRODUCTIVITY DIVERGENCE WITHIN COUNTRIES

FINDINGS & IMPLICATIONS FOR WAGES

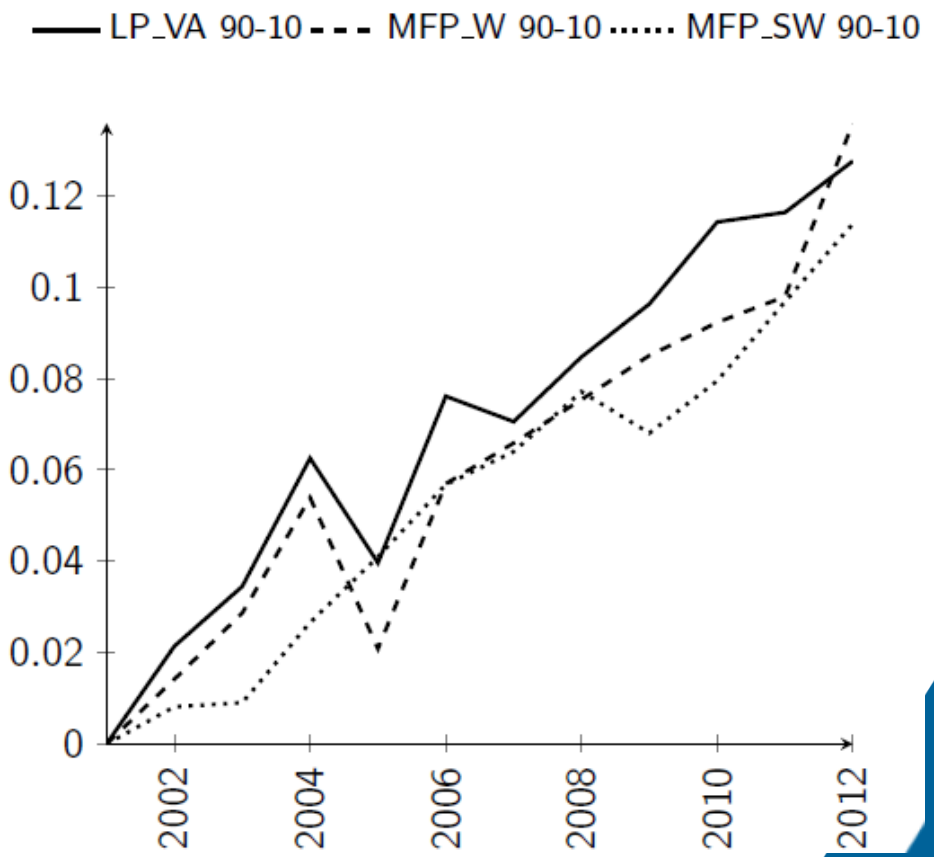
Robust divergence within countries too

Look at productivity dispersion *within* 2-digit sectors by estimating :

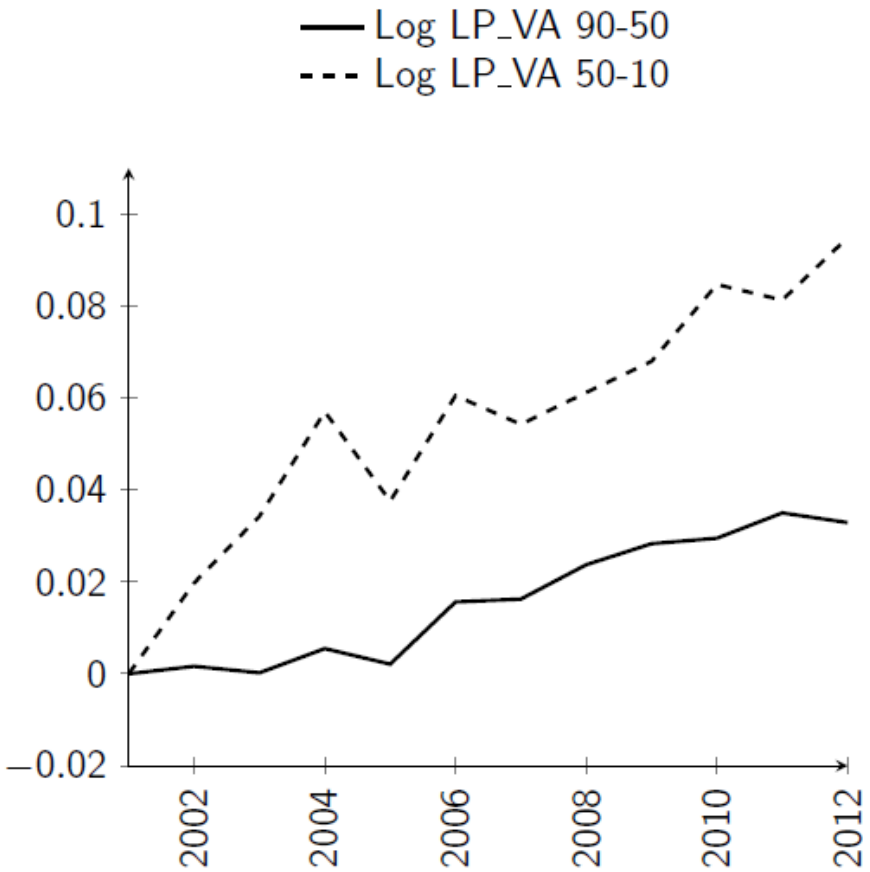
$$\log\left(\frac{P^{90}}{P^{10}}\right)_{cjt} = \alpha + \beta_t \boldsymbol{y}_t + \boldsymbol{z}_{cj} + \varepsilon_{cjt}$$

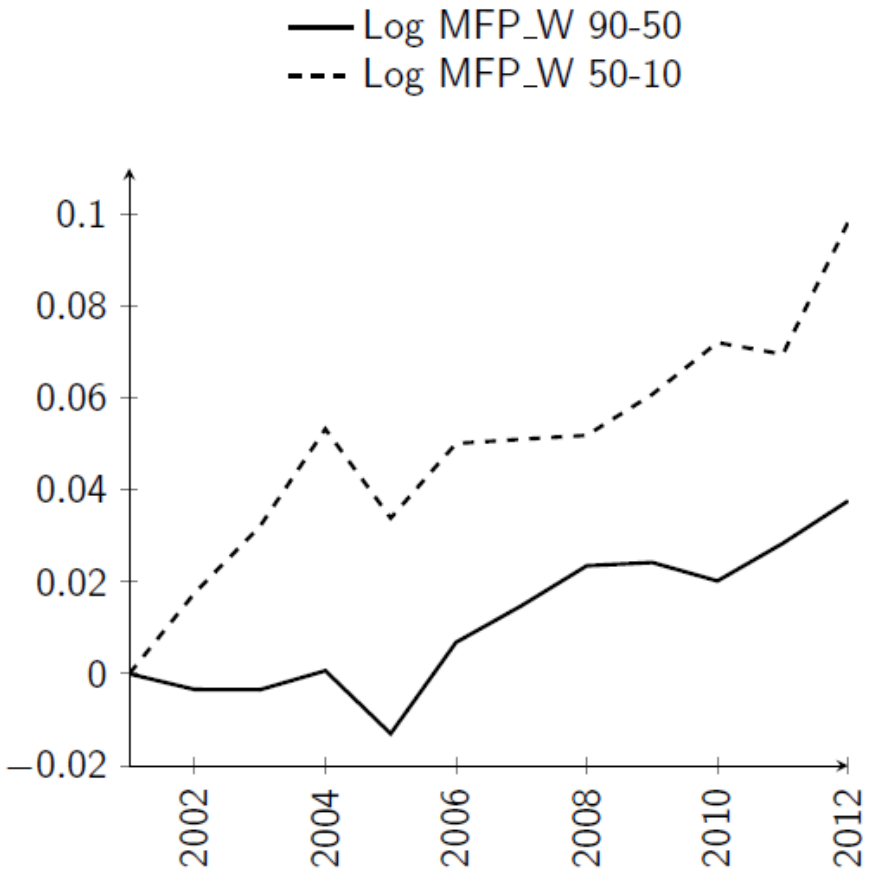
Results:

- Estimated β_t are increasing over time, for all three measures of productivity
- “Great Divergence” of productivity
- Heterogeneity across countries and sectors



…especially at the bottom of the distribution





Year fixed-effects of a regression of log-LP_VA and log-MFP_W dispersion, within country-sector pairs.

Within-industry wage dispersion increases, too…

Look at evolution of dispersion *within* 2-digit sectors by estimating

$$\log\left(\frac{W^{90}}{W^{10}}\right)_{cjt} = \alpha + \beta_t \boldsymbol{y}_t + \boldsymbol{z}_{cj} + \varepsilon_{cjt}$$

Rationale: most of the variance comes from within sectors

Results:

- Estimated β_t are increasing over time
- "Great Divergence" of wages
- Heterogeneity across countries

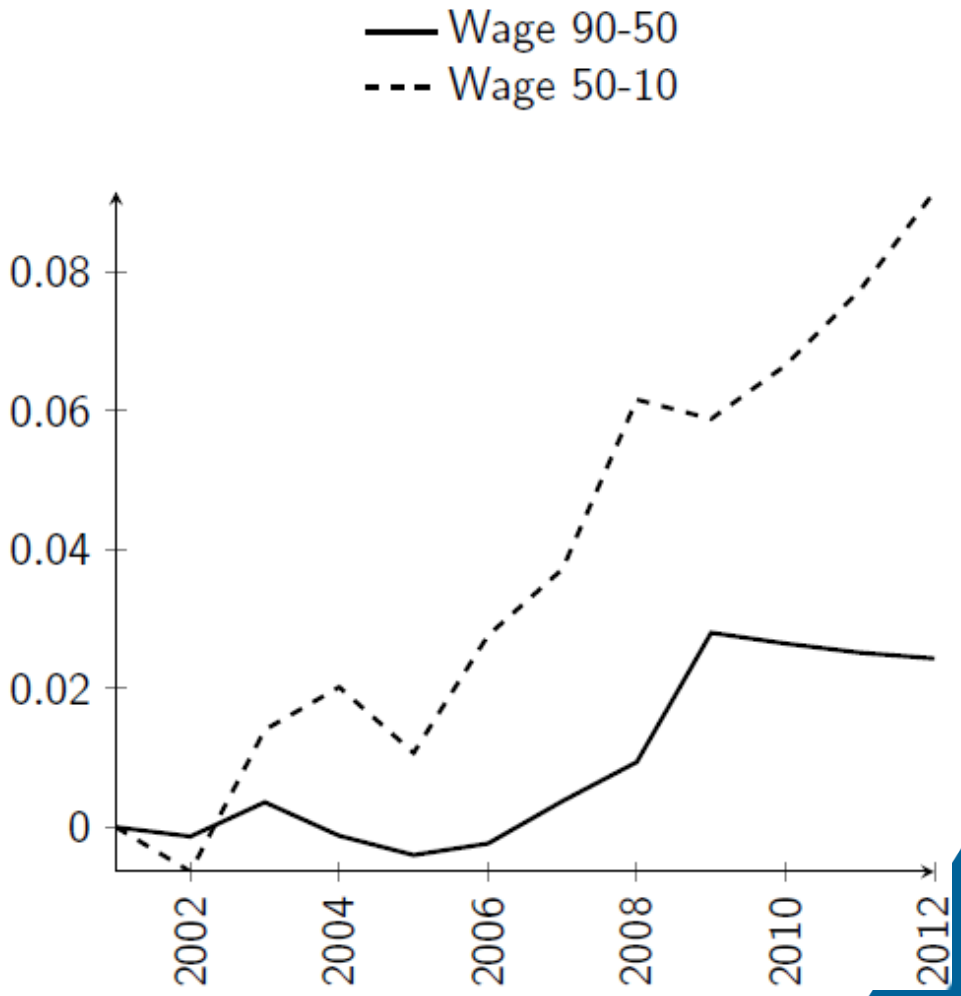
…driven by the bottom of the distribution, too…

Compare year fixed effects for divergence at:

- Top (90-50 wage ratio)
- Bottom (50-10 wage ratio) of wage distribution

Result:

- Divergence more pronounced for the bottom half of the wage distribution



Between-firm wage and productivity divergences are significantly related

	(1) Log Wage (90-10)	(2) Log Wage (90-10)	(3) Log Wage (90-10)
Log LP (90-10)	0.358***		
	(0.019)		
Log MFP_W (90-10)		0.224***	
		(0.016)	
Log MFP_SW (90-10)			0.047***
			(0.014)
N.	3,739	3,624	3,712
Adjusted R-square	0.988	0.988	0.988
Year FE	YES	YES	YES
Country-sector FE	YES	YES	YES
Nb. Sectors	22	22	22
Nb. Countries	14	14	14

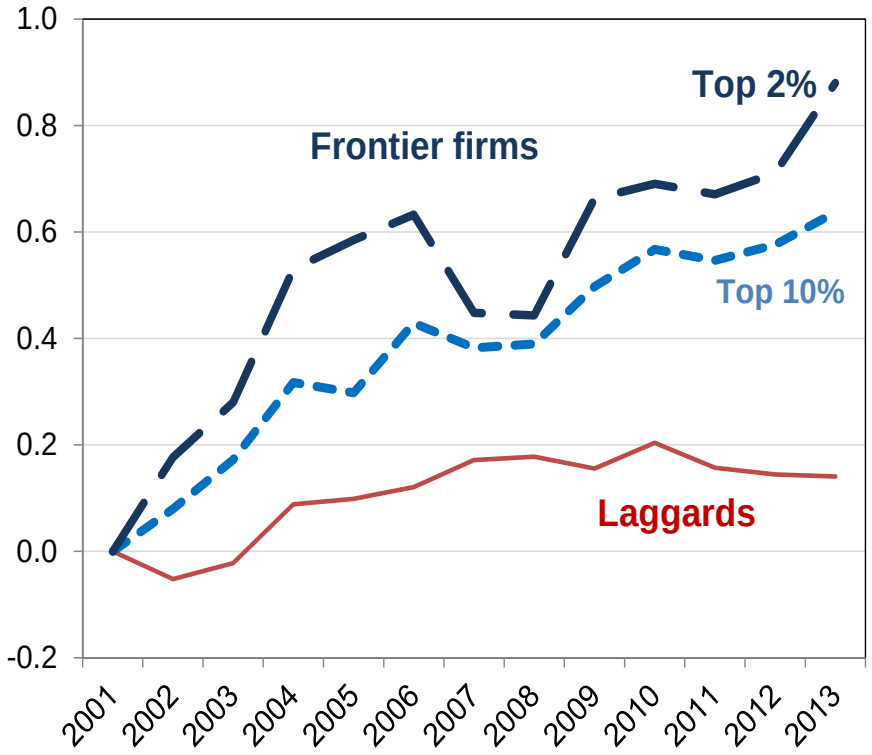
Standardized beta coefficients; standard errors in parentheses. Countries: AUS, AUT, BEL, CHL, DNK, FIN, FRA, HUN, ITA, JPN, NLD, NOR, NZL, SWE. *** p<0.01, ** p<0.05, * p<0.1.

PRODUCTIVITY DIVERGENCE: *STRUCTURAL DRIVERS*

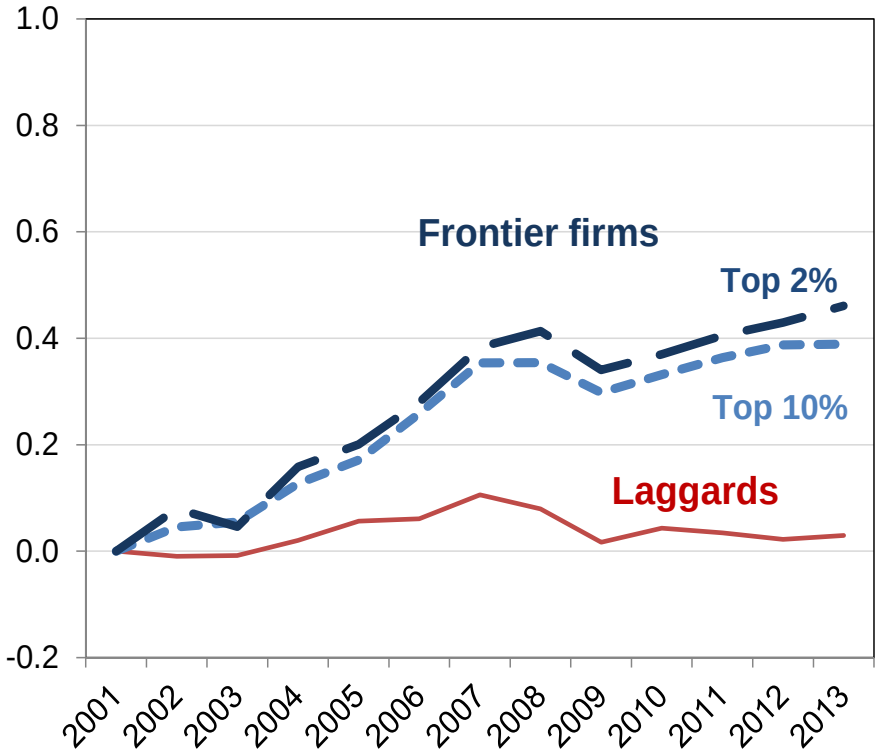
Technological divergence: *winner takes all dynamics?*

MFPR divergence

ICT-intensive services



Non ICT-intensive services

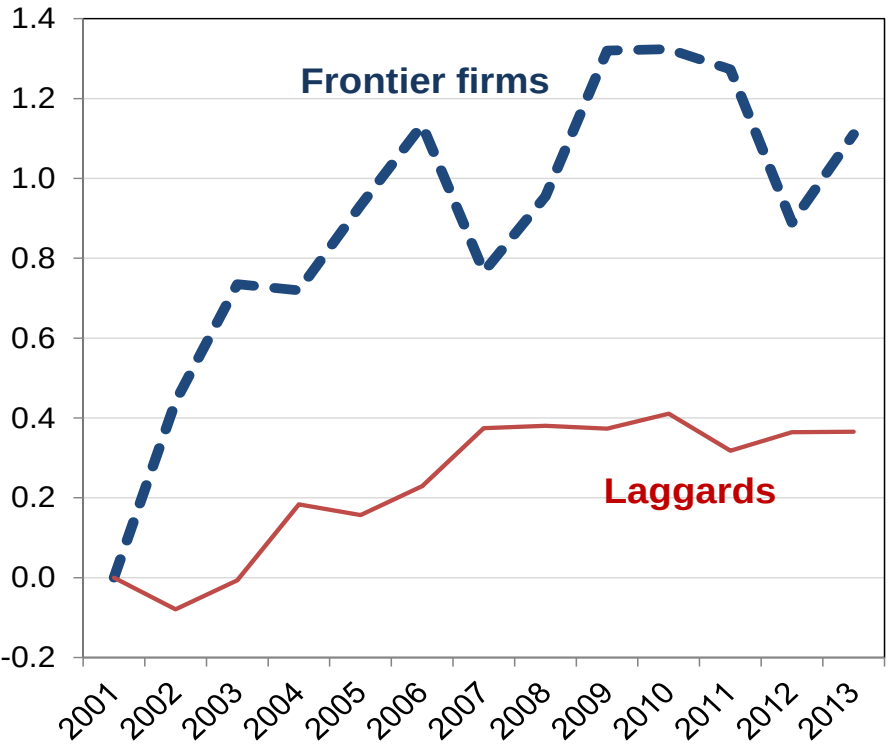


Further recent evidence: more intensive digital technology adoption at sector level (measured by Eurostat) is associated with stronger productivity growth at the top of the distribution *(Gal et al, forthcoming; Sorbe et al, forthcoming)*

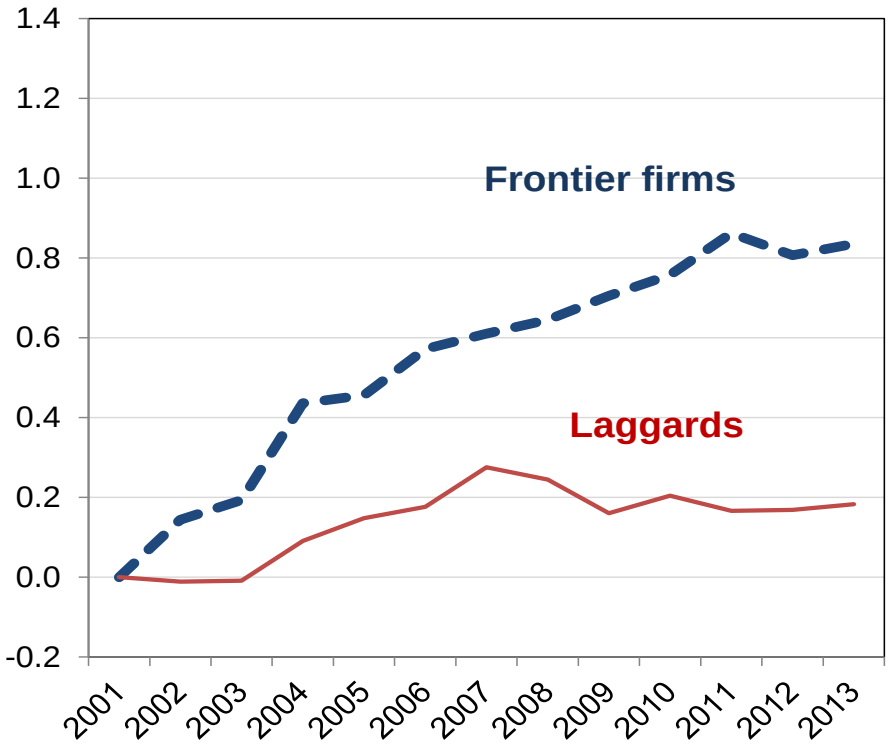
Technological divergence: *winner takes all dynamics?*

Sales divergence

ICT-intensive services



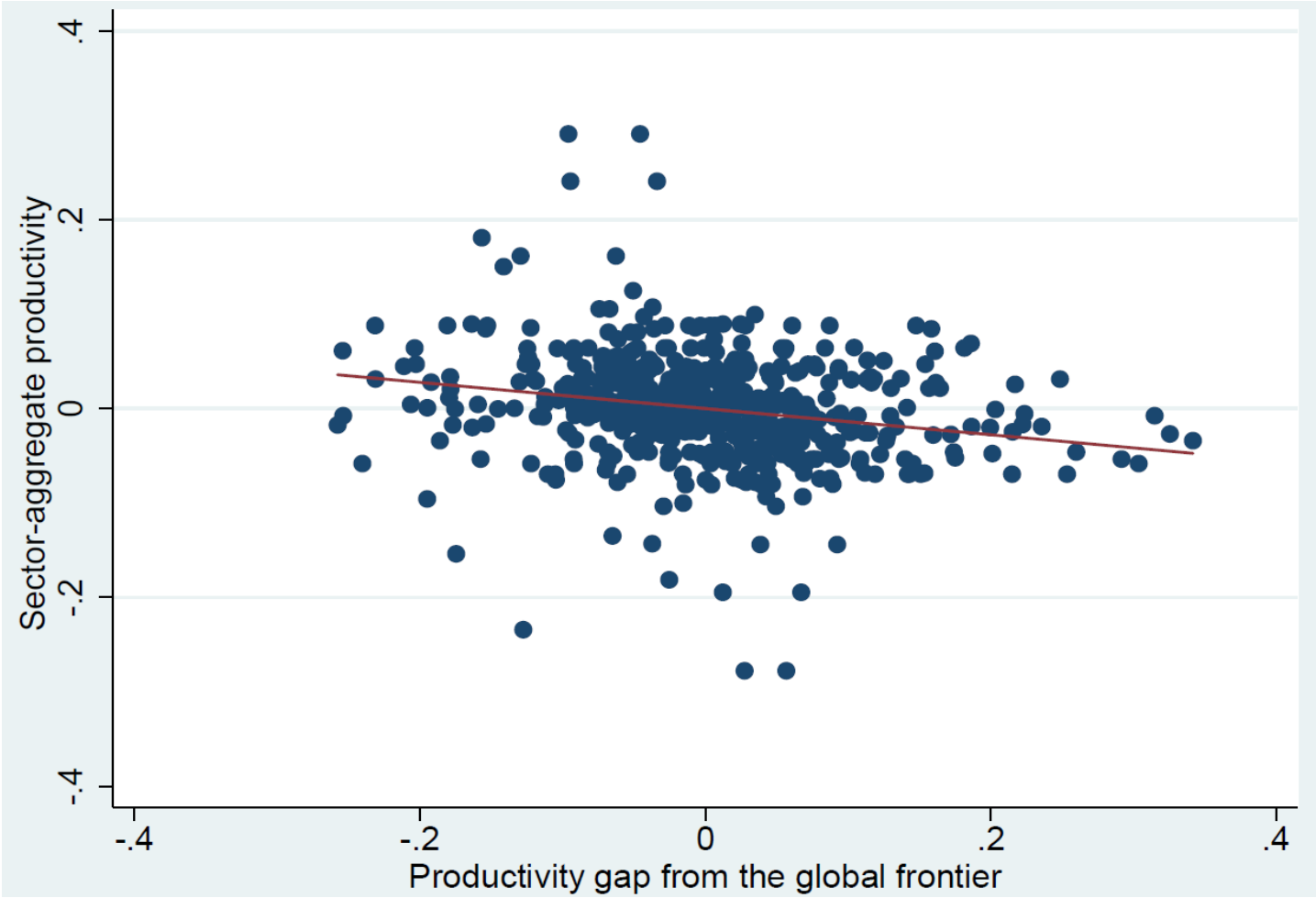
Non ICT-intensive services



Higher MFPR divergence, weaker aggregate MFP performance

Residual aggregate MFP and the MFPR gap at the industry level; 1998-2007

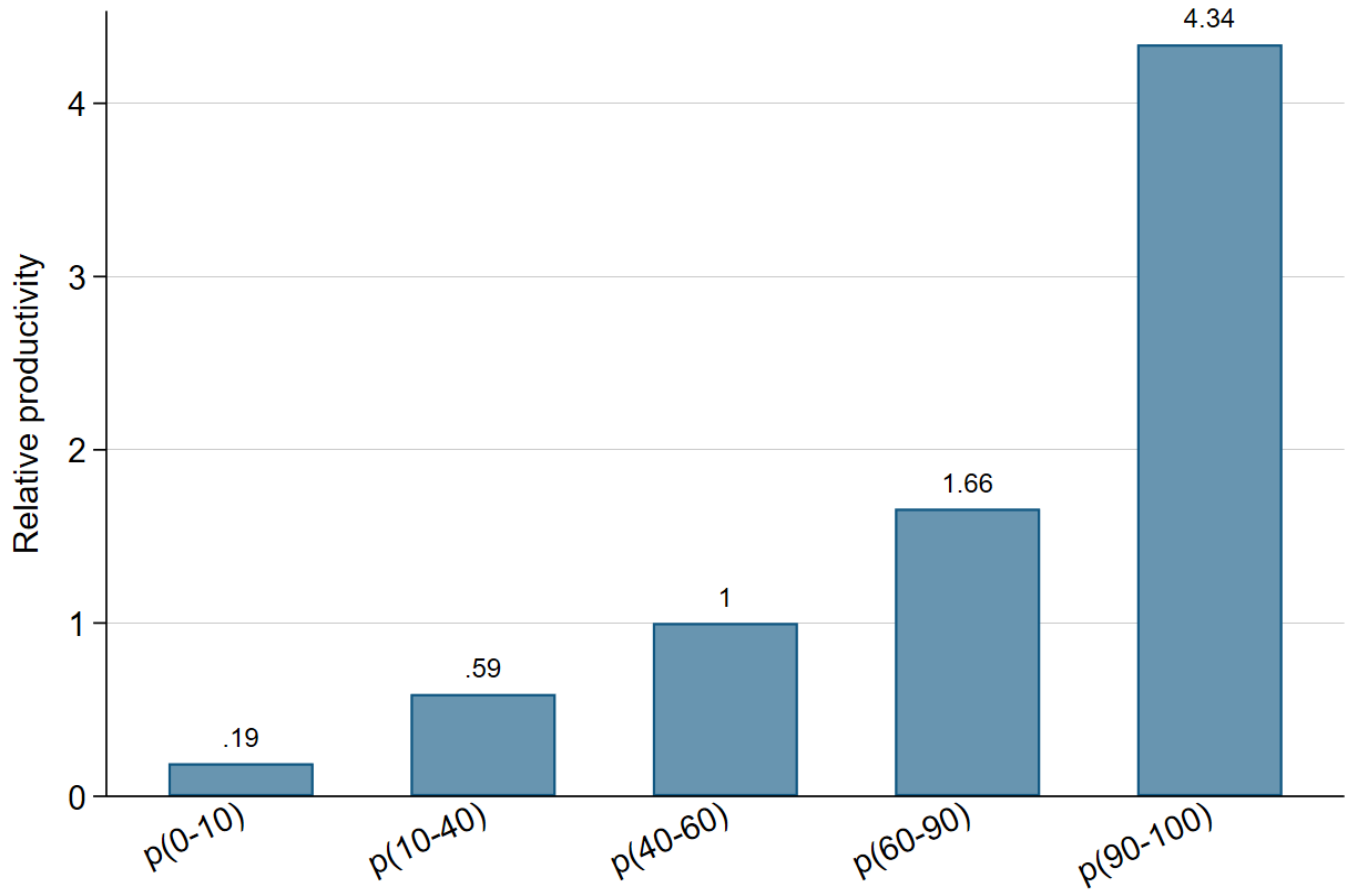
Data averaged across 12 OECD countries and purged of industry and year fixed effects



Source: EU KLEMS and authors calculations based on ORBIS data

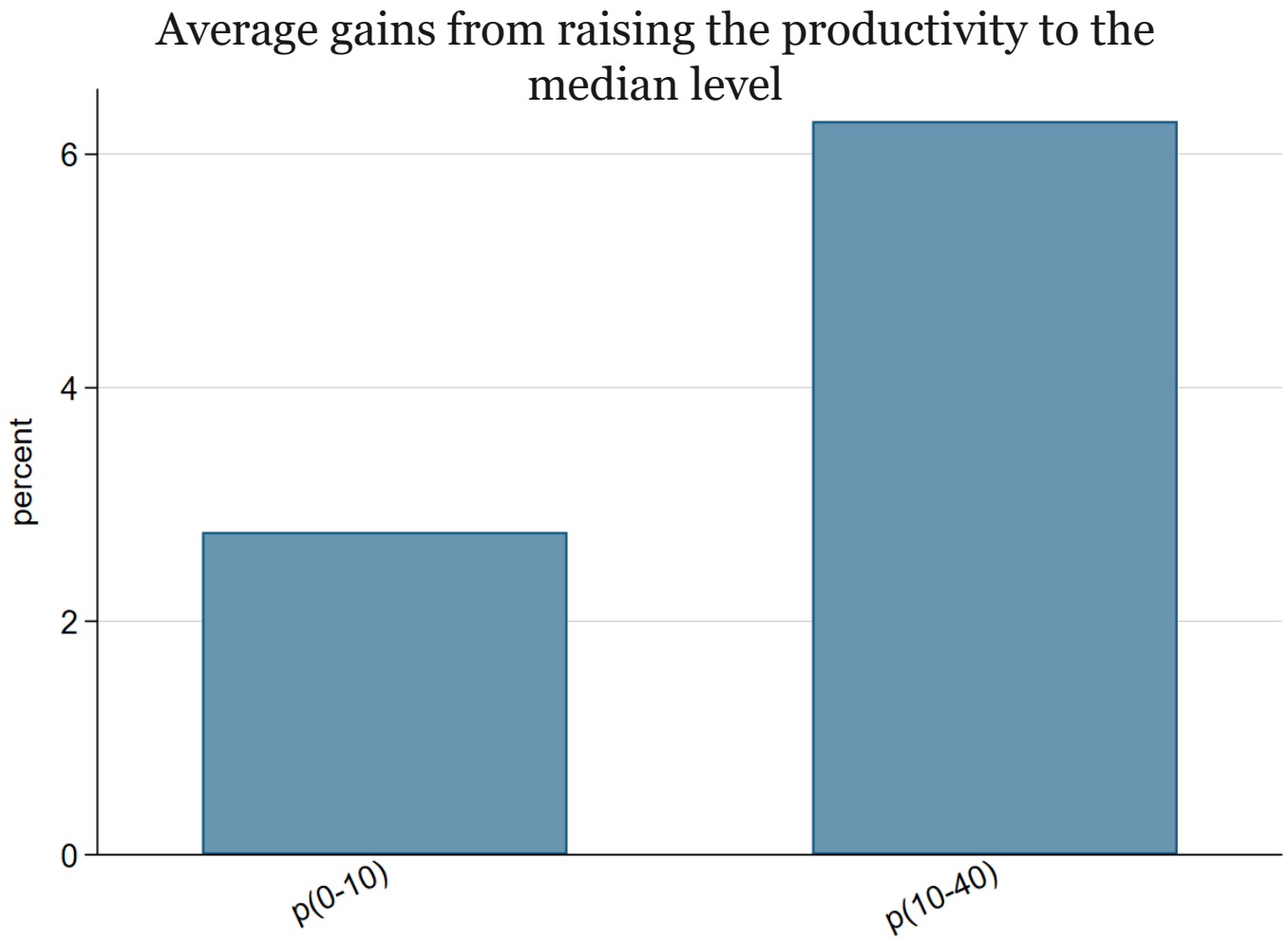
Why? (1)
Problems at the ***bottom***: low productivity

Average productivity by productivity (LP) groups relative to the median



Note: Manufacturing and non-financial market services only. Countries included: AUS, AUT, BEL, CAN, CHL, FIN, FRA, HUN, IRL, ITA, NOR, PRT, SWE.

…hence there are sizeable gains from bringing them up to the median



Note: The figure plots average gains hypothetically achievable by raising productivity in each bin of bottom of the productivity distribution to the median level. Manufacturing and non-financial market services only. Countries included: AUS, AUT, BEL, CAN, CHL, FIN, FRA, HUN, IRL, ITA, NOR, PRT, SWE.

Neo-Schumpeterian convergence framework

- Regression framework; see
  - Country level: Aghion & Howitt (2006), Acemoglu et al. (2006)
  - Industry level: Nicoletti & Scarpetta (2003), Saia et al. (2015)
  - Firm level: Griffith et al. (2004), Bartelsman et al. (2008), Andrews et al. (2015, 2016)

- Empirical model

$$\Delta P_{cjq,t+5} = \beta_1 + \beta_2 gap_{cjq,t} + \beta_3 (gap_{cjq,t} \times X_{cj(q),t}) + \beta_4 X_{cj(q),t} + \\ + \beta_5 \Delta P^F_{cjq,t+5} + \delta_{cjq} + \tau_t + \varepsilon_{cjq,t+5},$$

where

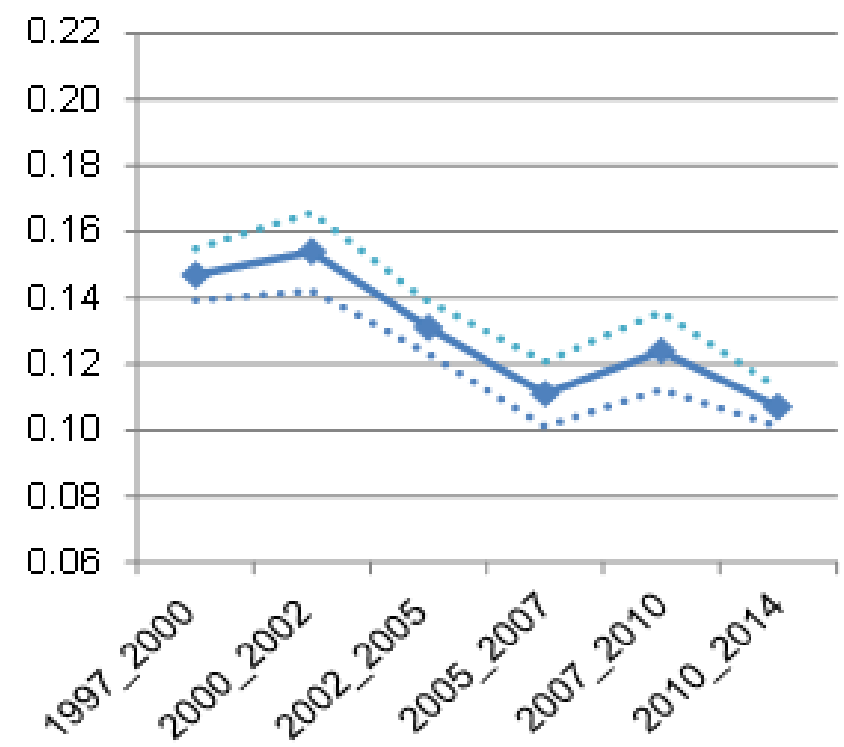
- $\Delta Pcjq,t+5$ is the 5-year annualized (log) LP growth of laggards at time t in country c, ind j, productivity group q
- ΔP^Fcjq,t+5 is the 5-year (log) LP growth of firms at the national $gap_{cjq,t}$ is the productivity gap at time t
- $X_{cj\ (q),t}$ includes reflects structural factors, policies, and firms' characteristics
- δ_{cjq} are country-industry-productivity performance fixed effects, and τ_t are year fixed effects

The speed of convergence to the frontier slowed, even before the crisis

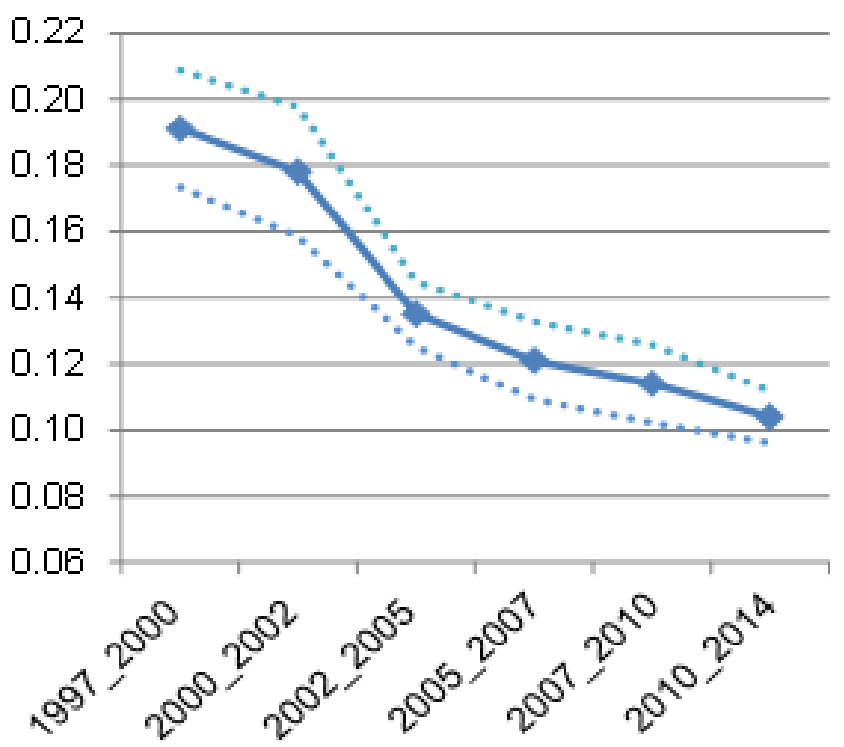
Estimated convergence parameter from a neo-Schumpeterian model

Dotted line: 95% confidence intervals

A: MFPR



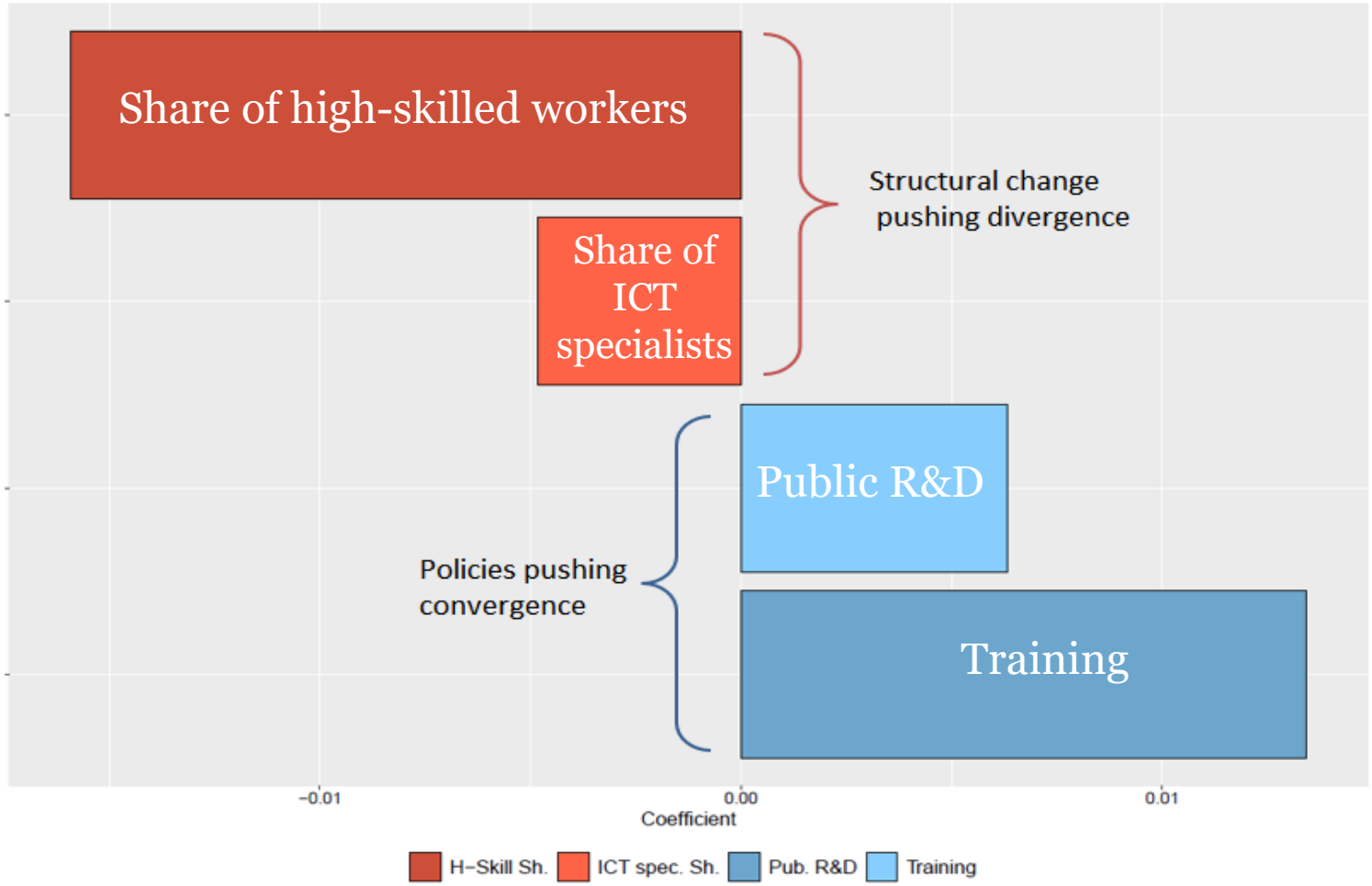
B: Mark-up adjusted MFPR



$$\Delta \ln A_{icst} = \delta_1 \Delta \ln A_{Fcst} + \delta_2 gap_{icst-1} + \sum_j \delta_3^j gap_{icst-1} * D_t^j + \sum_j \delta_4^j X_{isct}^j + \delta_s + \delta_{ct} + \varepsilon_{icst}$$

Structural changes push divergence, but some policies help convergence

Structural factors and policy determinants of catch-up



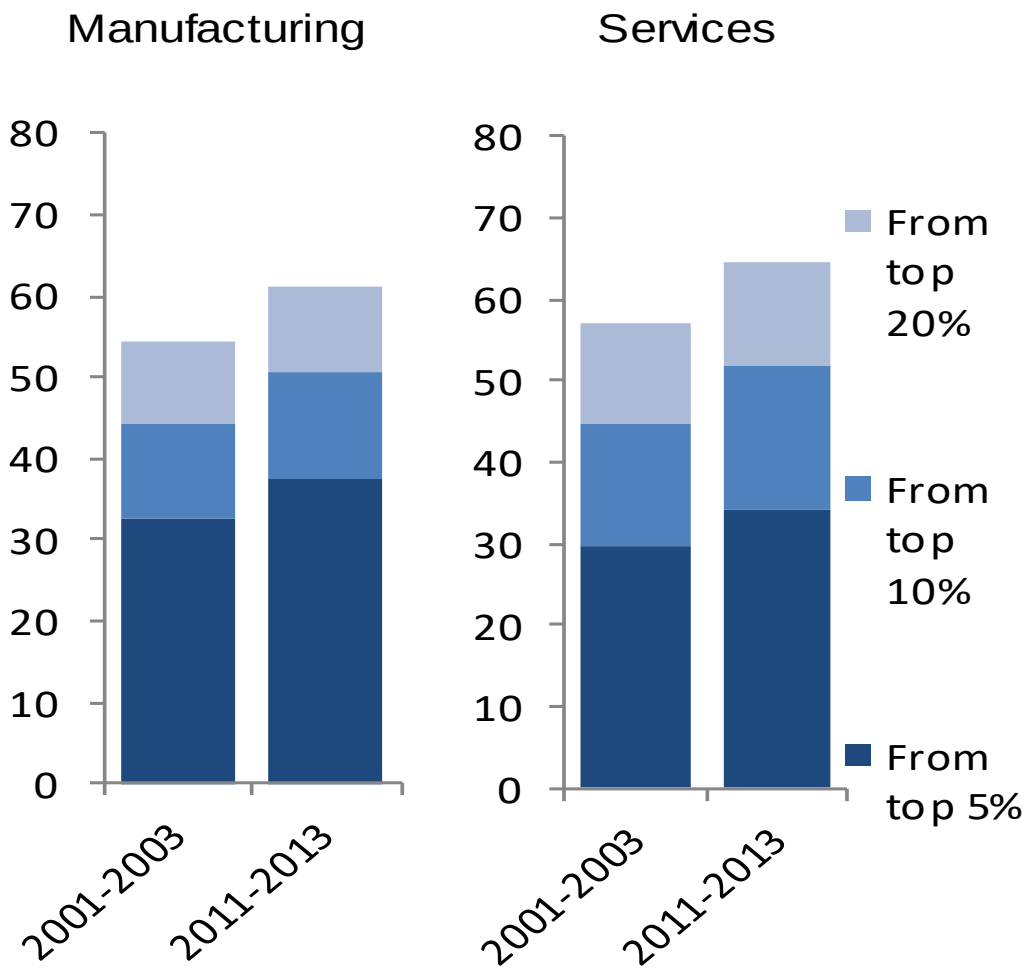
Note: The figure plots the effect of each of the following variables on laggards' catch-up: share of hours worked by high skill workers, share of ICT specialists, public R&D expenditures, training expenditures. Each bar represents the estimate of the coefficient for the distance of laggards from the national frontier (productivity gap) interacted with each structural

Why? (2)

Problems ***at the top***?

Entry to the frontier has become more entrenched amongst top firms

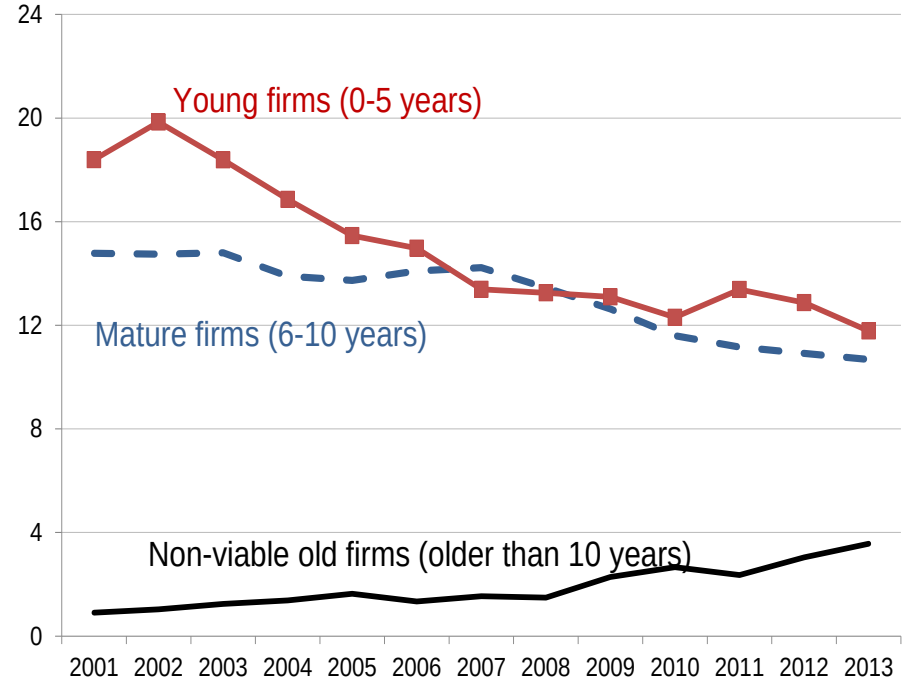
Proportion of frontier firms in time *t* according to their frontier status in *t-2*



Technological divergence: *is declining market contestability an issue?*

Share of firms

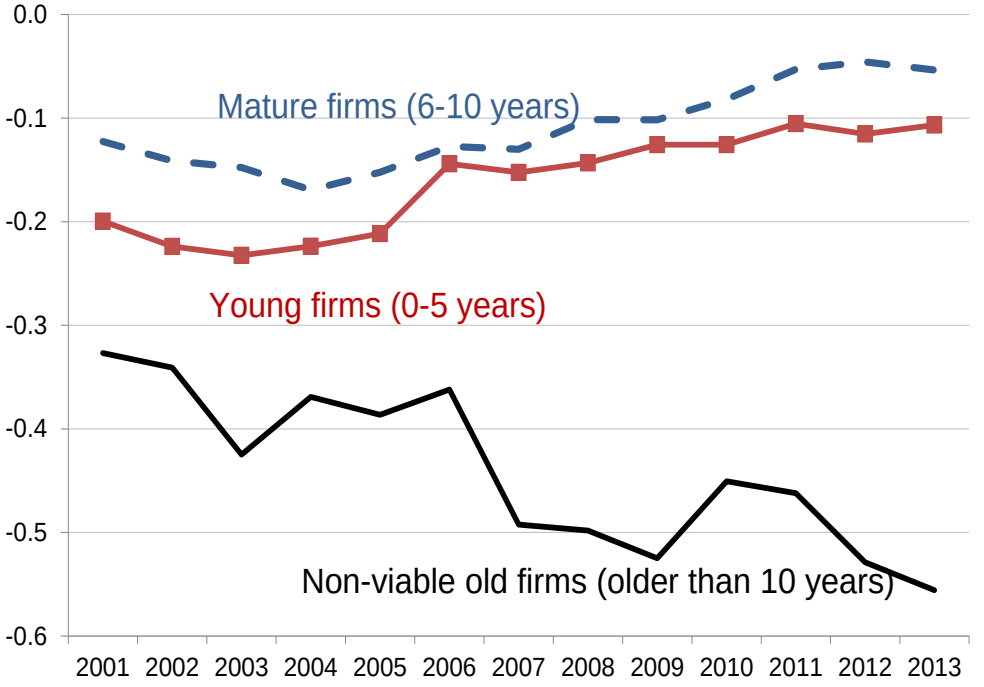
Percent



Declining firm turnover: fewer young firms, while marginal firms increasingly survive.

MFPR relative to viable old firms

Log point differential



A higher productivity threshold for entry, while marginal firms survive despite a collapse in their MFPR

Notes: Non-viable old firms are those older than 10 years that record negative profits over at least two consecutive years. The omitted group are firms older than 10 years that do not record negative profits over at least two consecutive years (viable old firms).

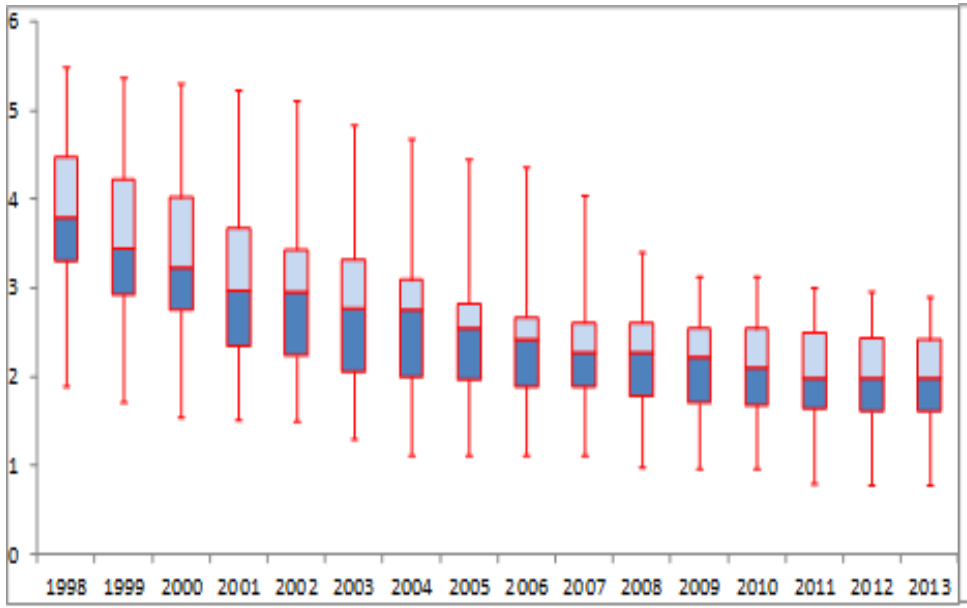
PRODUCTIVITY DIVERGENCE:

ZOOMING IN ON REGULATORY POLICY

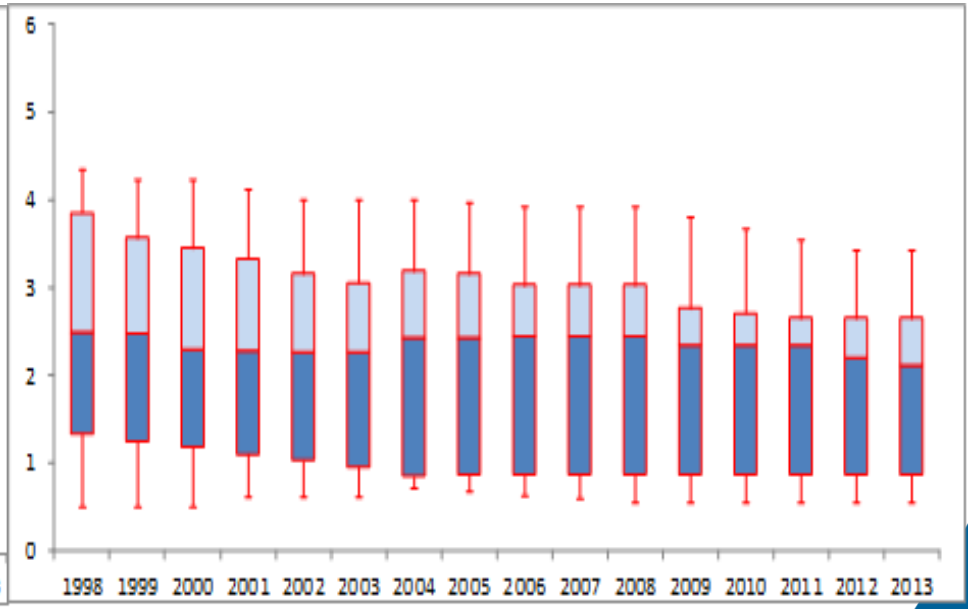
The pace of deregulation in services has slowed

The restrictiveness of product market regulations

A: Network industries



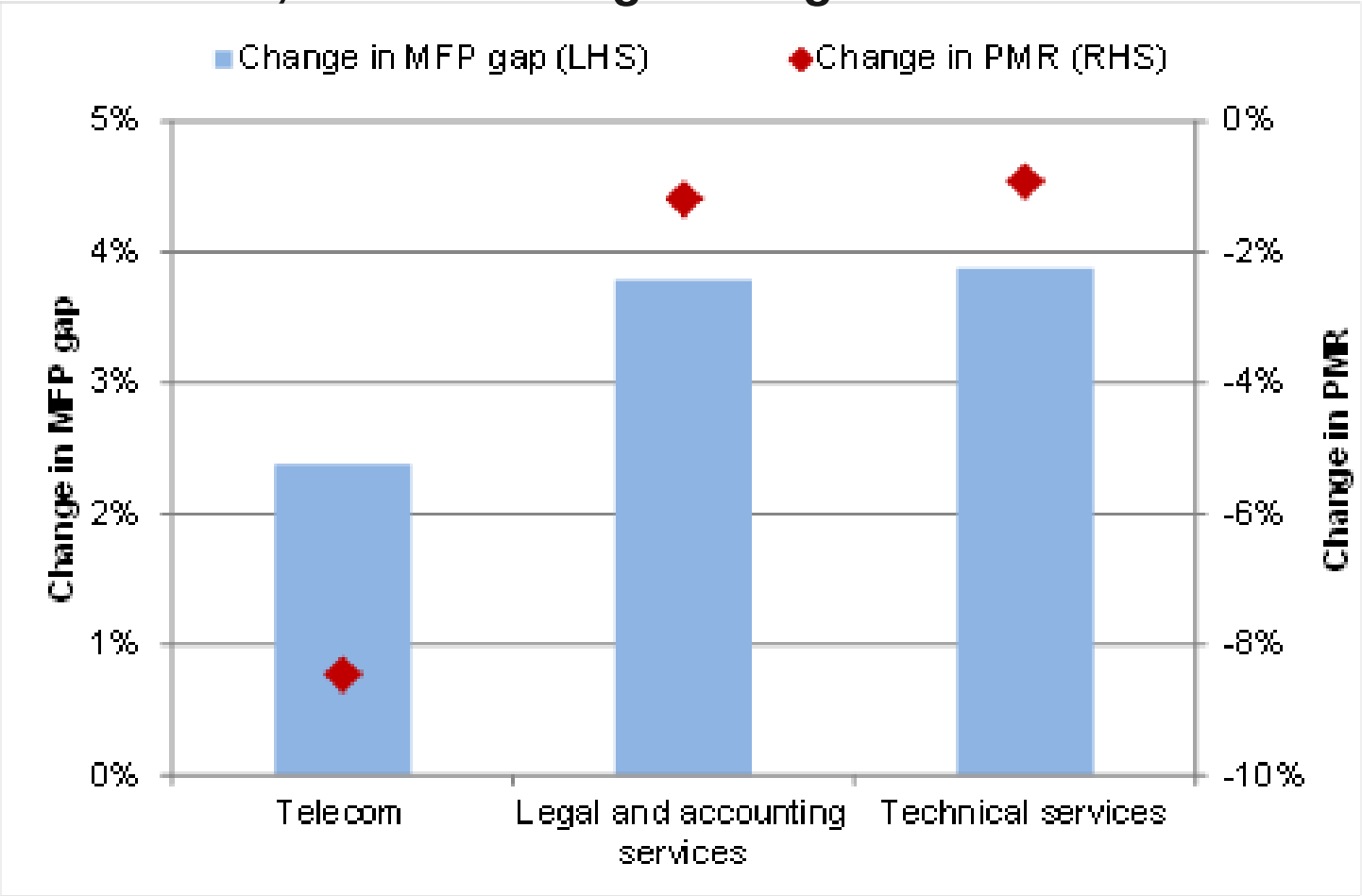
B: Professional Services



Notes: The horizontal line in the boxes represents the median, the upper and lower edges of each boxes reflect the 25th and 75th percentiles and the markers on the extremes denote the maximum and the minimum across countries.

Slower product market reform: a larger increase in the gap

Selected industries; annual average change over time and across countries



Note: The figure shows the annual change in the (log) MFPR gap between the frontier and laggard firms and the change in the (log) PMR indicator. Technical services refer to architecture and engineering.

Slower product market reform: a larger increase in the gap

Empirical approach: country x industry x year level regressions

1. Long differences

$$\Delta^{ld} MFPgap_{s,c,t} = \beta_0 + \beta_1 \Delta^{ld} PMR_{s,c,t} + \beta_2 \Delta^{ld} E_{s,c,t} + \delta_c + \delta_s + \delta_t + \varepsilon_{s,c,t}$$

2. Dynamic OLS (Stock and Watson, 1993)

$$MFPgap_{s,c,t} = \beta_0 + \beta_1 PMR_{s,c,t} + \beta_2 E_{s,c,t} + \sum_{t+k,t-k} \Delta X^{j}_{c,s,t} + \delta_{ct} + \delta_{st} + \delta_{cs} + \varepsilon_{s,c,t}$$

3. Instrumental variables:
   "Reform pressure" or "reform waves"

Slower product market reform: a larger increase in the gap

MFP divergence and product market regulation in services

Estimation method – five-year long differences; 1998-2013

	Y: Δ MFP gap		Y: Δ Mark-up corrected MFP gap	
	(1)	(2)	(3)	(4)
Δ Product Market Regulation$_{s,c,t}$	0.205***	0.231***	0.332***	0.311**
	(0.065)	(0.083)	(0.103)	(0.132)
Country fixed effects	YES	NO	YES	NO
Industry fixed effects	YES	YES	YES	YES
Year fixed effects	YES	NO	YES	NO
Country X year fixed effects	NO	YES	NO	YES
Observations	458	458	376	376
R-squared	0.201	0.323	0.327	0.463

Notes: Cluster robust standard errors (at the industry-year level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Both the MFP gap and the PMR indicator are measured in log terms. The MFP gap is calculated at the country-industry-year level, by taking the difference between the global frontier and the average of log productivity of non-frontier firms.

Slower product market reform: a larger increase in the gap

MFP divergence and product market regulation in services

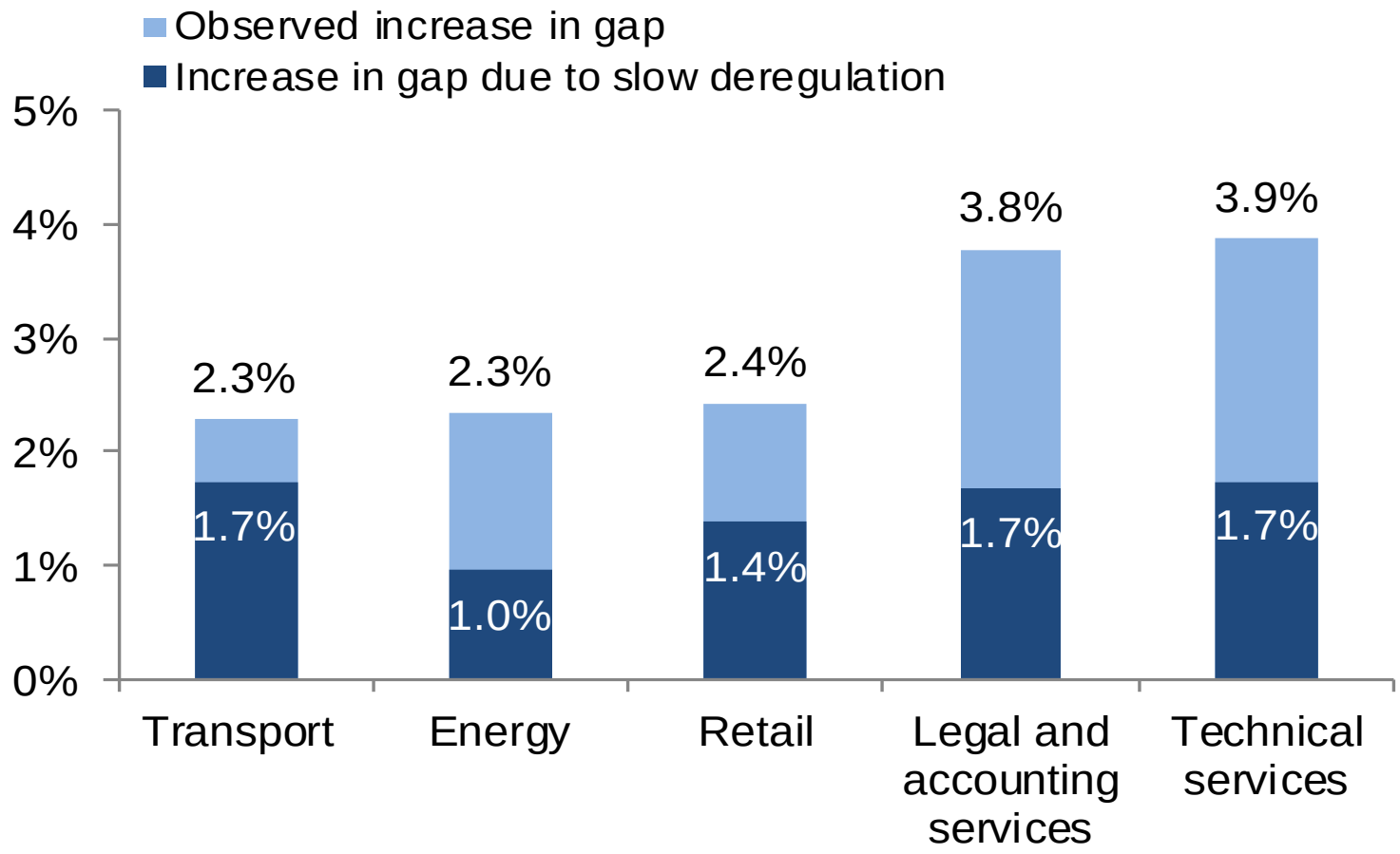
Estimation method – IV; 1998-2013

	"Reform pressure"		"Reform waves"	
Δ Product Market Regulation$_{s,c,t}$	0.326**	0.338*	0.569***	0.676***
	(0.163)	(0.194)	(0.189)	(0.179)
Country fixed effects	YES	NO	YES	NO
Industry fixed effects	YES	YES	YES	YES
Year fixed effects	YES	NO	YES	NO
Country X year fixed effects	NO	YES	NO	YES
Observations	458	458	458	458
R-squared	0.193	0.318	0.125	0.235

Notes: Cluster robust standard errors (at the industry-year level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1 Both the MFP gap and the PMR indicator are measured in log terms. The MFP gap is calculated at the country-industry-year level, by taking the difference between the global frontier and the average of log productivity of non-frontier firms.

Sluggish market reform effort in services amplified MFP divergence

Estimated contribution to the annual change in the MFP gap of the slower pace of reform relative to the fastest reforming industry (telecoms)



MFP divergence was perhaps inevitable due to structural changes in the global economy but policy could have worked harder

Summary and some conjectures

- The slowdown in aggregate productivity growth masks an **increasing divergence** between GF and laggard firms:
  - Structural trends in the global economy unleashed winner takes all dynamics and made adoption more difficult.
  - Thus, MFP divergence was partly inevitable but the policy framework didn't sufficiently adapt to these structural trends
  - Evidence of declining market contestability is a real worry
- What other factors may matter?
  - Role of digitalisation and network economies
  - Increasing benefits from agglomerations *(OECD, 2016, Regional Outlook; The Economist: Superstar Cities)*
  - Role of complementary factors (e.g. managerial quality, skills)
  - Intellectual property (patent) regimes need updating?
  - Lobbying blocking penetration of ICT and new business models in services

THANK YOU

Further questions: peter.gal@oecd.org

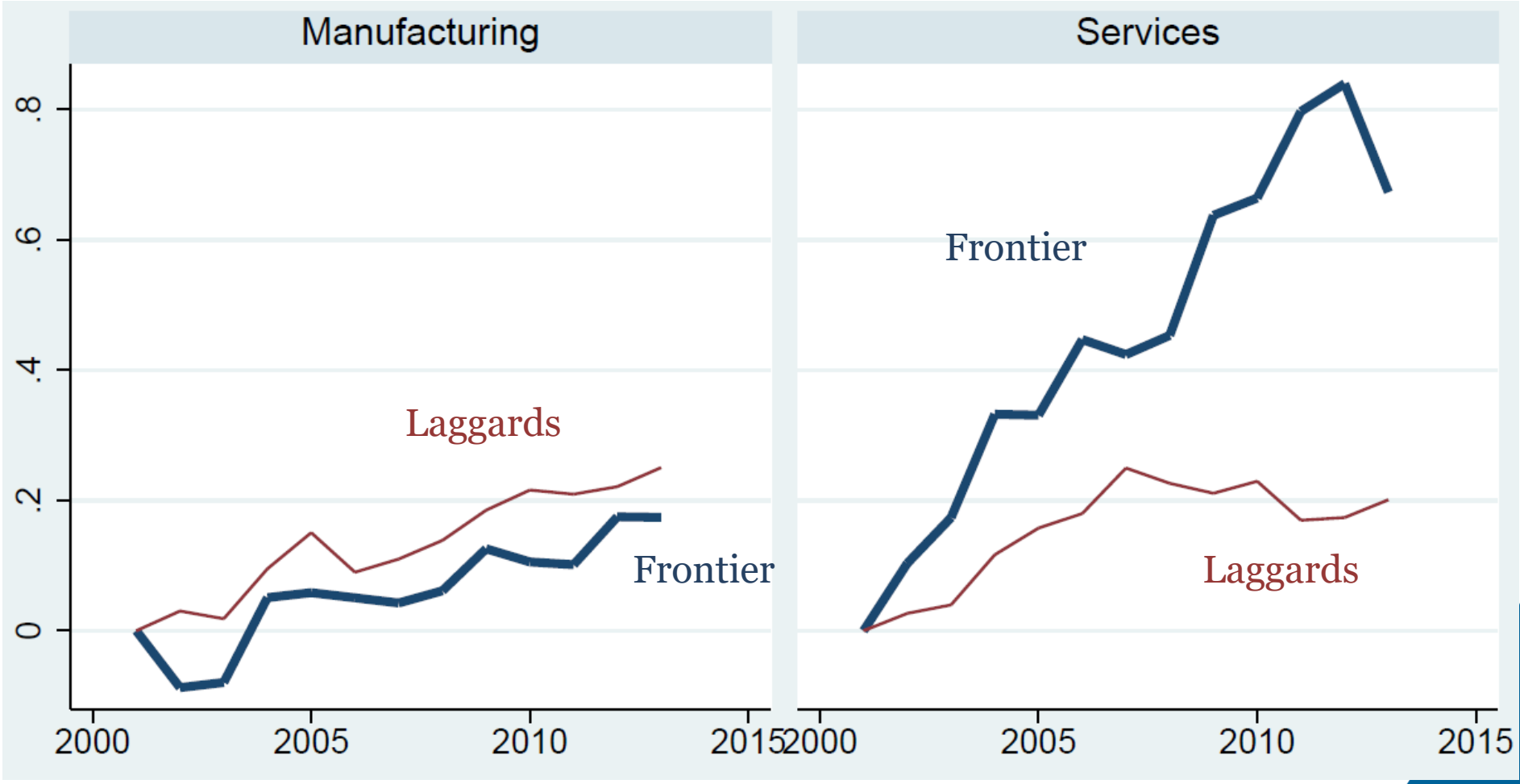
Further reading and background:

- 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, OECD Publishing, Paris, https://doi.org/10.1787/5jrql2q2jj7b-en.
- Andrews, D., C. Criscuolo and P. Gal (2016), "The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy", *OECD Productivity Working Papers*, No. 5, OECD Publishing, Paris, https://doi.org/10.1787/63629cc9-en.
- Berlingieri, G., P. Blanchenay and C. Criscuolo (2017), "The great divergence(s)", *OECD Science, Technology and Industry Policy Papers*, No. 39, OECD Publishing, Paris,https://doi.org/10.1787/953f3853-en.
- Berlingieri, G., S. Calligaris and C. Criscuolo (2018), "The productivity-wage premium: Does size still matter in a service economy?", *OECD Science, Technology and Industry Working Papers*, No. 2018/13, OECD Publishing, Paris, https://doi.org/10.1787/04e36c29-en.
- Andrews, D., G. Nicoletti and C. Timiliotis (2018), "Digital technology diffusion: A matter of capabilities, incentives or both?", *OECD Economics Department Working Papers*, No. 1476, OECD Publishing, Paris, https://doi.org/10.1787/7c542c16-en.
- Calligaris, S., C. Criscuolo and L. Marcolin (2018), "Mark-ups in the digital era", *OECD Science, Technology and Industry Working Papers*, No. 2018/10, OECD Publishing, Paris, http://dx.doi.org/10.1787/4efe2d25-en.
- Gal, P., G. Nicoletti, S. Sorbe, T. Renault, C Timiliotis,"Digitalisation and productivity: In search of the holy grail", *OECD Economics Department Working Papers*, forthcoming
- Sorbe, S. et al "Digital dividend: policies to harness the productivity potential of digital technologies", *OECD Economics Department Working Papers, forthcoming*
- Berlingieri, G. Calligaris, S., C. Criscuolo, R. Verlhac (2018), *Last but not least: laggard firms, technology diffusion and its structural and policy determinants*, OECD Directorate for Science, Technology and Innovation, *forthcoming*
- Bartelsman, E. J., J. C. Haltiwanger, and S. Scarpetta (2004): "Microeconomic evidence of creative destruction in industrial and developing countries," IZA Discussion Paper, No. 1374.

ADDITIONAL SLIDES

How much is divergence a capital deepening story?

Average capital deepening across each 2-digit sector (log, 2001=0)



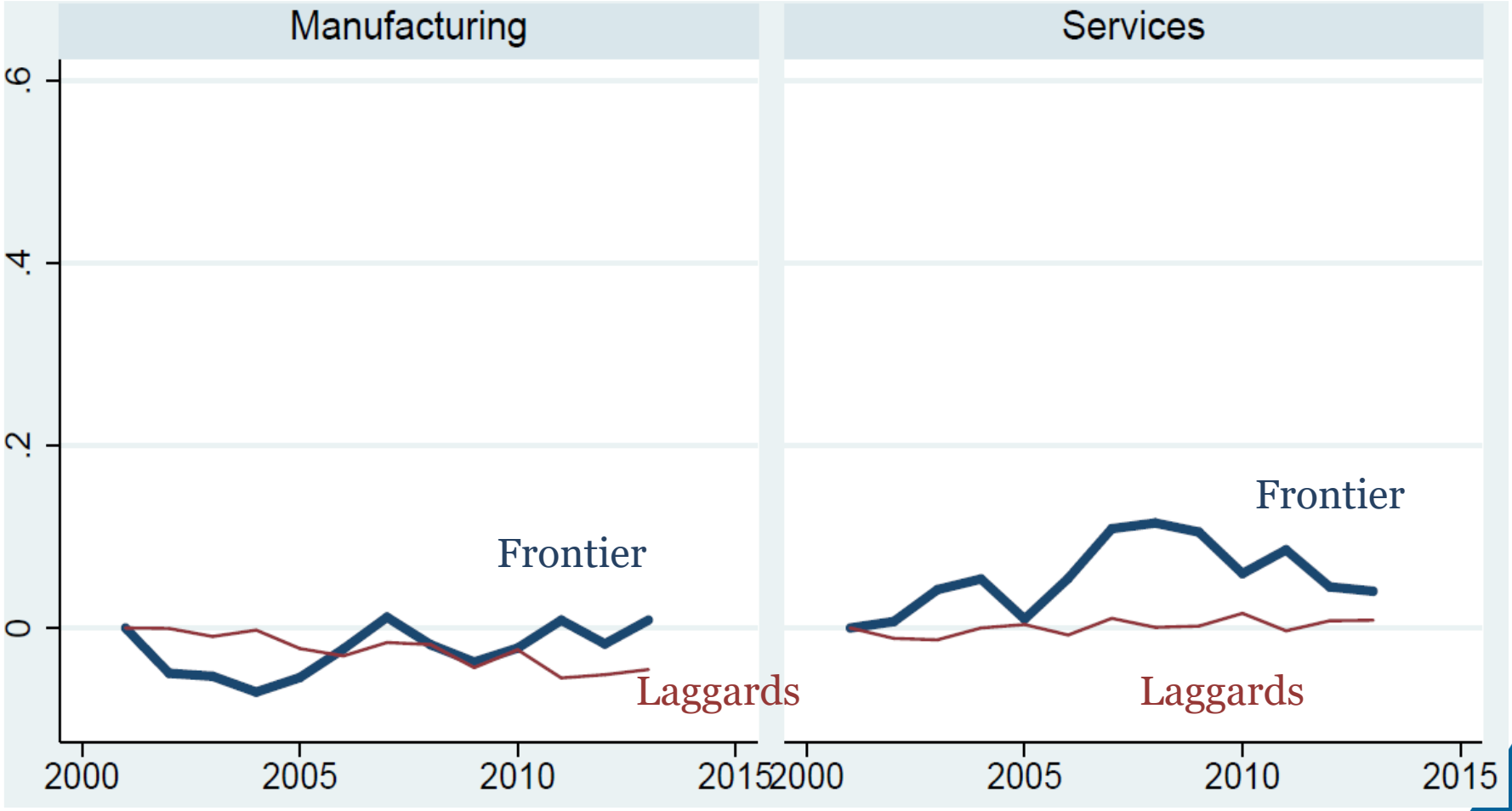
The globally most productive firms: *Who are they?*

MFP based frontier definition

Sector	Manufacturing			Services		
Frontier status	Below frontier	At the frontier		Below frontier	At the frontier	
Variable	Mean st.dev.	Mean st.dev.	Sign. diff.	Mean st.dev.	Mean st.dev.	Sign. diff.
Productivity	10.4 *(0.6)*	11.6 *(0.4)*	***	11.6 *(0.7)*	11.7 *(0.7)*	***
Employees	48.3 *(46.8)*	73.7 *(126)*	***	59.1 *(155.3)*	53.4 *(115.6)*	
Capital-labour ratio [1]	89.3 *(125.1)*	214.3 *(406)*	***	12.7 *(32.6)*	16.5 *(75.6)*	***
Revenues [2]	11.5 *(19.9)*	50.5 *(74.1)*	***	1.1 *(2.2)*	5.1 *(13.1)*	***
Markup (log)	0.05 *(0.4)*	0.04 *(0.4)*		0.07 *(0.4)*	0.20 *(0.5)*	***
Wages [1]	31.0 *(15.1)*	51.0 *(17.1)*	***	12.3 *(20)*	27.6 *(37.7)*	***
Number of firms	21,317	706		22,147	538	

Mark-ups for frontier firms has grown in services but not in manufacturing

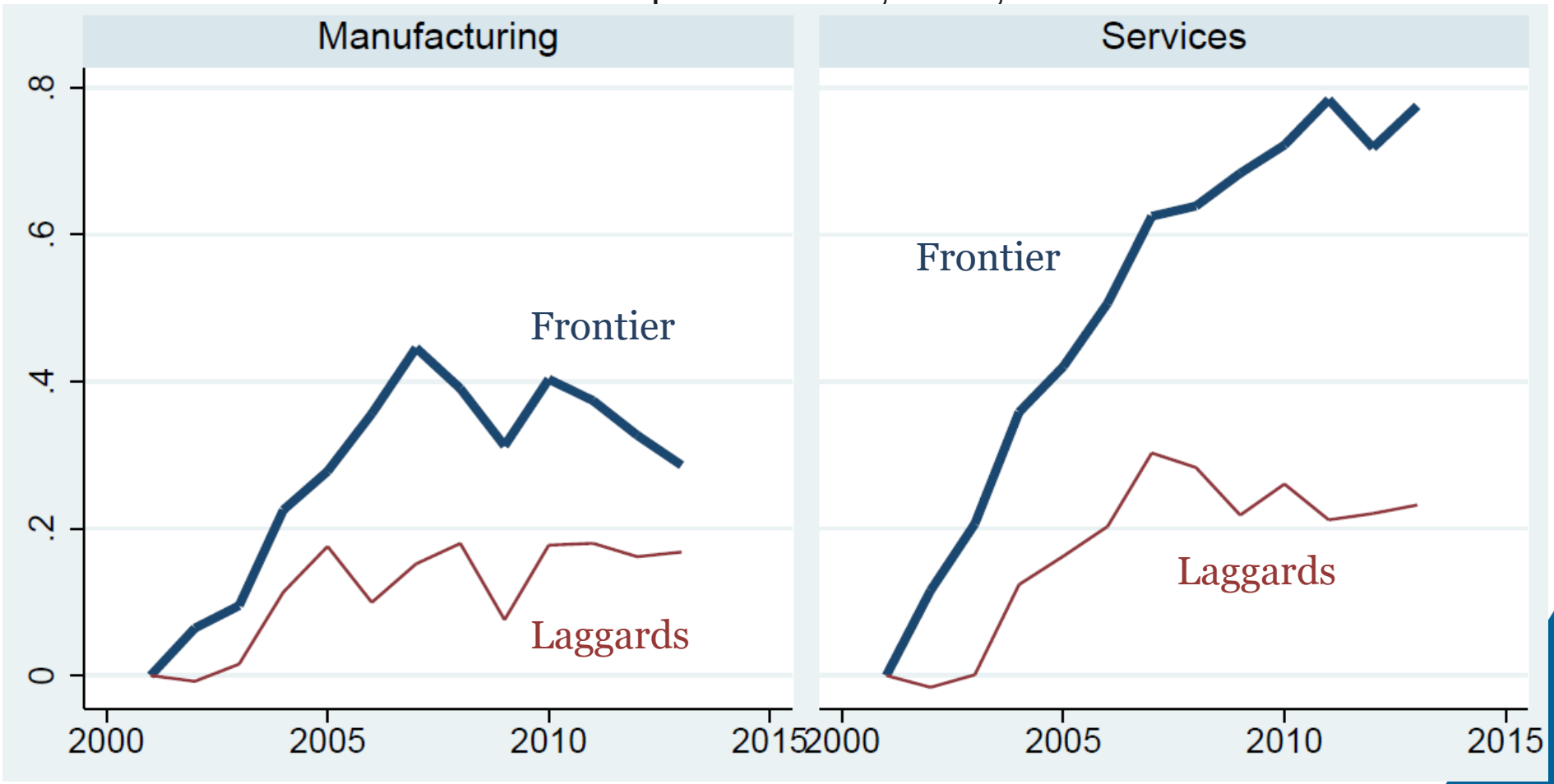
Average estimated mark-up across each 2-digit sector (log, 2001=0)



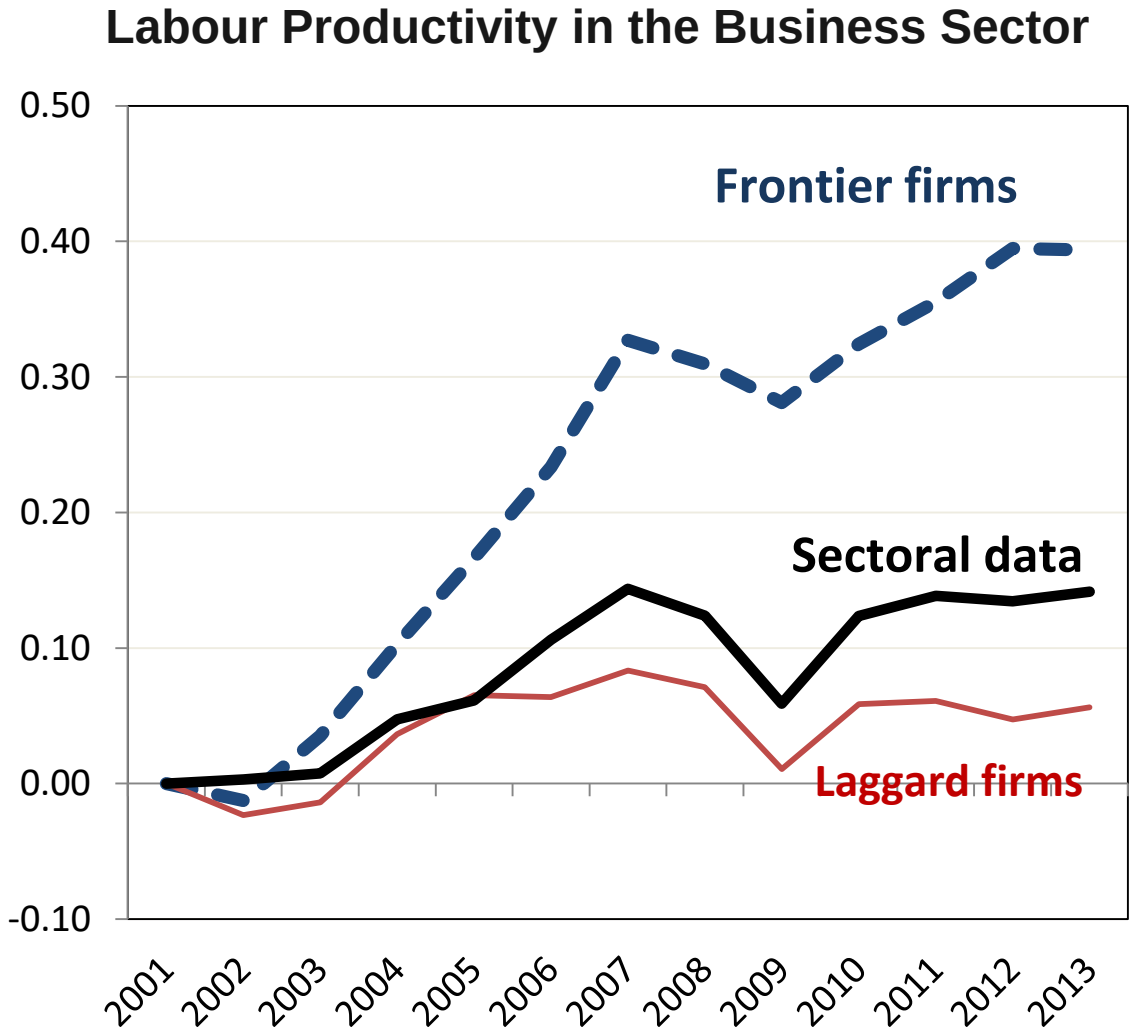
Frontier firms are *getting larger in terms of sales*

Average of log sales for global frontier firms and the rest

Based on top 5% of MFP; index, 2001=0



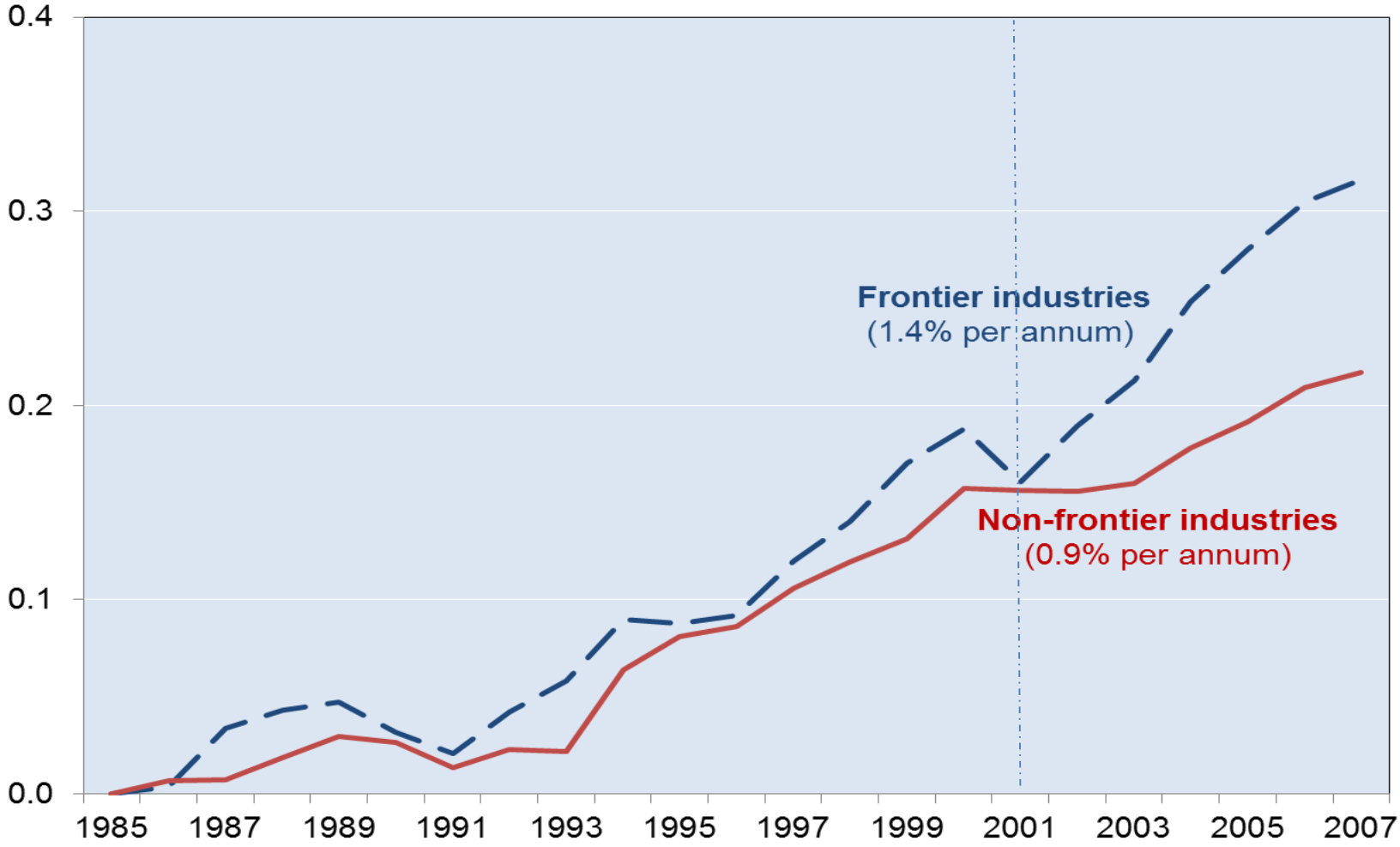
Firm-level patterns *vs* average industry level productivity



Source: Andrews, D. C. Criscuolo and P. Gal (2016), "The Global Productivity Slowdown, Technology Divergence and Public Policy: a Firm Level Perspective", *forthcoming.*

Industry-level data show bigger divergence from early 2000s

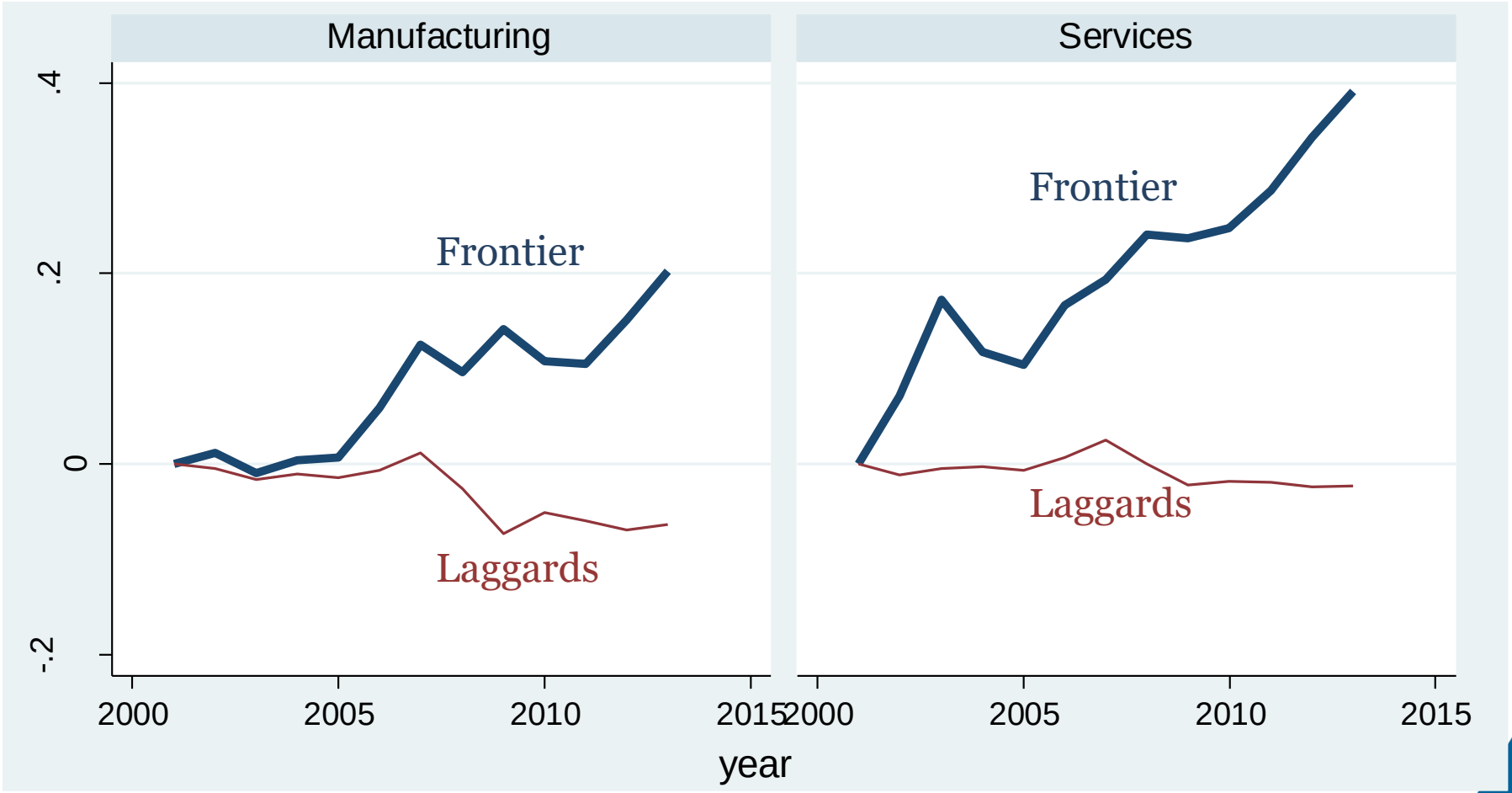
Unweighted average of TFP in the non-farm business sector; index 1985=0



Source: OECD calculations based on Bourles et al (2013) dataset.

Labour quality adjusted MFP also shows divergence

MFP estimation based on wagebill instead of employment



Productivity estimation
Wooldridge (2009)

- Value added based production function, estimated separately for each industry:

$$y_{it} = \beta_K^j k_{it} + \beta_L^j l_{it} + \nu_{c,j} + \eta_{t,j} + \varepsilon_{it}$$

- Proxy *g(k,m)* (rich polynomial) for productivity and use GMM to control for endogeneity

$$y_{it} = \beta_K^j k_{it} + \beta_L^j l_{it} + g(k_{it-1}, m_{it-1}) + \nu_{c,j} + \eta_{t,j} + u_{it}$$

- Define MFP as residual:

$$MFPR_{it} \doteq y_{it} - \hat{\beta}_K^j k_{it} - \hat{\beta}_L^j l_{it}.$$

Mark-up correction

De Loecker and Warzynski (2012)

- $MFPR_{it}^{c} = MFPR_{it} - \log(\mu_{it})$,where the MFP values are measured in logs and μ denotes the estimated mark-up.
- $MFPR^{c}$ is purged from mark-up variations and hence is not influenced by market power changes under the assumptions:
  - At least one input of production is fully flexible
  - Firms minimize costs

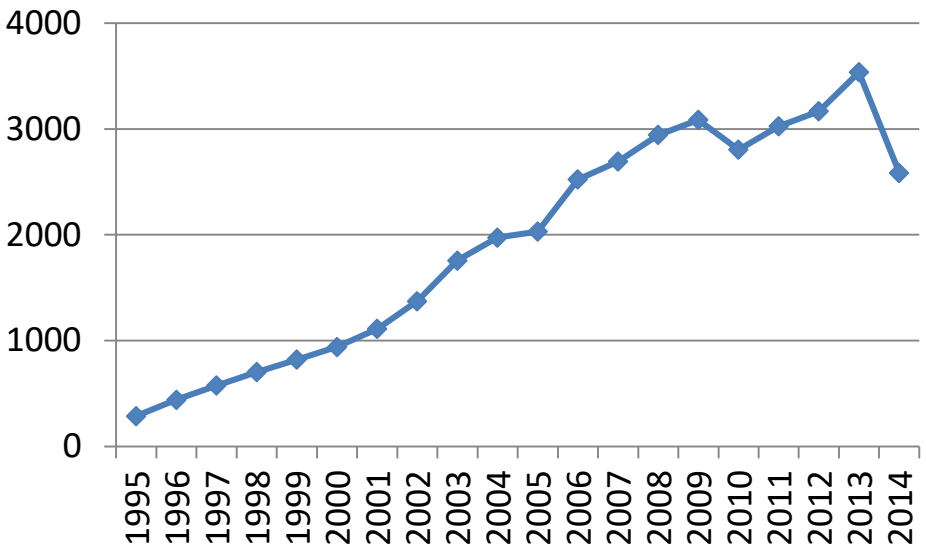
$$\mu_{it} = \frac{P_{it}}{MC_{it}} = Output\ Elasticity_{ikt} / Output\ Share_{ikt} = \frac{\hat{\beta}_{L}^{j}}{ws_{it}}$$

- The labour coefficient is estimated using the GMM estimation method by Wooldridge (2009).
- The denominator is obtained by using a prediction of firm-level value added by a rich polynomial function of observable inputs in order to retain only the anticipated part of output developments.

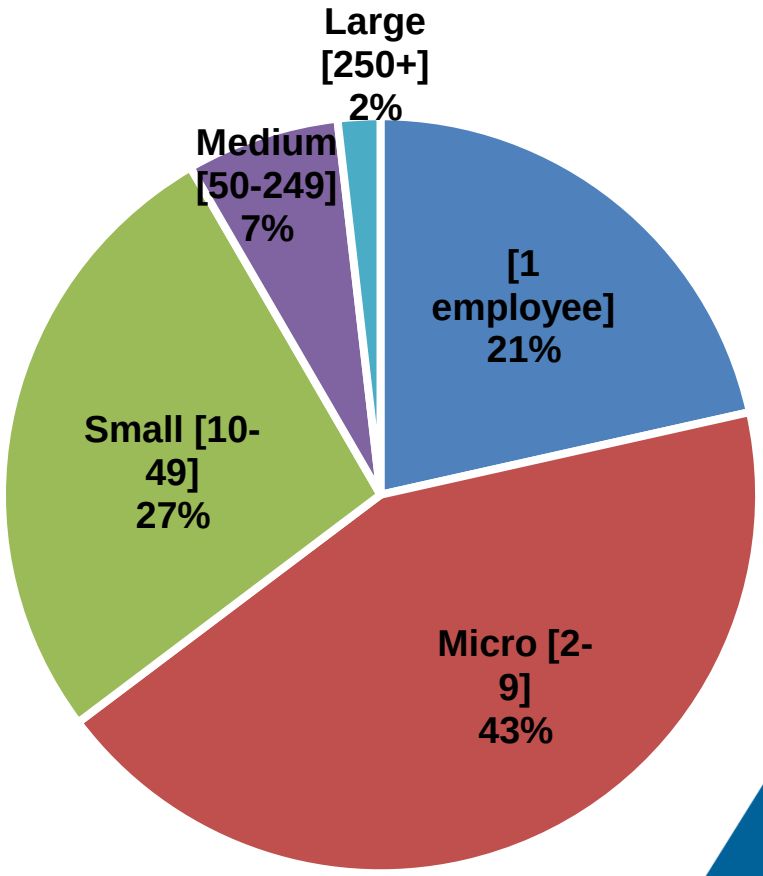
ORBIS: Coverage I

Number of firms by year

Number of firms* by year, in thousands



Firm size distribution (number of employees), 2013*

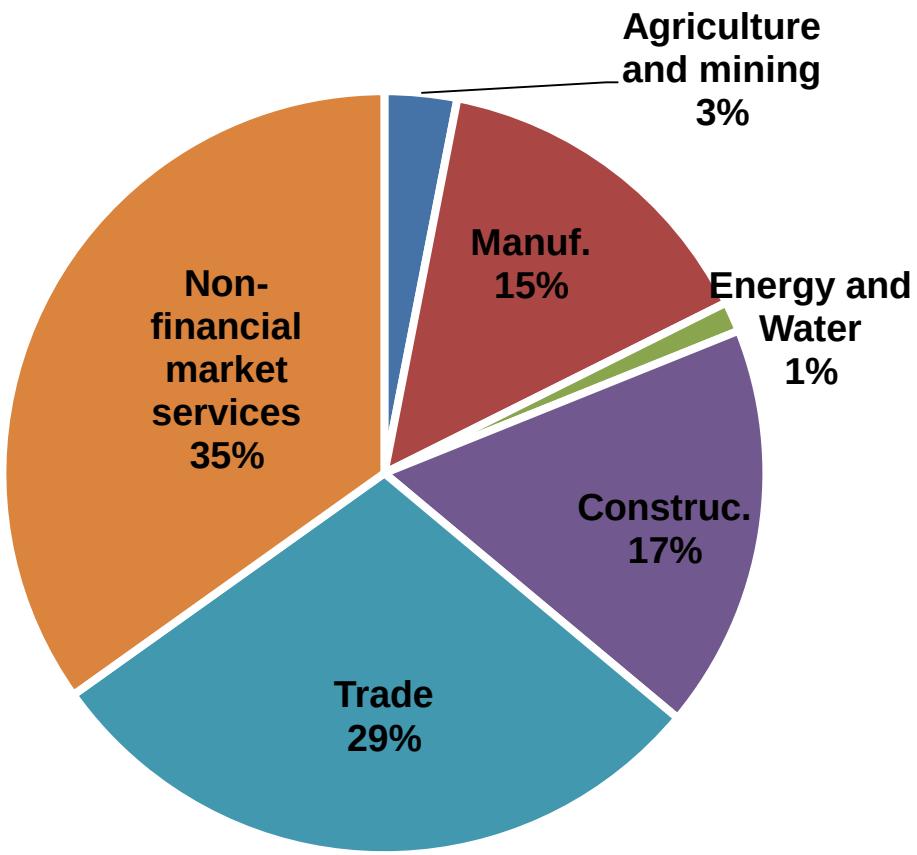


Based on number of accounts with gross turnover and employment information

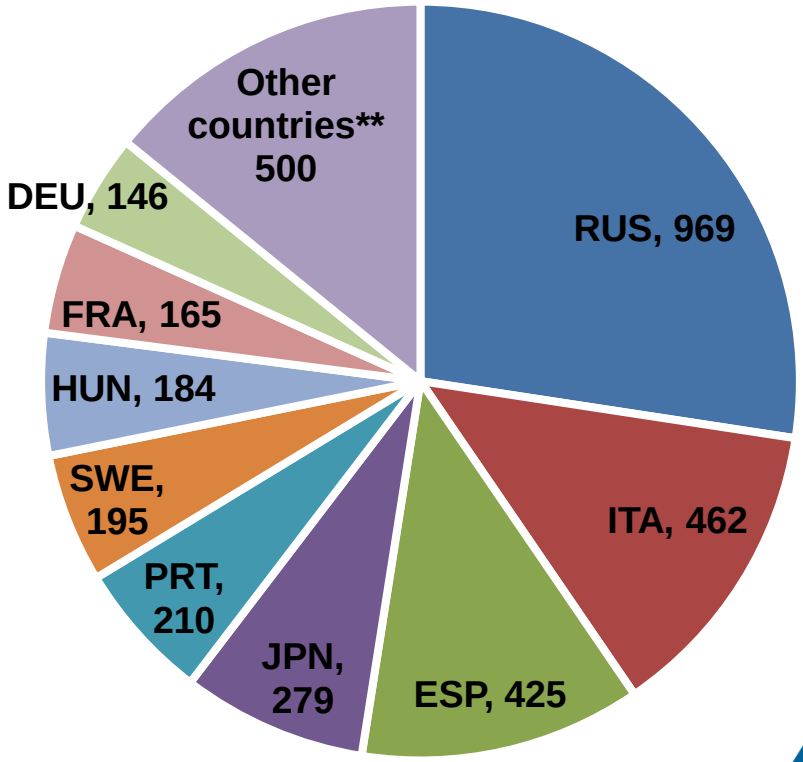
ORBIS: Coverage II

Distribution by country and industry

Share of firms* by industry, 2013



Number of firms* by country, in thousands, 2013



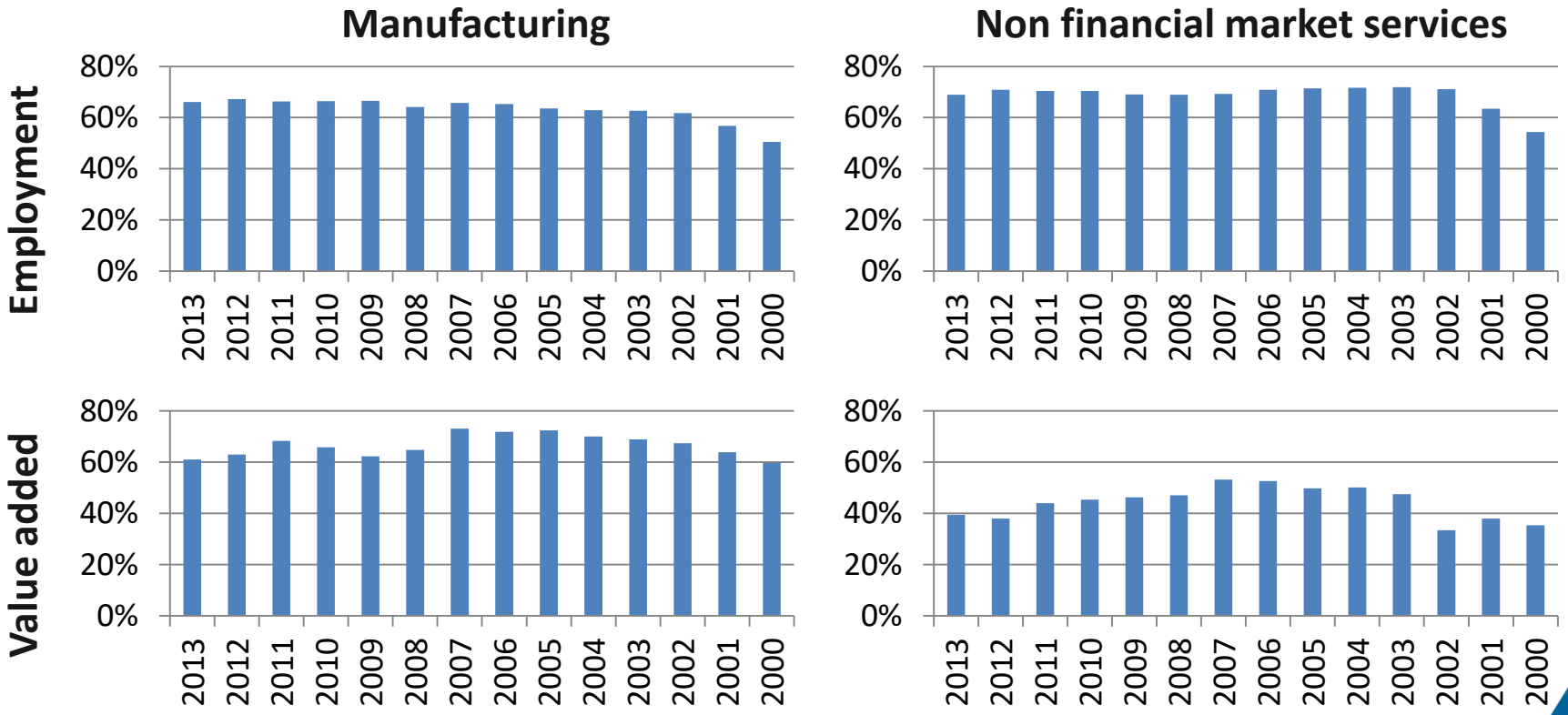
**including USA: 3.25

Based on number of accounts with gross turnover and employment information

ORBIS: Coverage III

Comparison with National Accounts Data

- Share of employment/turnover/value added covered by ORBIS firms by country, industry*, year
- Example: Spain



*Based on NACE Rev. 2 classification, Manuf.= section C, Non fin.market services= section H, I,J, L, M

Enriching ORBIS with other micro-data sources

ORBIS may be matched it with other firm-level or infra-firm-level data sources, e.g.:

- IPR registers: patents, trademarks, designs (Thoma et al. 2010, Andrews et al. 2014)
- Bank data, e.g. BvD's Bankscope (Ioannidou et al. 2015, Jimenez et al. 2014)
- Pollution data (European Pollutant Release and Transfer Register)
- Firm-level surveys, linked employer-employee data
- etc.

Easy way: both databases contain a common identifier

→ generally not the case

Alternative (less easy) way: harmonising and linking firm names

→ using word-matching algorithms, correcting for different spellings, misspellings, abbreviations, name conventions (e.g. IBM vs IBM Corp. vs International Business Machine – IBM)

→ Manual checks needed to correct for false positive/ false negative

Fundamentals –what does MultiProd rely on?

Data sources and representativeness

- Typically have whole population of firms
- For countries with partial data (that is, production survey)
  - Reweight using Business Register population weights (if available)
  - Compute nb. of firms by year / sector / size class

Coverage

- 24 countries (and expanding) [AUS, AUT, BEL, BRA, CAN, CHE, CHL, CRI, DEU, DNK, FIN, FRA, GBR, HUN, IDN, ITA, JPN, LUX, NLD, NOR, NZL, PRT, SWE, VNM]
- Period: 1995-2014
- Whole economy, detailed at 2-digit level and further refined by size class, age and productivity quantiles (granularity)

Outcome –what info does MultiProd collect?

Collected statistics

- Measures of productivity: LP; MFPR Wooldridge; MFPR Solow;…
- Changes in distributions over time (productivity; wage and size).
- Firm-level productivity and employment growth
- Static and dynamic productivity decompositions
- Measures of misallocation
- (Many) statistics further refined by: i) age or/and size classes, ii) ownership, iii) quantiles of the productivity distribution or quantiles of the size distribution.

Representativeness

Country	Years	Firms	Employees
Australia	2002-2012	68,499	761,602
Austria	2008-2012	255,701	2,258,626
Belgium	2004-2011	103,126	1,790,926
Canada	2000-2012	509,460	8,058,557
Chile	2005-2012	339,492	5,273,453
Denmark	2000-2012	80,030	1,281,035
Finland	1995-2012	85,038	981,772
France	1995-2012	812,850	11,453,356
Hungary	1998-2012	191,064	1,786,685
Italy	2001-2012	317,181	1,549,184
Japan	1994-2011	25,786	10,552,236
Luxemburg	2003-2012	1,136	105,252
Netherlands	2000-2012	39,375	332,449
Norway	1995-2012	63,593	890,001
New Zealand	2000-2011	90,973	992,208
Sweden	2002-2012	176,652	1,889,764

Use –what questions does MultiProd answer?

Some of the policy questions that can be answered

- Has divergence in productivity increased over time? Is the increase due to the top or the bottom of the distribution?
- Is wages dispersion linked to productivity patterns?
- Who are the laggard firms? What policies accelerates the catchup?
- What is the relationship between size, productivity and wages?
- (Is the allocation of resources efficient in a particular economy?)
- (What is the role of large firms for the economy?)