THE INTERNATIONAL DIMENSION TO THE PRODUCTIVITY PUZZLE: EVIDENCE FROM MICRO-DATA

Chiara Criscuolo
OECD

Based on joint work with Dan Andrews, Matej Bajgar, Giuseppe Berlingieri, Patrick Blanchenay, Sara Calligaris, Flavio Calvino, Peter Gal, Jonathan Timmis and Rudy Verlhac

EscoE Seminar "Micro-data perspectives on the productivity puzzle: evidence for policy"

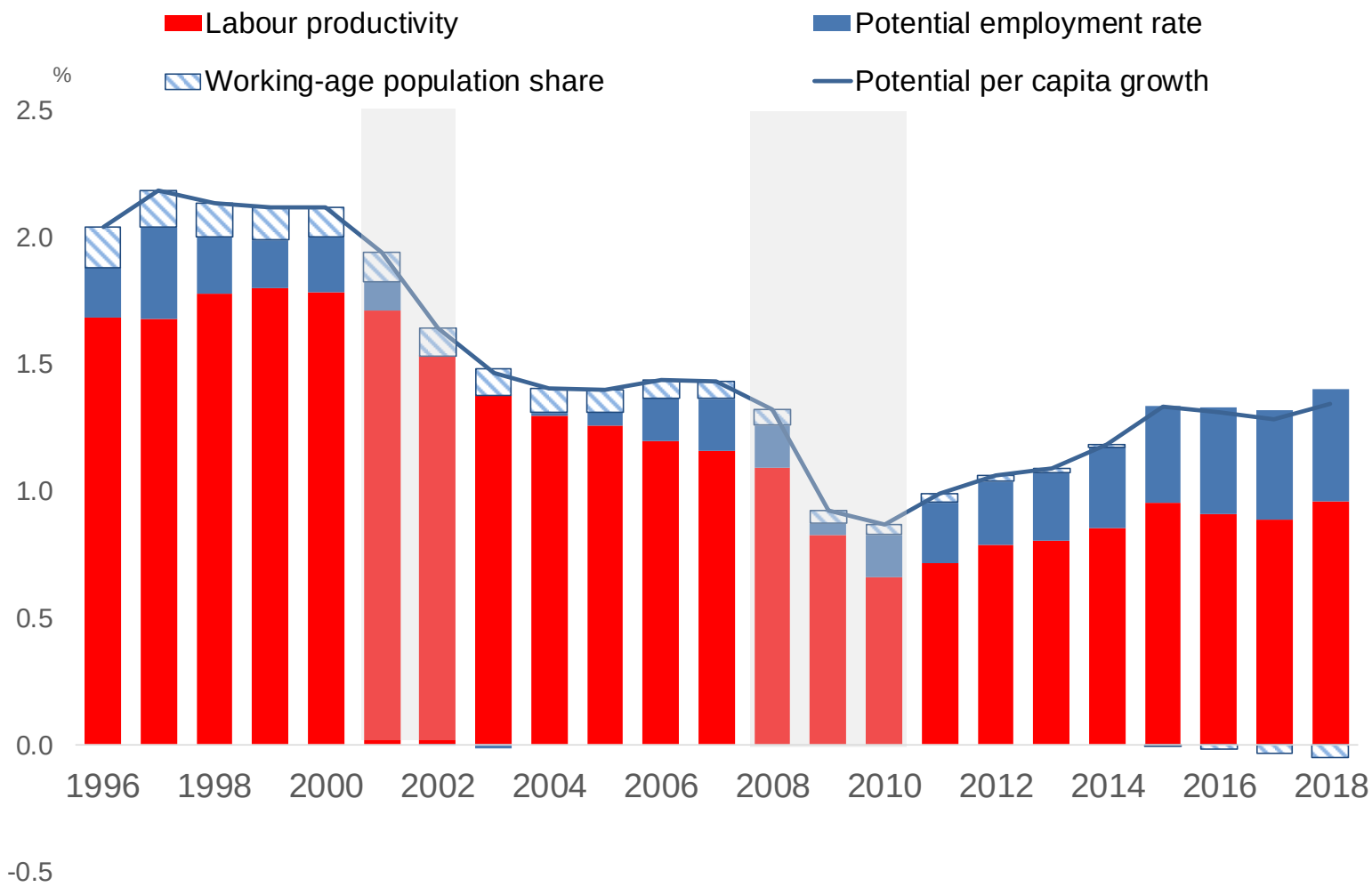
London, 18 April 2019

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.

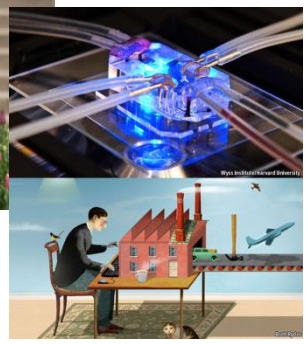
The slowdown has ignited a spirited debate …

Pessimists:

- Gordon
- Cowen
- Thiel
- …

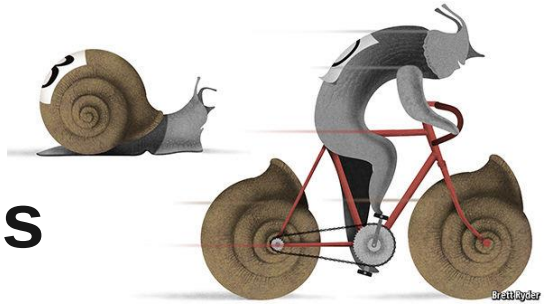
Optimists:

- Brynjolfsson
- McAfee
- Mokyr
- Jovanovic
- …



OECD contribution: bring cross-country micro evidence to the debate

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



2. This holds also **within countries**
3. Some **explanations**:
    1. “Winner takes most” dynamics
    2. Stalling diffusion of technologies
    3. Market dynamism fell
    4. Policy reforms lacking

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; Akcigit & Sinas, 2019)
   - A “return to normal” after a decade of exceptional IT-fueled gains (Fernald, 2014)
2. Rising resource misallocation or less efficient reallocation
3. Cyclical factors
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

Modus operandi:

- Harmonized Stata routine sent to NSOs with access to confidential (administrative) firm-level longitudinal data.
- They run the code on firm-level longitudinal data, which produces micro-aggregated data.
- Micro-aggregated data are sent back to us for analysis.

Coverage:

- 25 countries (and expanding); 13 countries in this paper [AUS, AUT, BEL, CAN, CHL, FIN, FRA, HUN, IRL, ITA, NOR, PRT, SWE].
- Data at the 2-digit sector level, further refined by: i) productivity performance groups; ii) firm size; iii) firm age; iv) ownership.
- Whole economy; in this paper focus on Manufacturing and Non-financial Market Services.

Measurement of Global Frontier
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

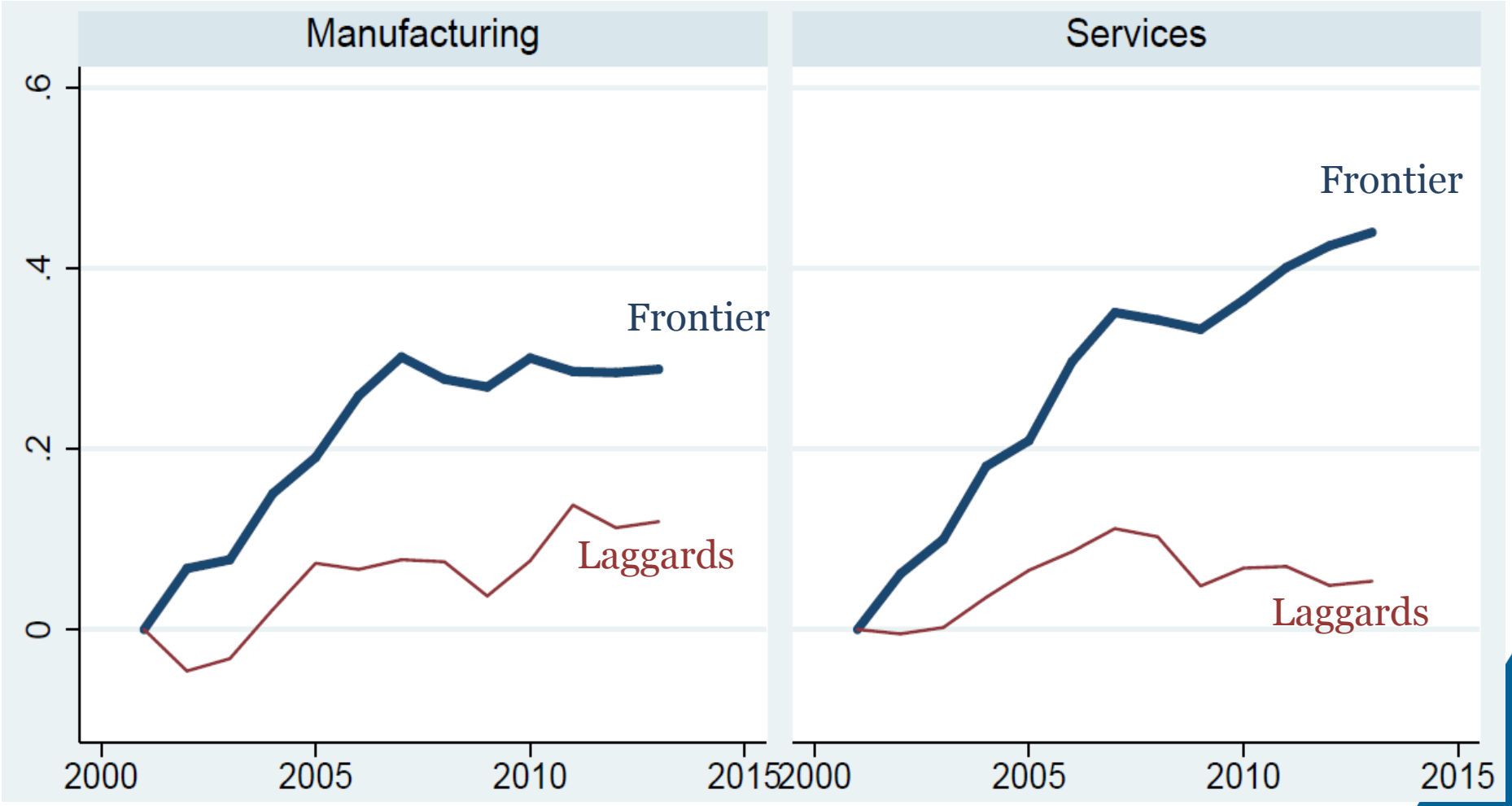
- **Sectors:** Non-farm, non-financial business sector

GLOBAL PRODUCTIVITY DIVERGENCE

THE FINDINGS

"The Best vs. the Rest": Rising labour productivity gap between global frontier and laggards**... which may reflect "technological" divergence**

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



PRODUCTIVITY DIVERGENCE WITHIN COUNTRIES

FINDINGS & IMPLICATIONS FOR WAGES

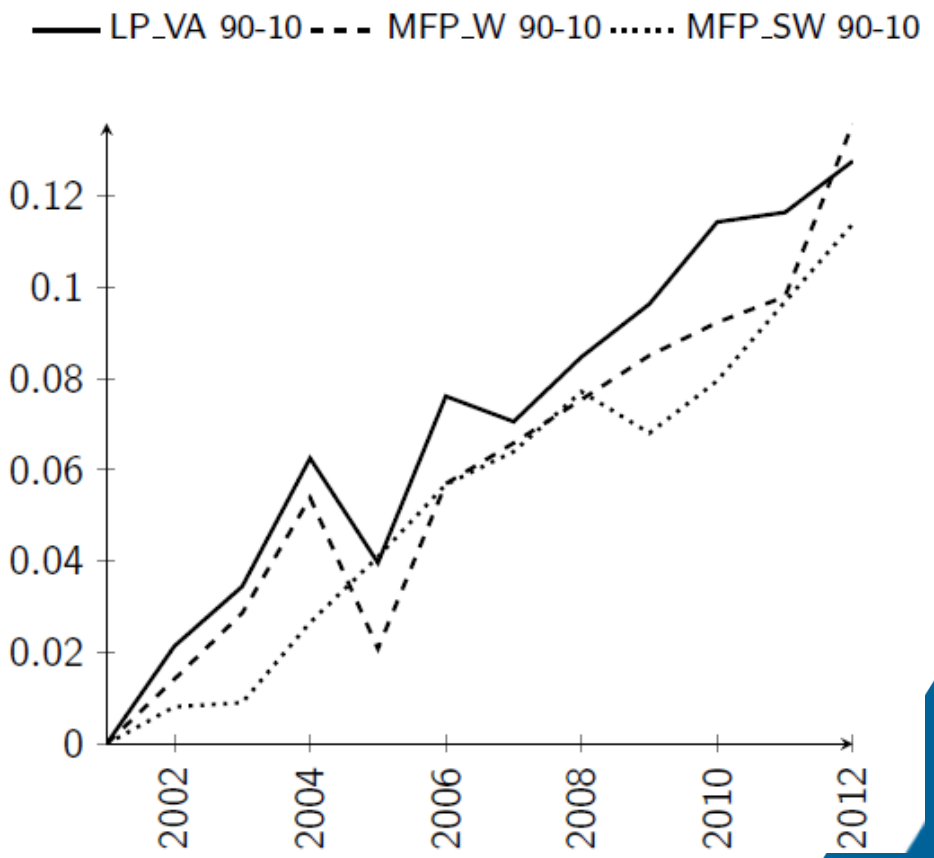
Robust divergence within countries too

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

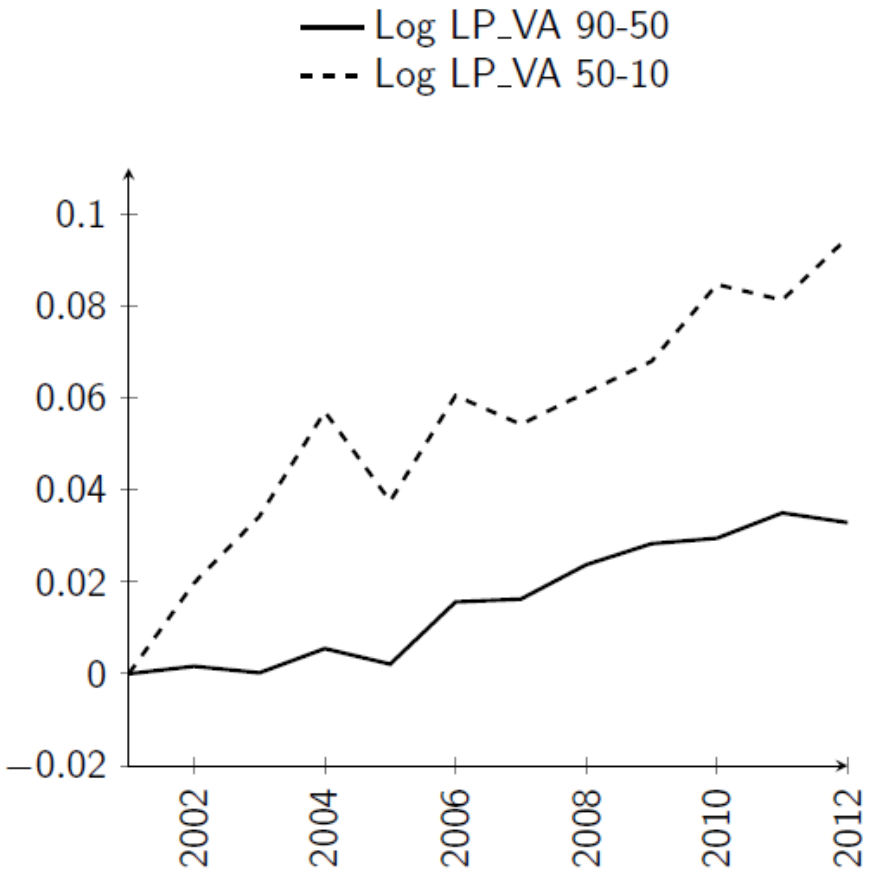
$$\log\left(\frac{P^{90}}{P^{10}}\right)_{cjt} = \alpha + \beta_t \boldsymbol{y}_t + \boldsymbol{z}_{cj} + \varepsilon_{cjt}$$

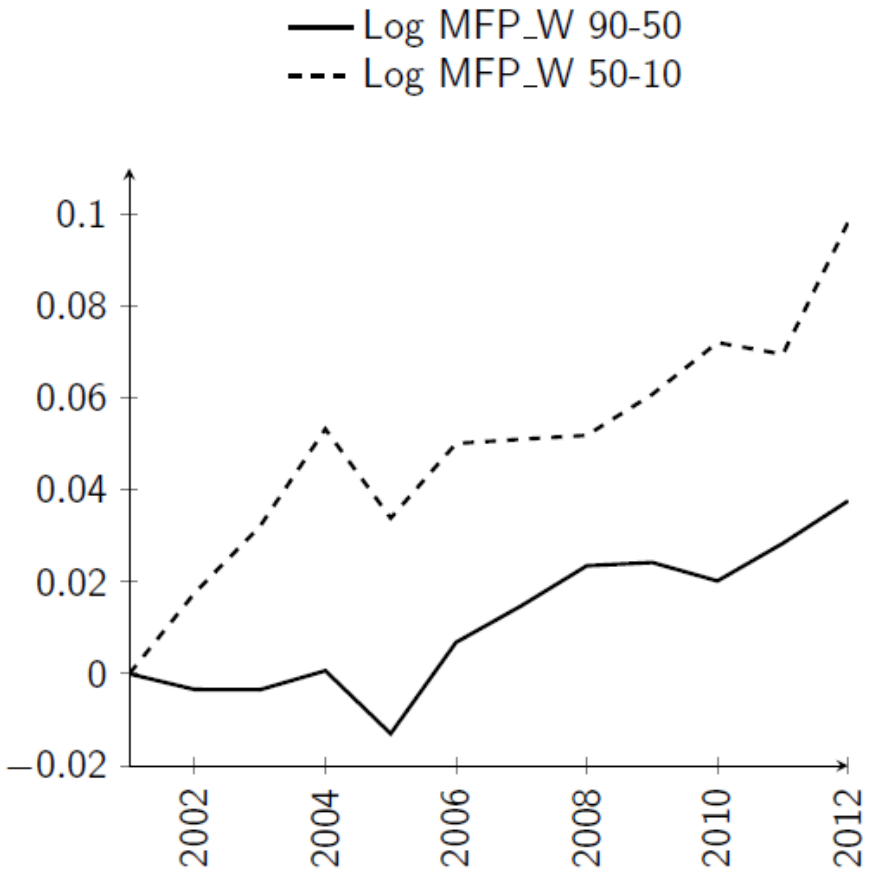
Results:

- 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

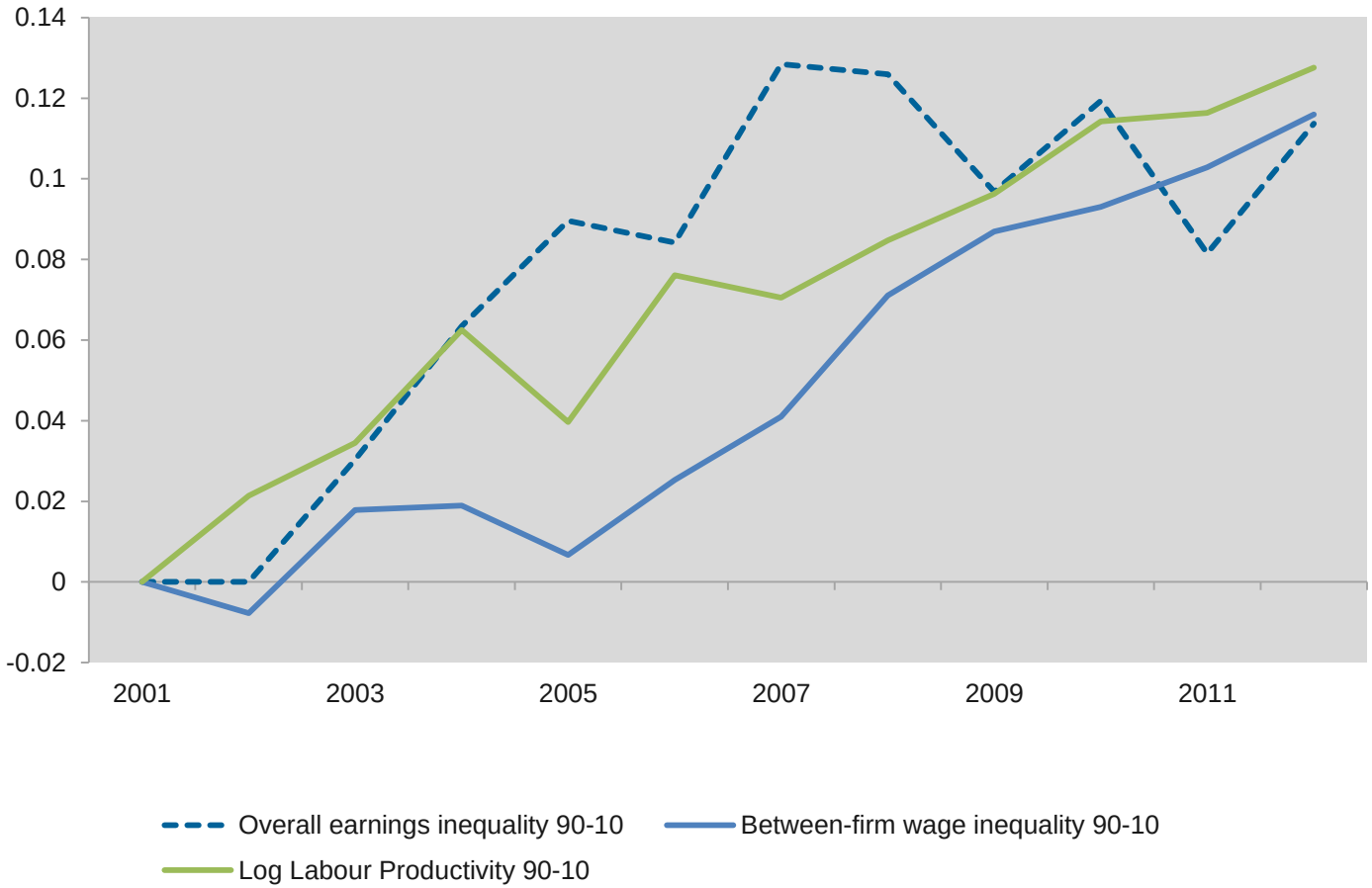




Year fixed-effects of a regression of log-LP_VA and log-MFP_W dispersion, within country-sector pairs.

Within-industry wage dispersion increases, too…

Rising inequality between firms and workers



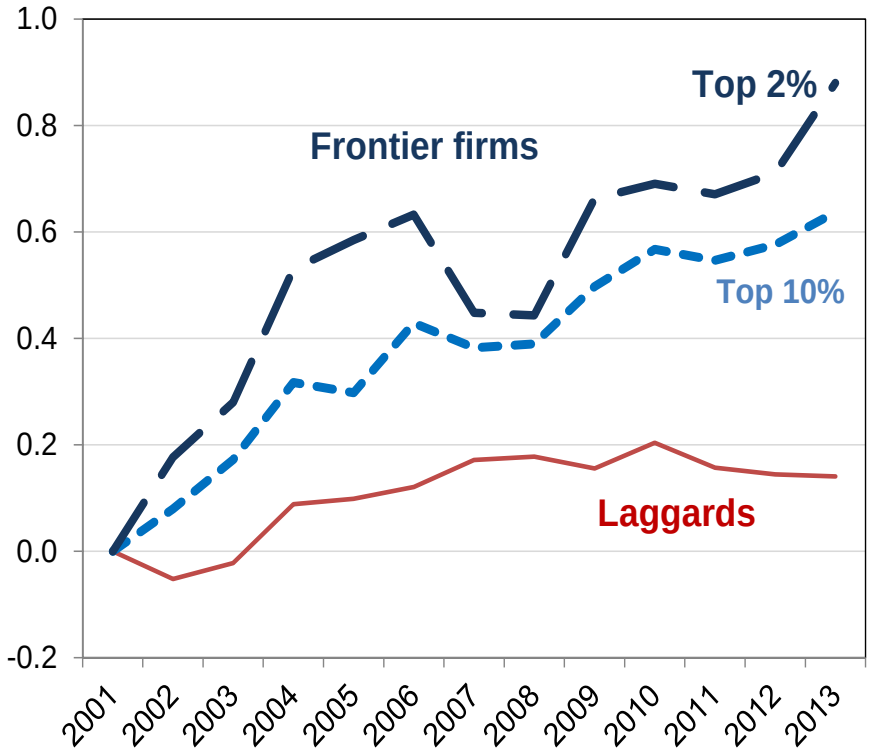
Source: Berlingieri, Blanchenay and Criscuolo (2017)

PRODUCTIVITY DIVERGENCE: *STRUCTURAL AND POLICY DRIVERS*

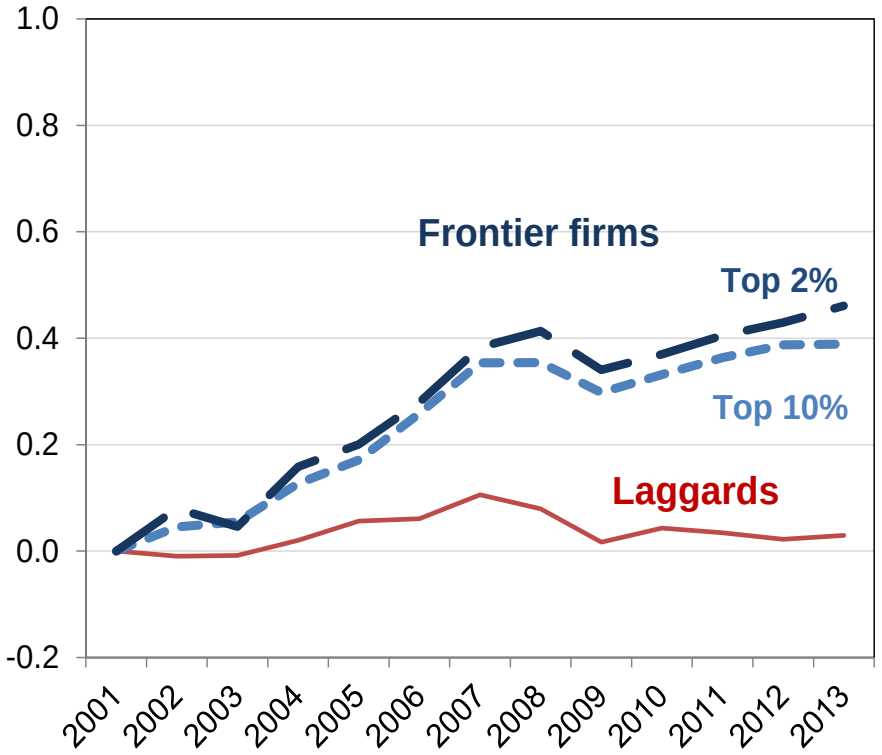
Technological divergence: *winner takes most dynamics?*

MFPR divergence

ICT-intensive services



Non ICT-intensive services

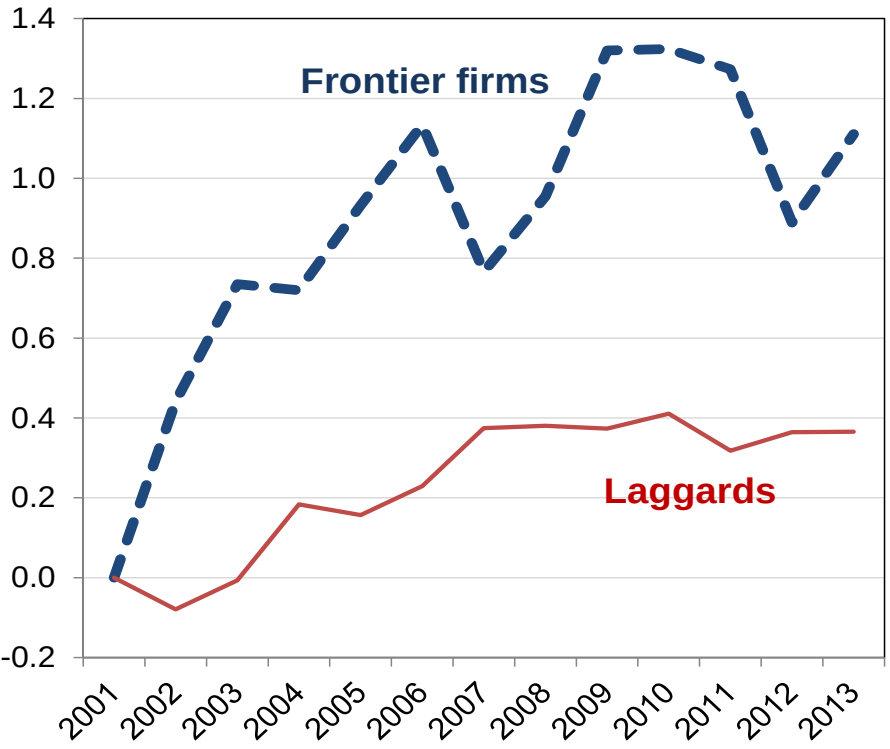


Further recent evidence: more intensive digital technology adoption at sector level (measured by Eurostat) is associated with stronger productivity growth at the top of the distribution *(Gal et al, forthcoming; Sorbe et al, forthcoming)*

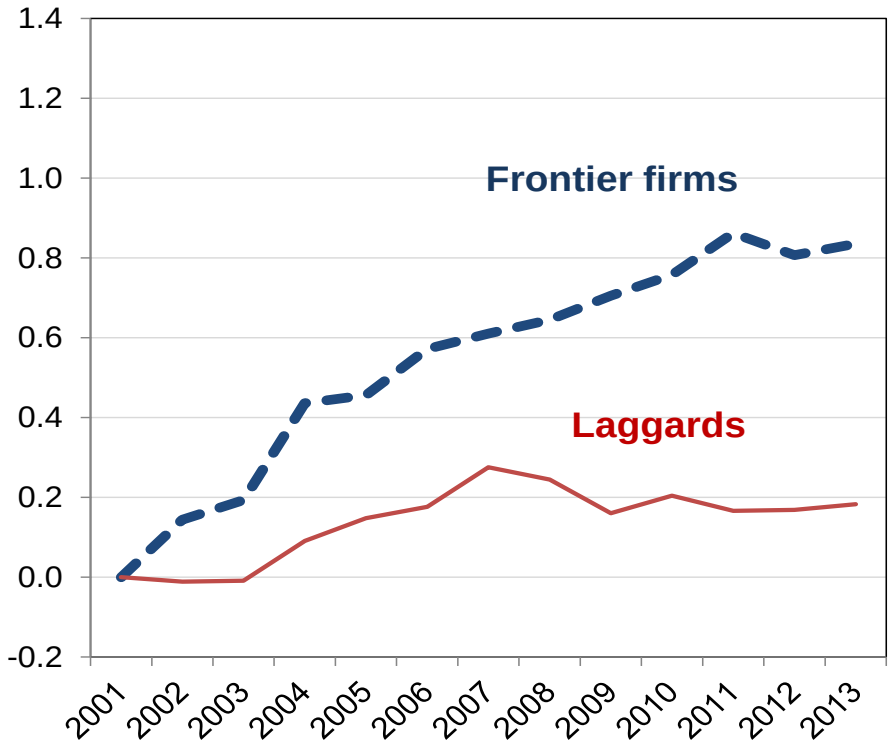
Technological divergence: *winner takes most dynamics?*

Sales divergence

ICT-intensive services



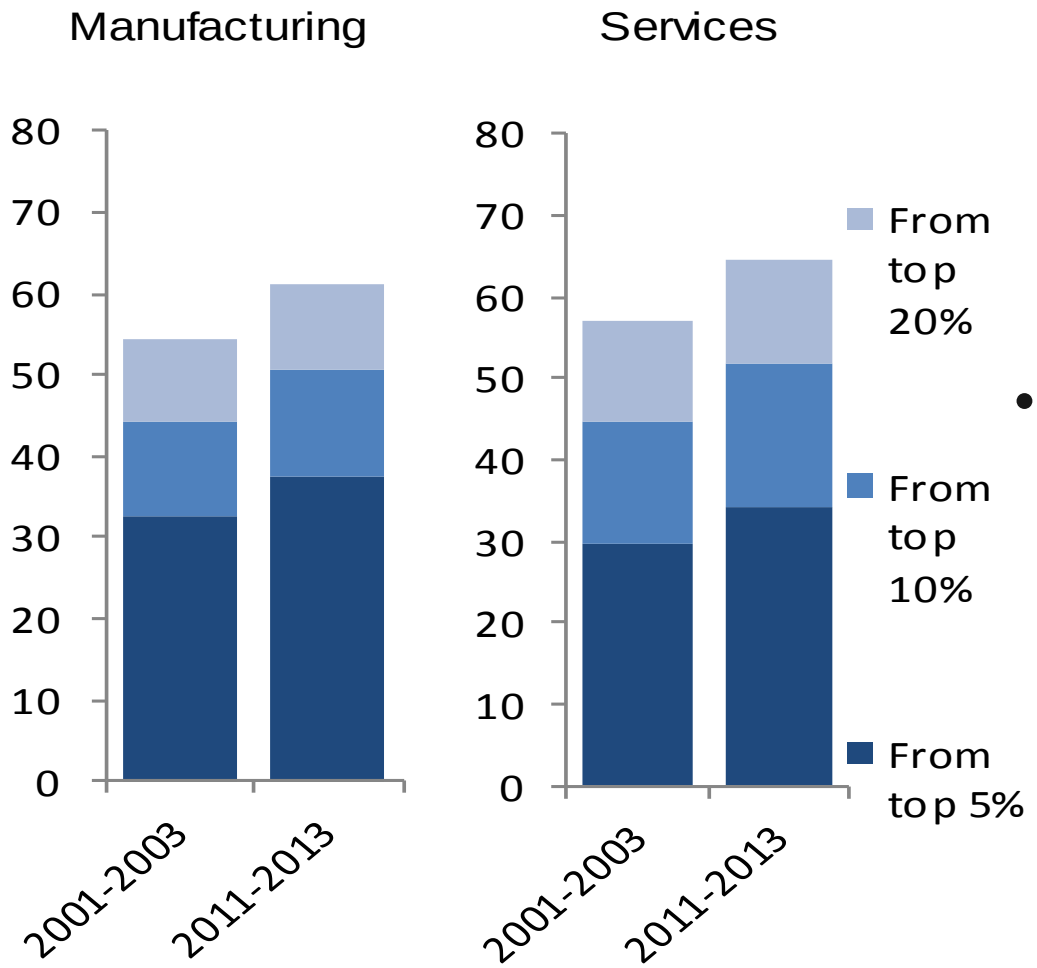
Non ICT-intensive services



Problems ***at the top***?

Entry to the frontier has become more entrenched amongst top firms

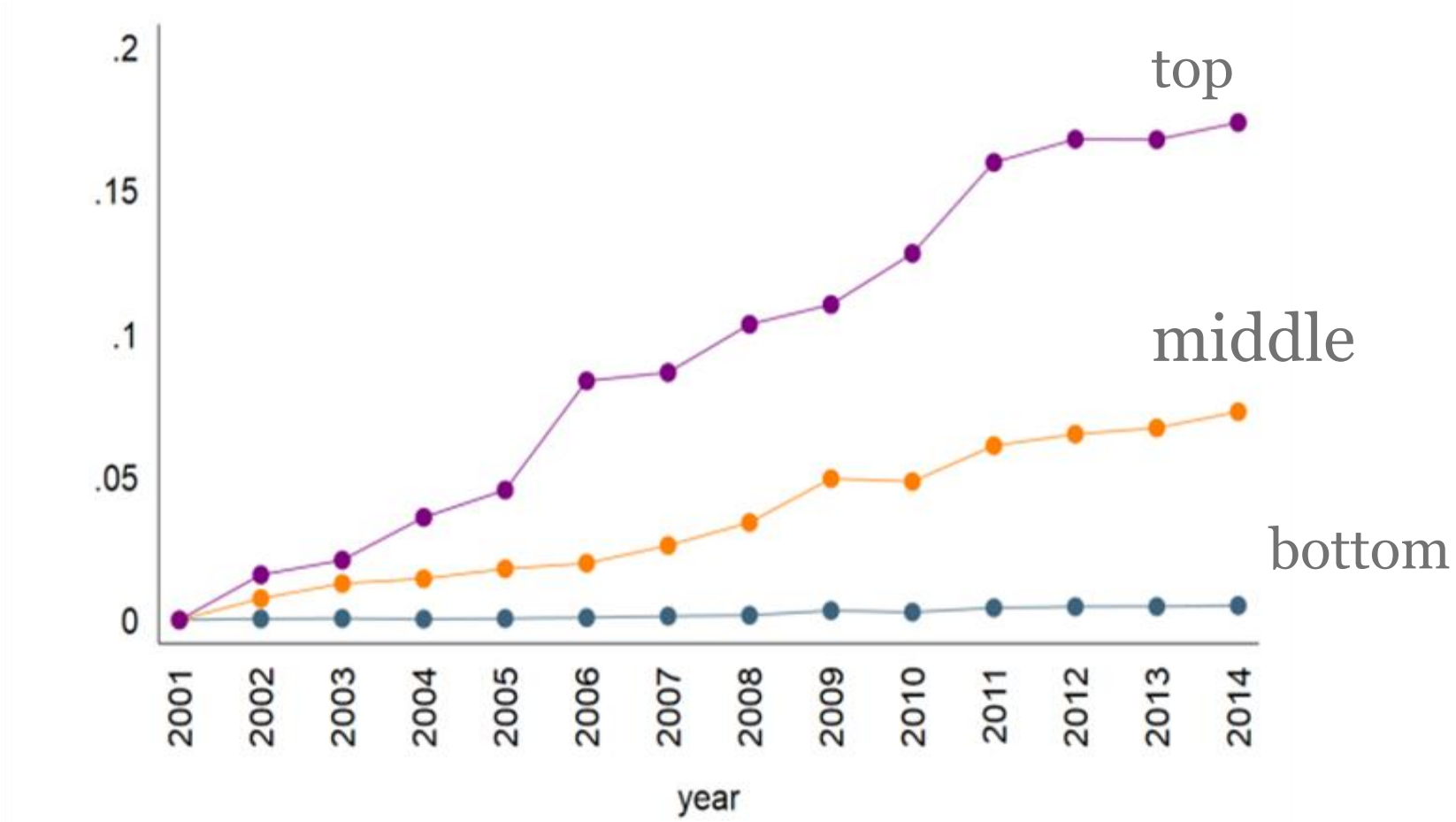
Proportion of frontier firms in time *t* according to their frontier status in *t-2*



And also:

- Increased **mark-ups** at the top and in digital intensive services (Calligaris, Criscuolo and Marcolin, 2018)
- Increased **concentration** (Share of sales of top 8 and top 20) in both Europe and North American (Bajgar, Berlingieri, Calligaris, Criscuolo and Timmis, 2019)

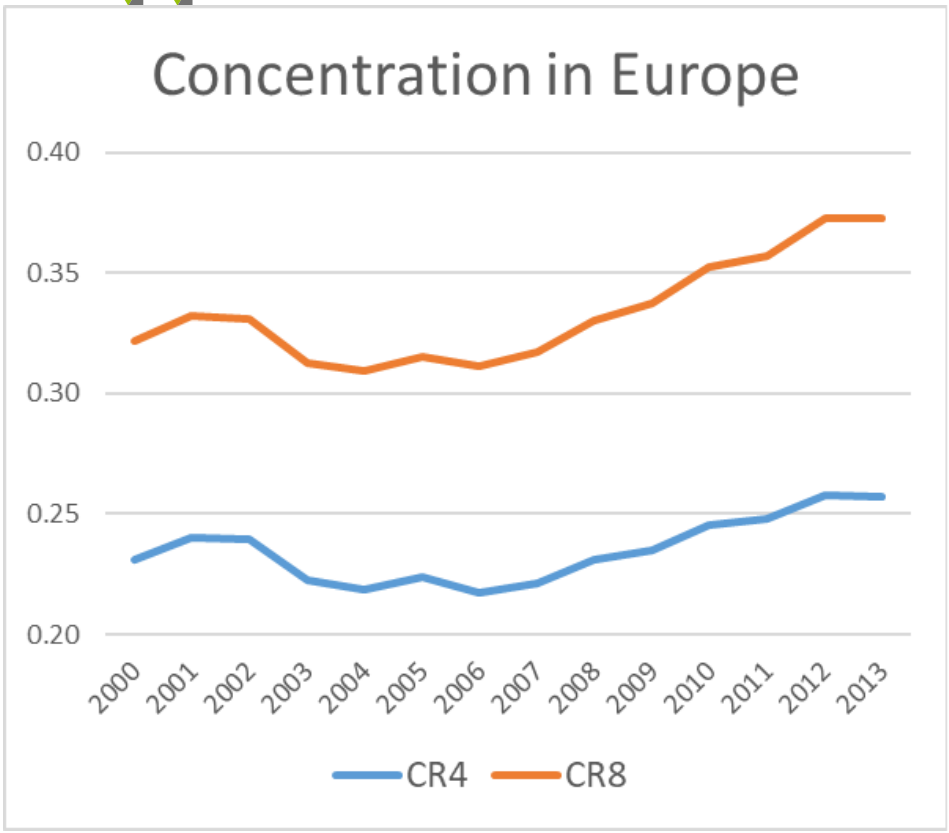
Rising mark-ups pushed by the top

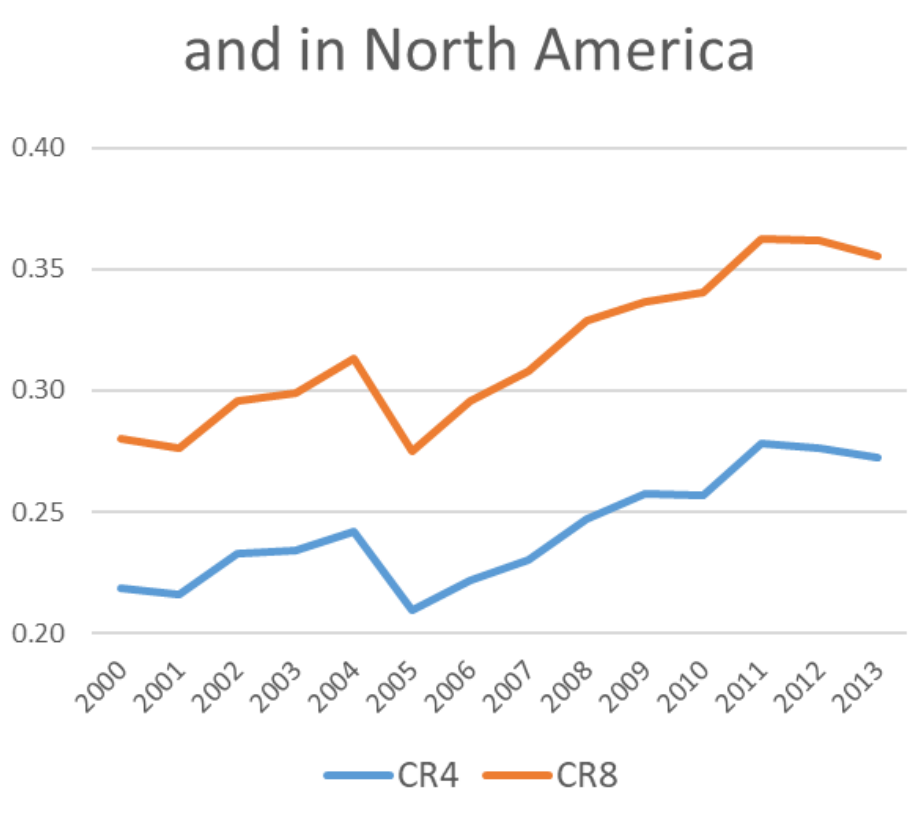


- *Within* the **year 2-digit industry** averaged across sectors;
- Dynamics not due to a particular country. But stronger in digital intensive sectors

Source: Calligaris, Criscuolo and Marcolin, 2018 "Mark-ups in digital era"

Rising concentration (across the globe)

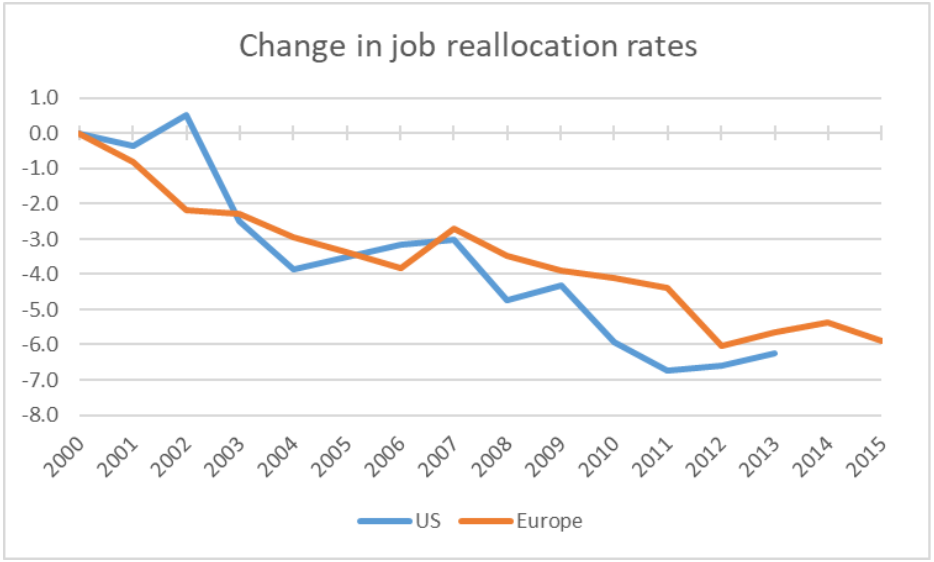


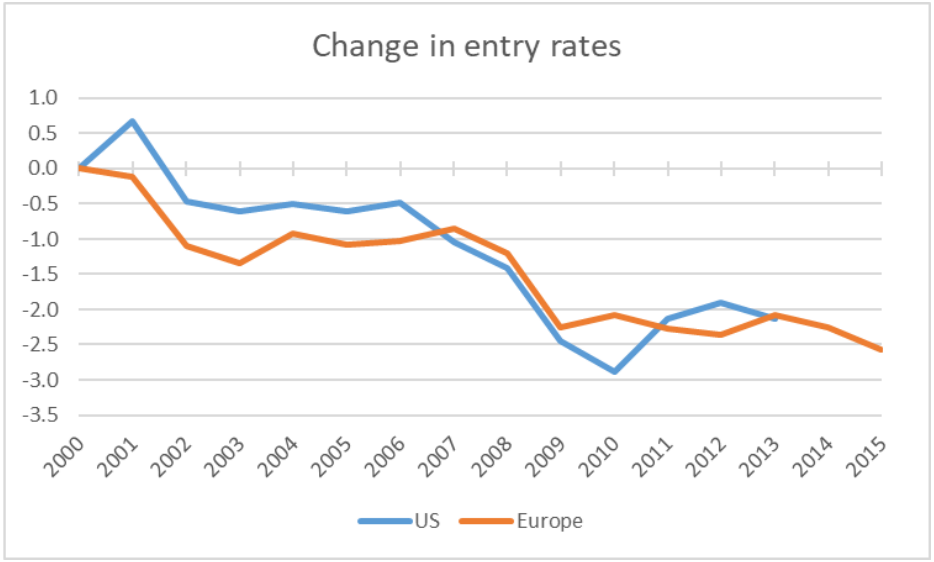


Source: Bajgar et al., (2018) **Industry Concentration in Europe and North America**

Note that the measures capture concentration within the respective global regions (Europe, North America), not within individual countries. The reported figures correspond to averages across all industries in each region and year.
Measure: The share of the top 4 firms (CR4) or the top 8 firms (CR8) in each industry in the total industry sales. The top firms are defined as the 4 or 8 firms with the largest sales in each year.
Data: The sales of top firms are based on a matched Orbis-Worldscope-Zephyr dataset constructed by the OECD. Industry sales come from the OECD STAN industry database (see http://www.oecd.org/sti/ind/stanstructuralanalysisdatabase.htm).
Countries: Europe (BE, DE, DK, EE, ES, FI, FR, GB, GR, HU, HR, IE, IS, IT, LV, NL, NO, PL, PT, RO, SI, SE). North America (CA, US)

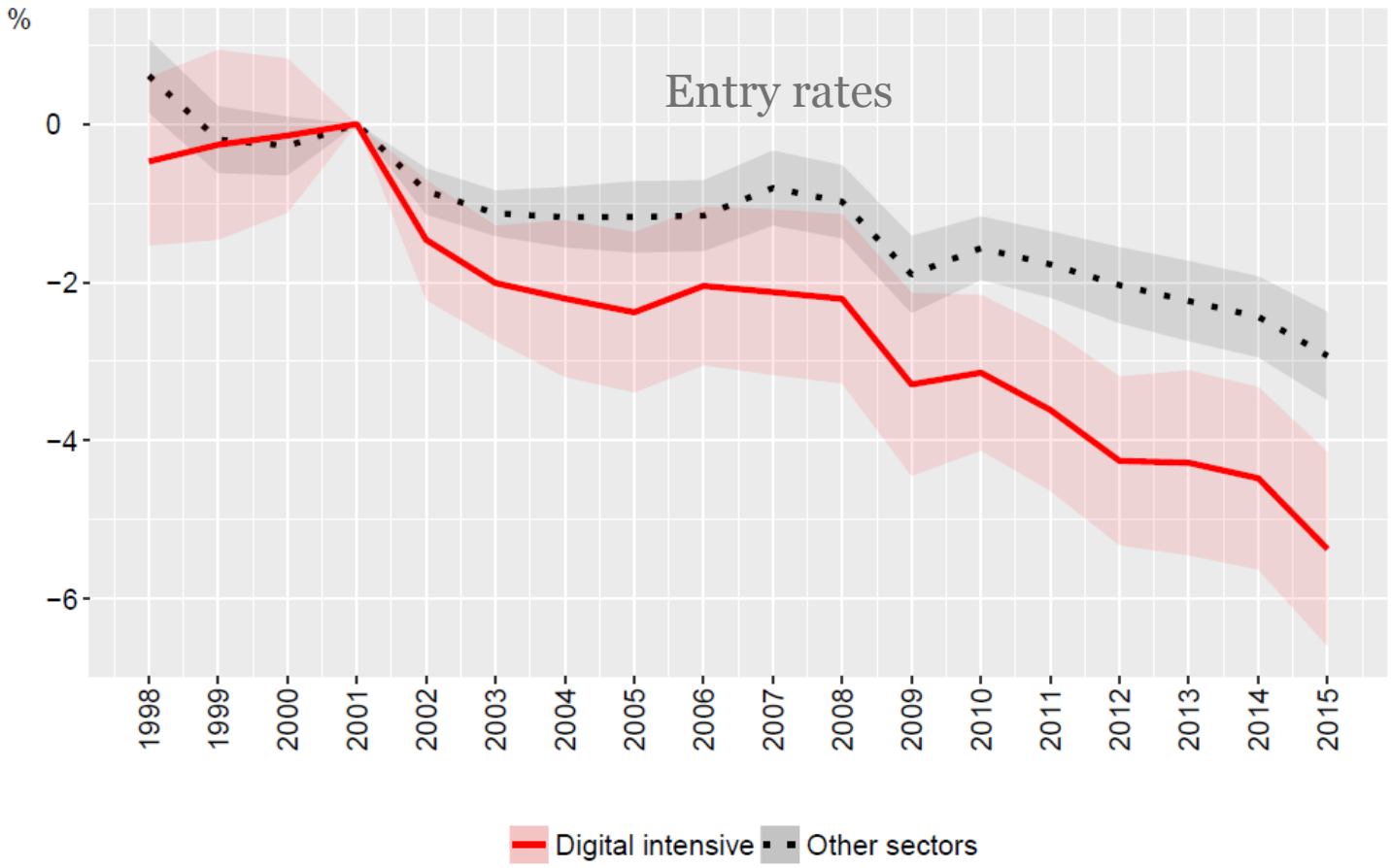
Entry rates and Job reallocation rates –





Source: “Declining Business Dynamism; Evidence and Causes”, F. Calvino, C. Criscuolo, R. Verlhac, based on OECD DynEmp v.2 and DynEmp3 database.

…especially in digital intensive sectors



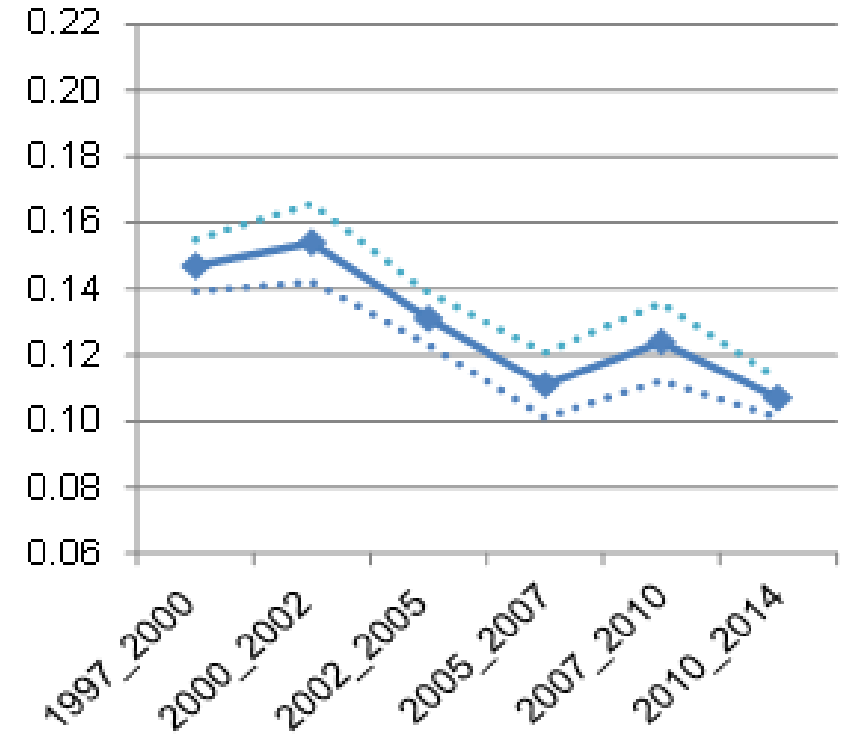
Source: Calvino and Criscuolo, 2018 "Business Dynamics and Digitalisation" based on OECD DynEmp3 database, August 2018.

Bottom not keeping up? The speed of convergence to the frontier slowed, even before the crisis

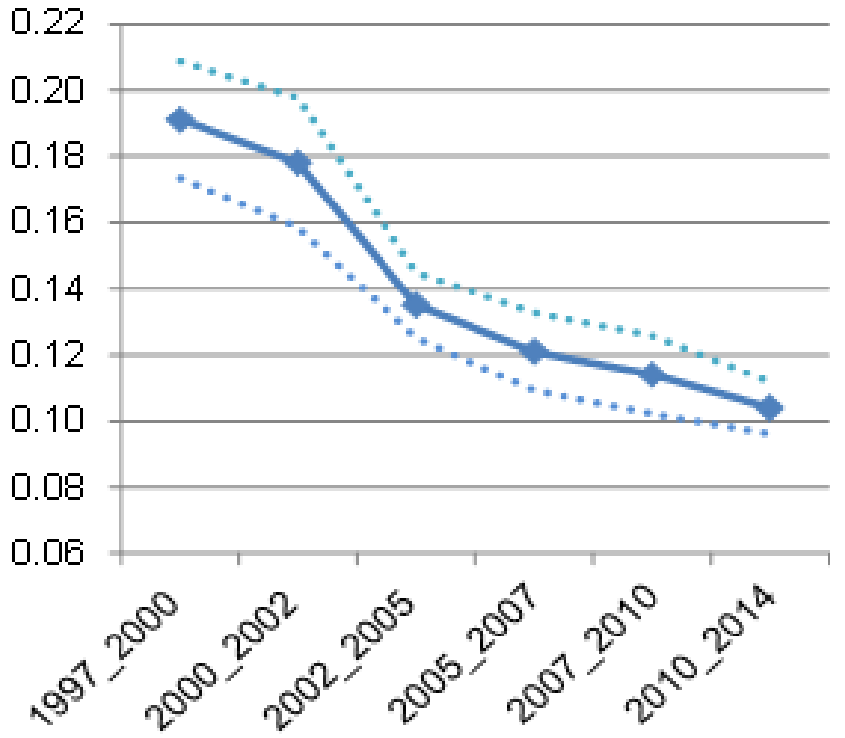
Estimated convergence parameter from a neo-Schumpeterian model

Dotted line: 95% confidence intervals

A: MFPR



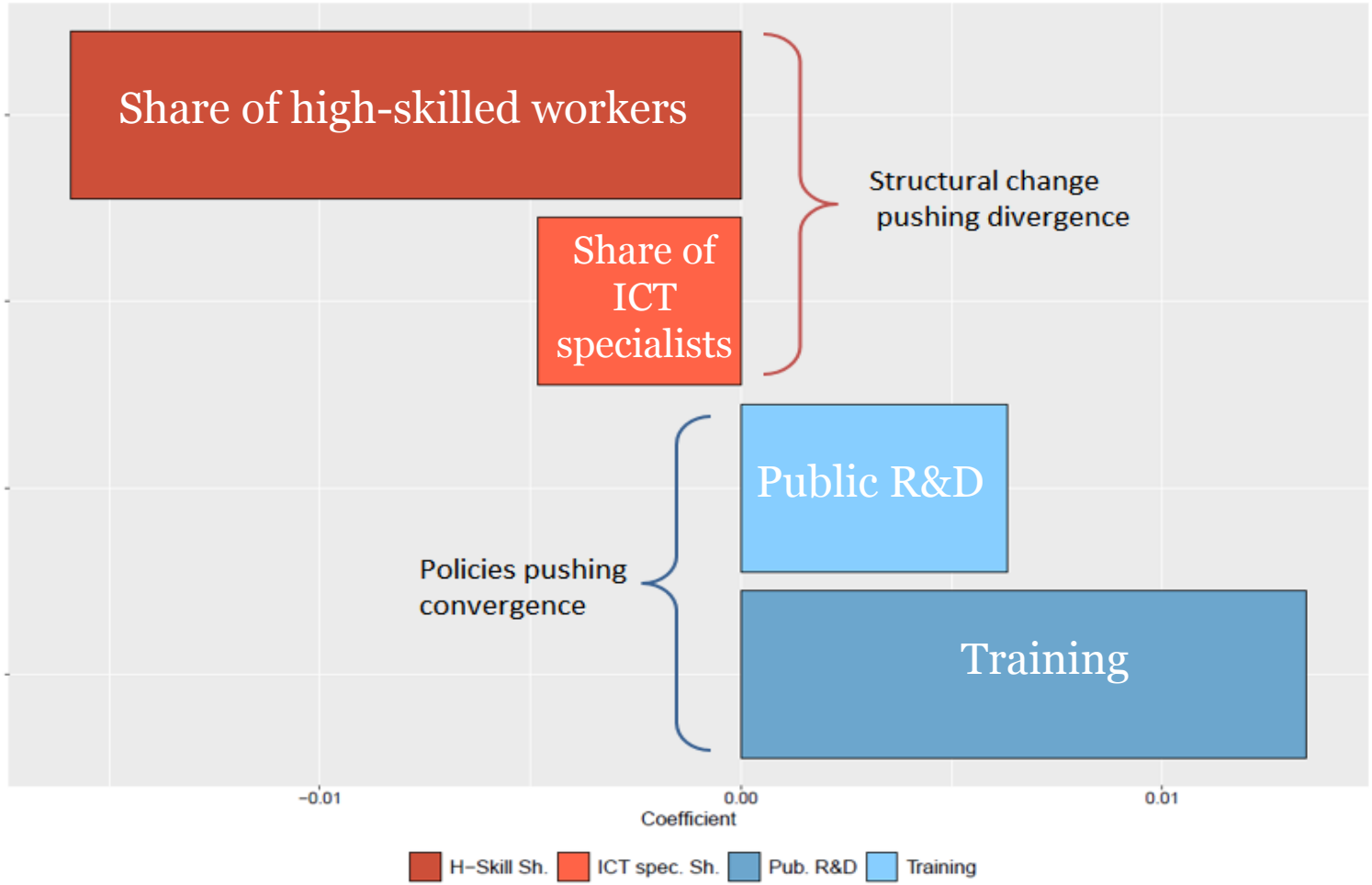
B: Mark-up adjusted MFPR



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

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 and policy variable (public active spending on training (as a share of GDP); ii) government-financed gross domestic expenditure on R&D (share of GDP)

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.

Summary and policy conclusions

- The slowdown in aggregate productivity growth masks an **increasing divergence** between GF and laggard firms:
  - Structural trends in the global economy unleashed winner takes-most dynamics and saw a slow down in catch-up.
  - Thus, MFP divergence was partly structural but it seems that the policy framework didn't sufficiently adapt to these structural trends
  - Evidence of declining business dynamism and increasing concentration are raising policy attention.
- What other factors may matter?
  - Role of digital transformation
  - Role of complementary factors (e.g. managerial quality, skills)
  - Increasing benefits from agglomerations *(OECD, 2016, Regional Outlook; The Economist: Superstar Cities)*
  - Intellectual property (patent) regimes need updating?

THANK YOU

Further questions: chiara.criscuolo@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.

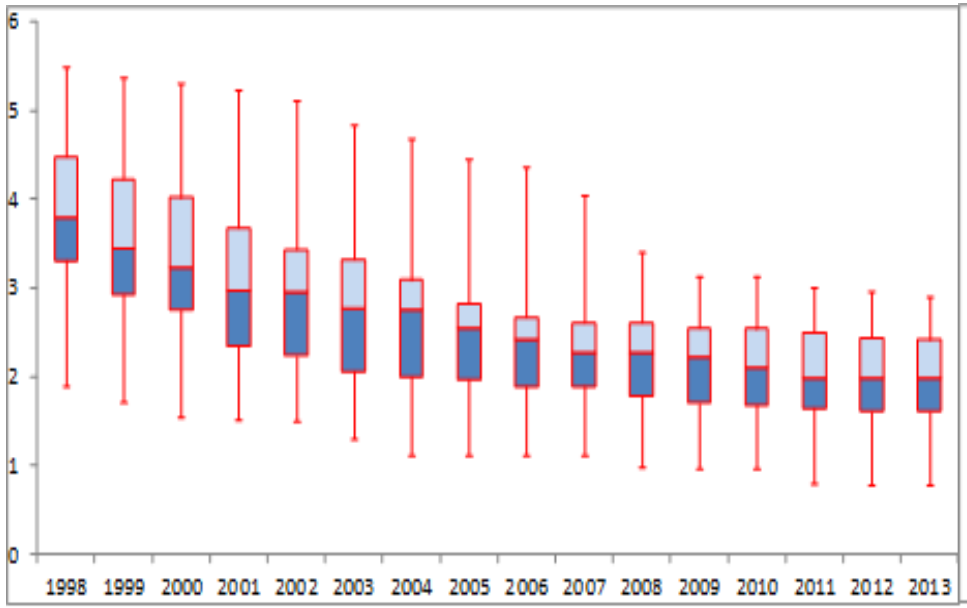
PRODUCTIVITY DIVERGENCE:

ZOOMING IN ON REGULATORY POLICY

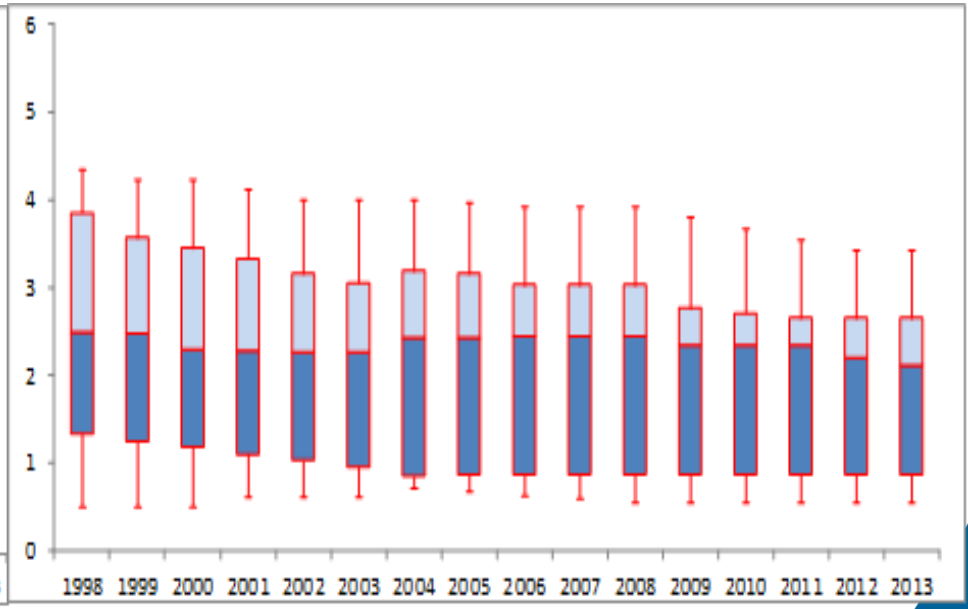
The pace of deregulation in services has slowed

The restrictiveness of product market regulations

A: Network industries



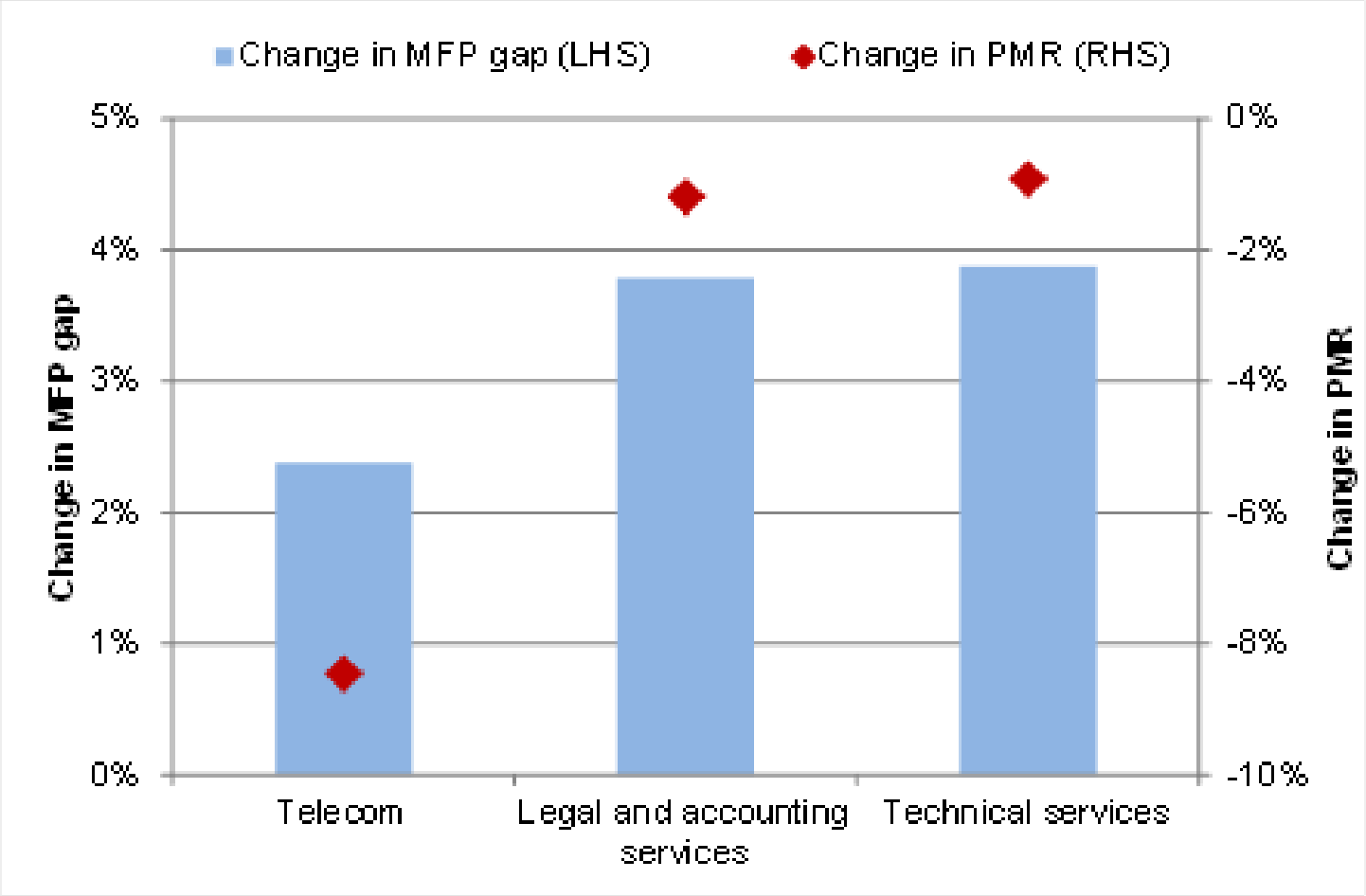
B: Professional Services



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

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

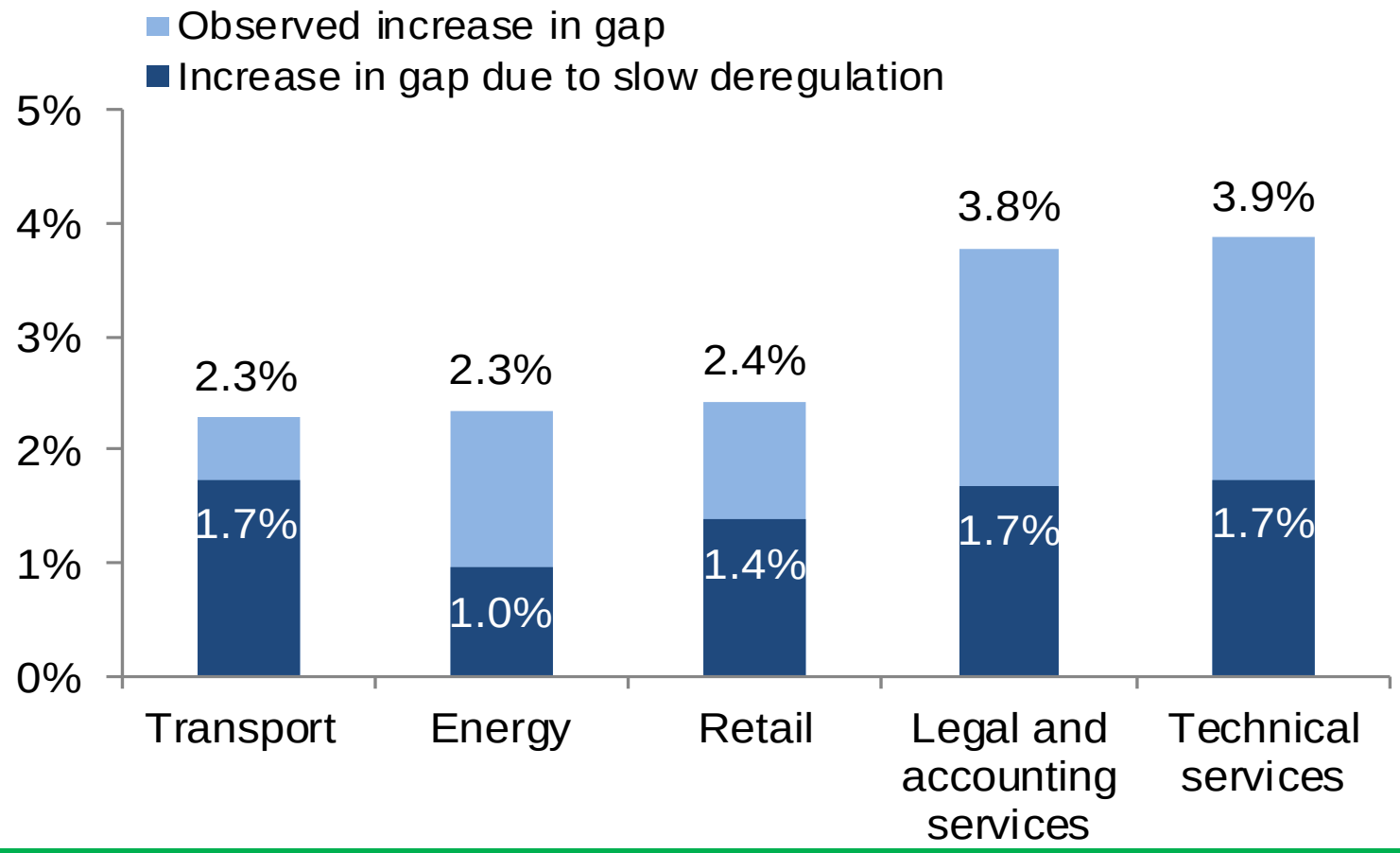
2. Dynamic OLS (Stock and Watson, 1993)

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

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

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)

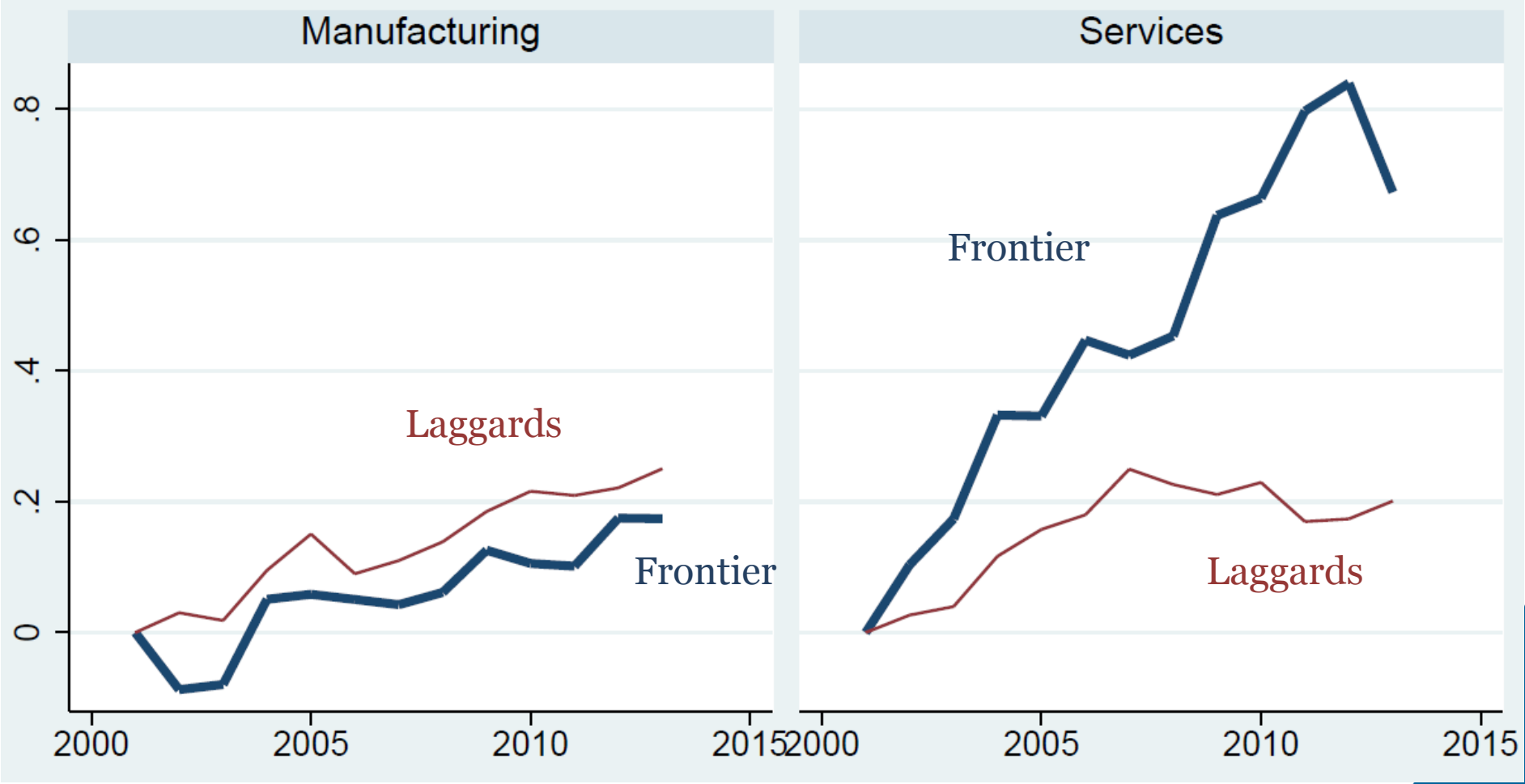


MFP divergence was perhaps inevitable due to structural changes in the global economy but policy could have worked harder

ADDITIONAL SLIDES

How much is divergence a capital deepening story?

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



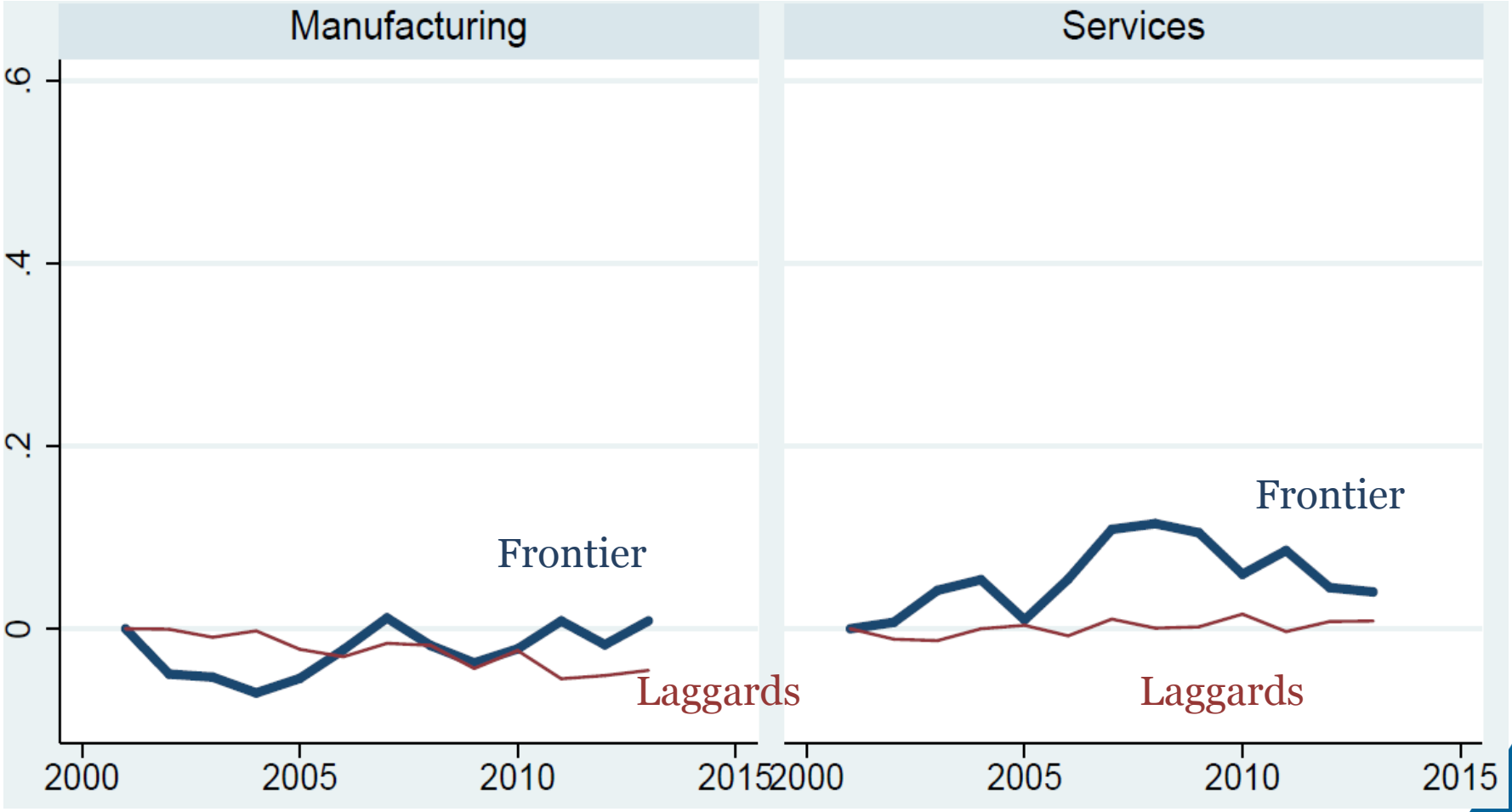
The globally most productive firms: *Who are they?*

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

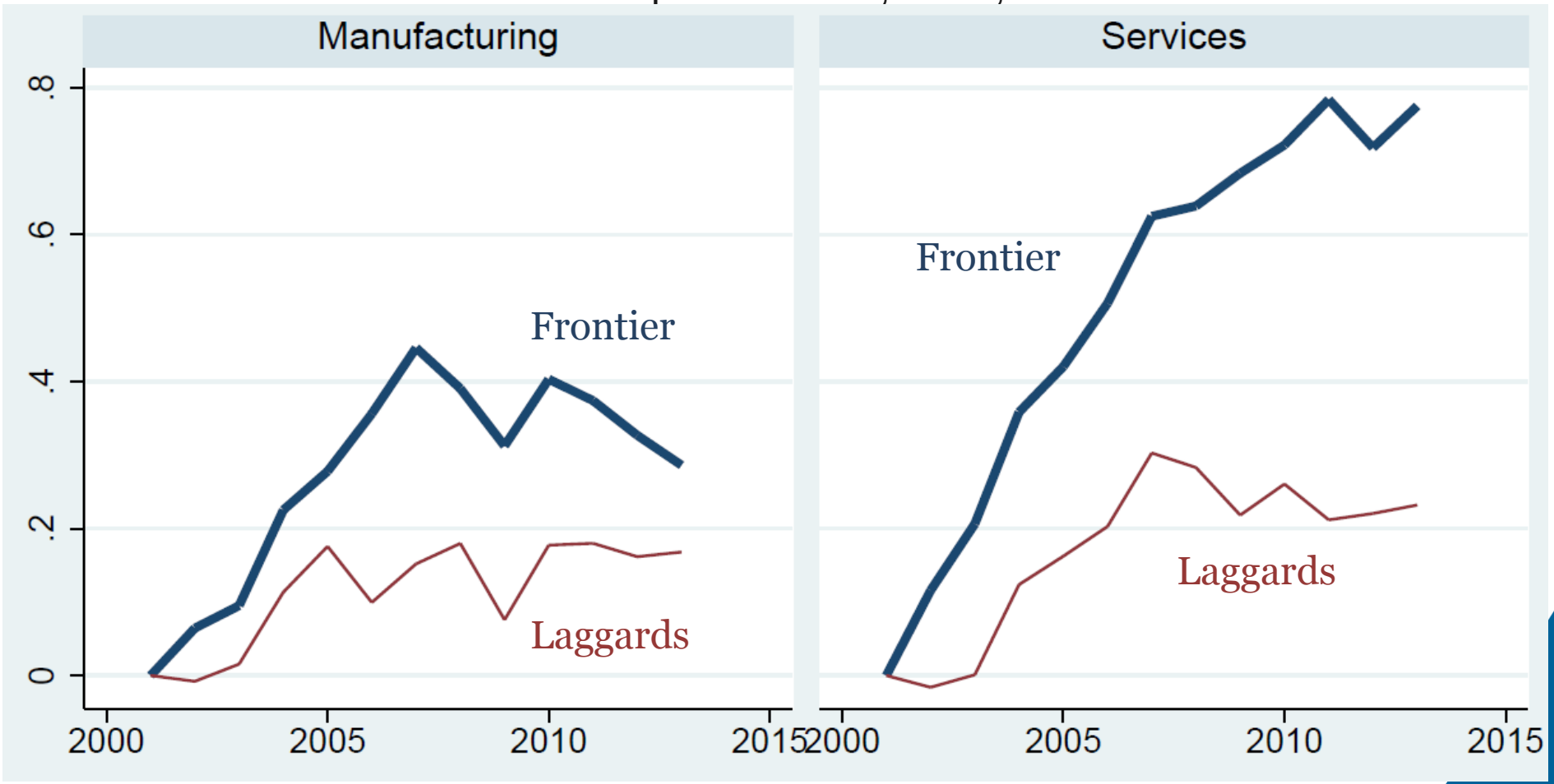
Average estimated mark-up across each 2-digit sector (log, 2001=0)



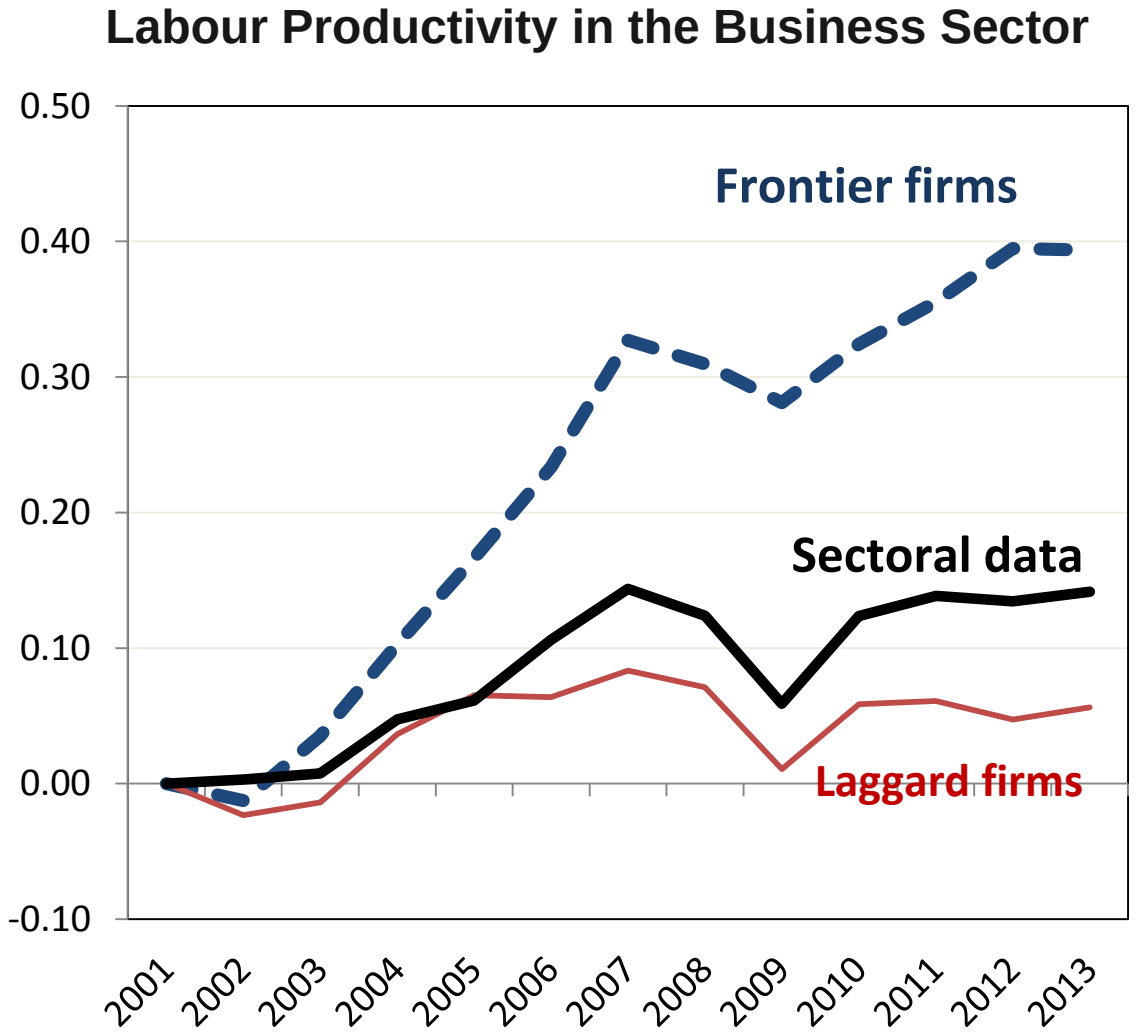
Frontier firms are *getting larger in terms of sales*

Average of log sales for global frontier firms and the rest

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



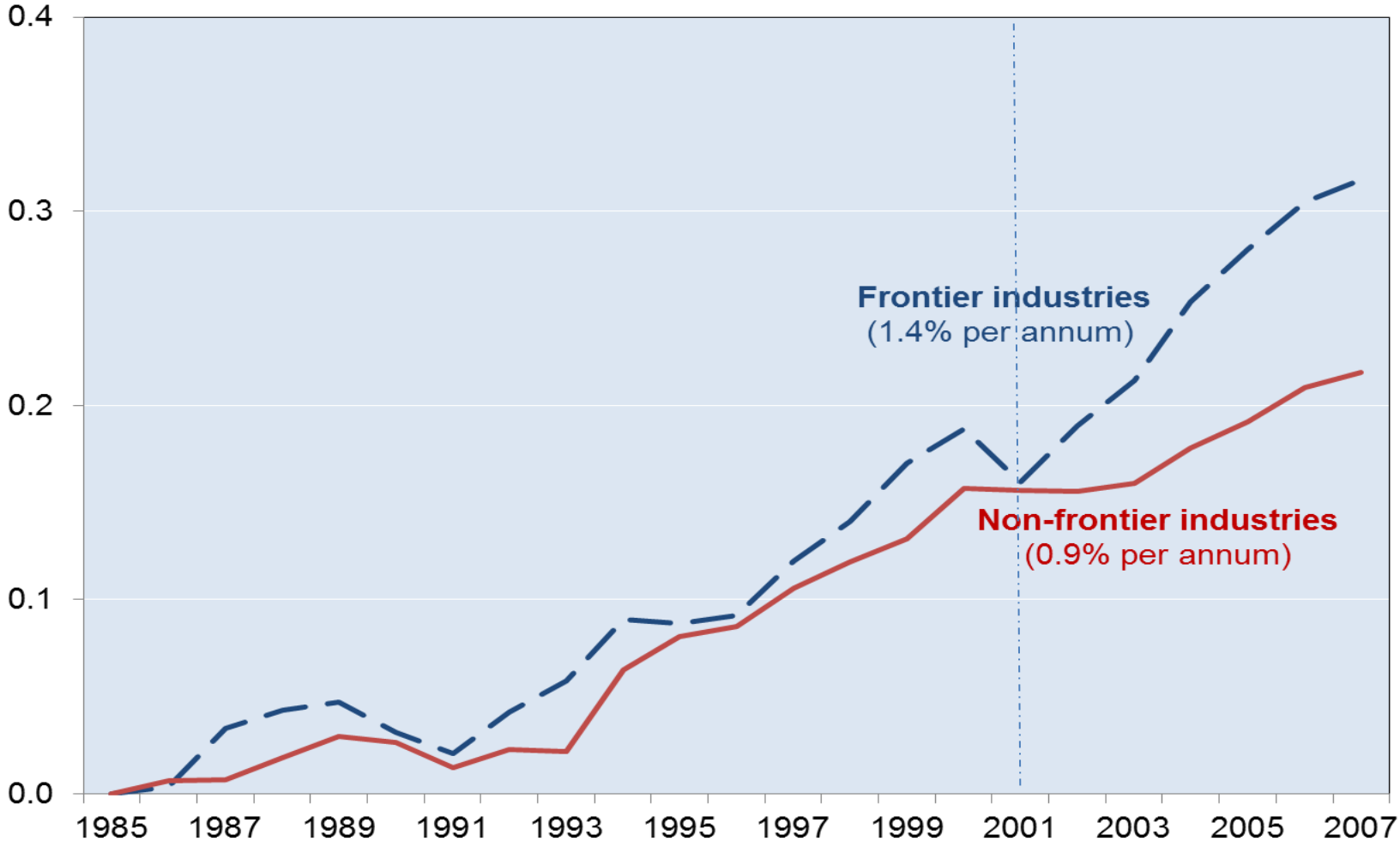
Firm-level patterns *vs* average industry level productivity



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

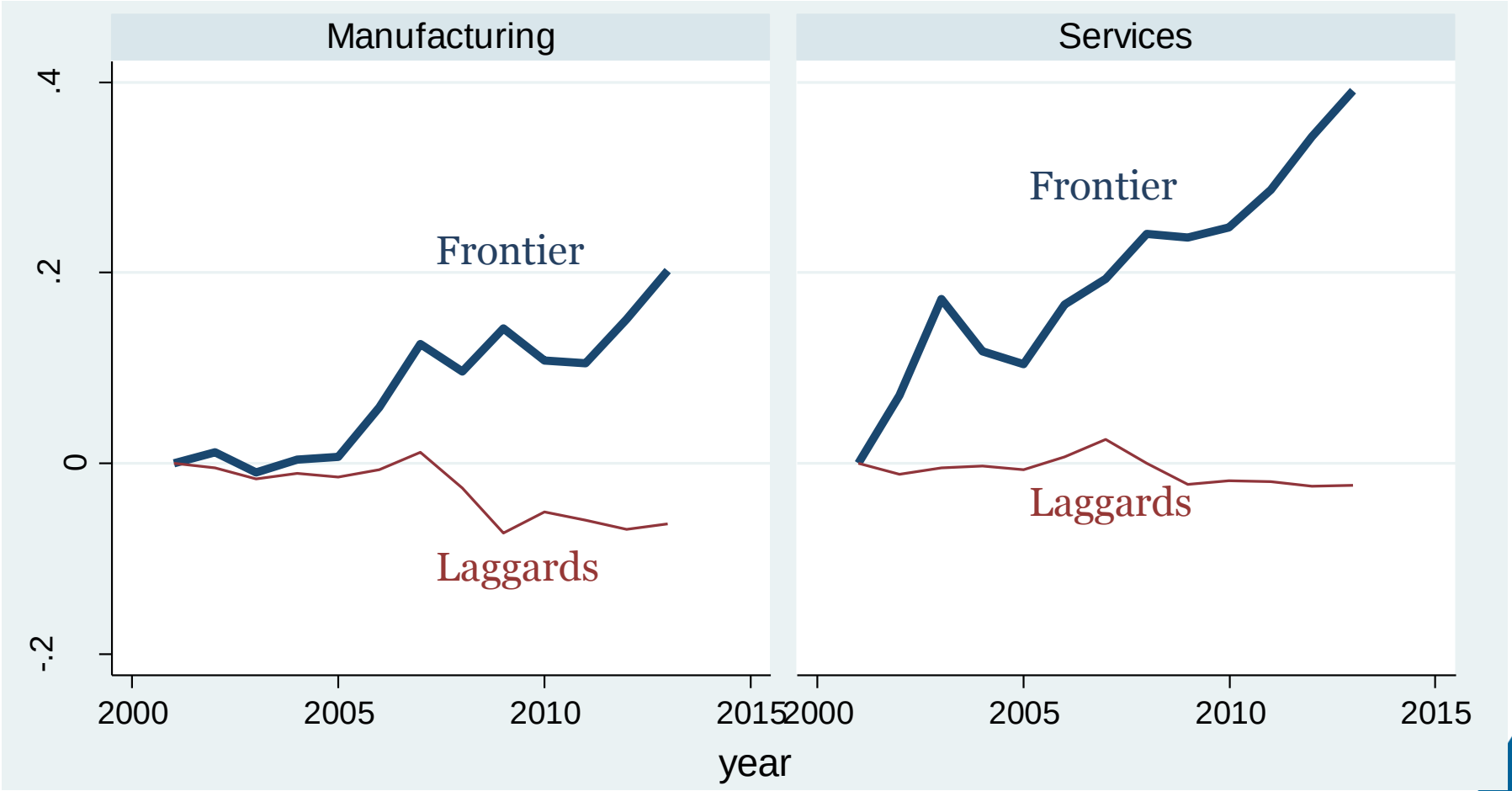
Unweighted average of TFP in the non-farm business sector; index 1985=0



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

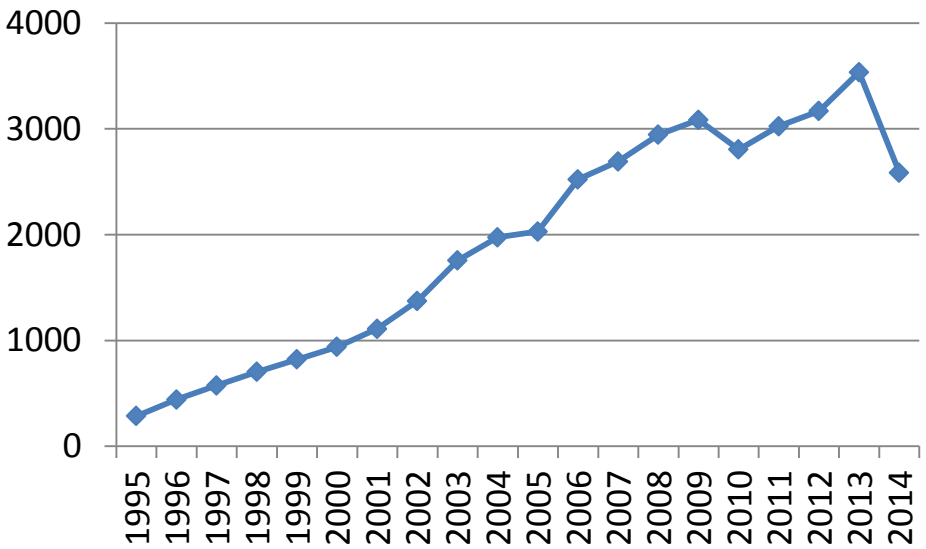
$$\mu_{it} = \frac{P_{it}}{MC_{it}} = Output\ Elasticity_{ikt} / Output\ Share_{ikt} = \frac{\hat{\beta}_{L}^{j}}{ws_{it}}$$

- 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.

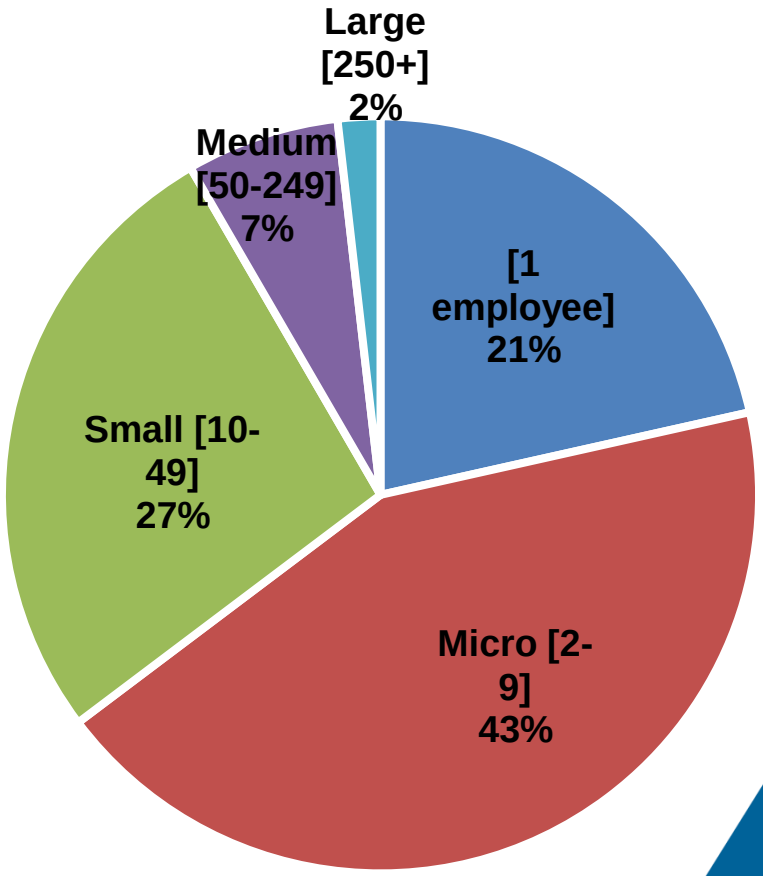
ORBIS: Coverage I

Number of firms by year

Number of firms* by year, in thousands



Firm size distribution (number of employees), 2013*

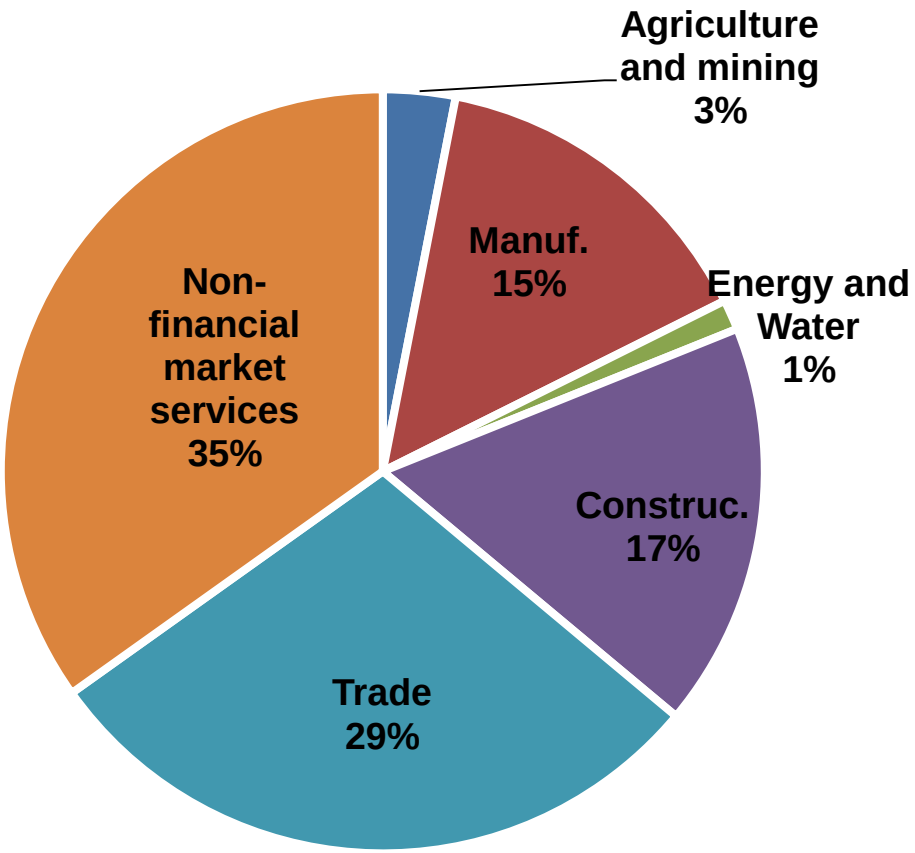


Based on number of accounts with gross turnover and employment information

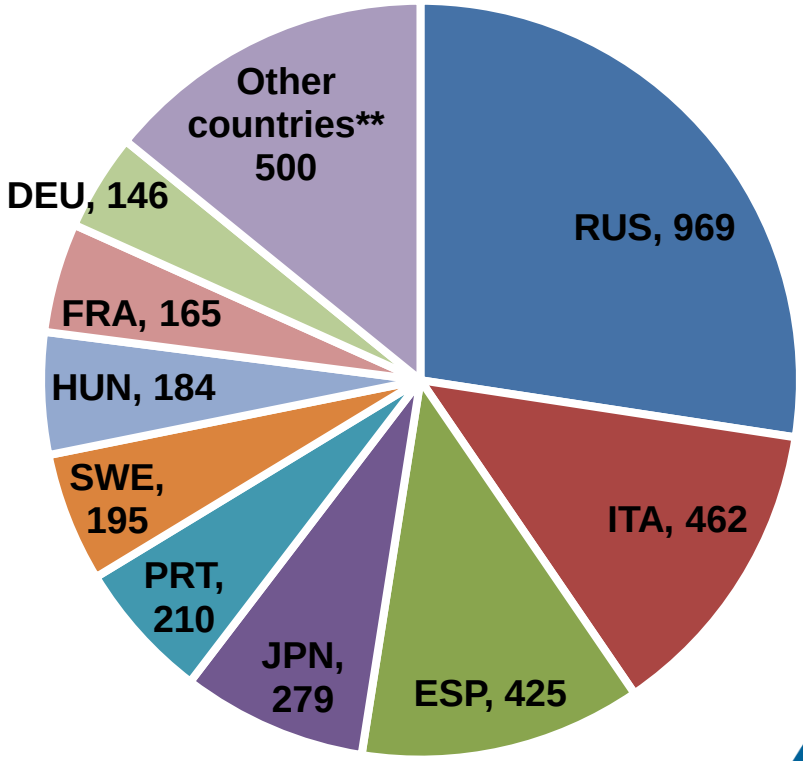
ORBIS: Coverage II

Distribution by country and industry

Share of firms* by industry, 2013



Number of firms* by country, in thousands, 2013



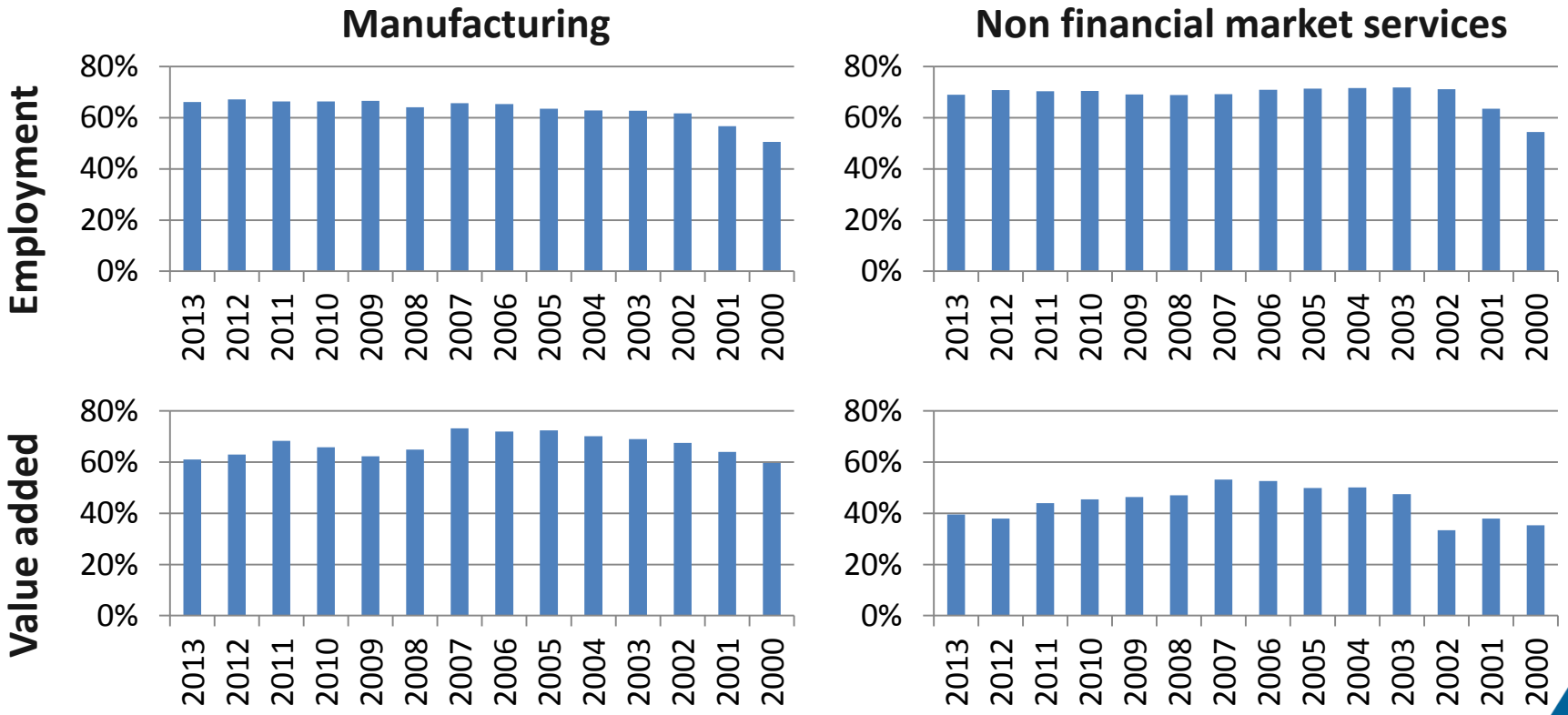
**including USA: 3.25

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?

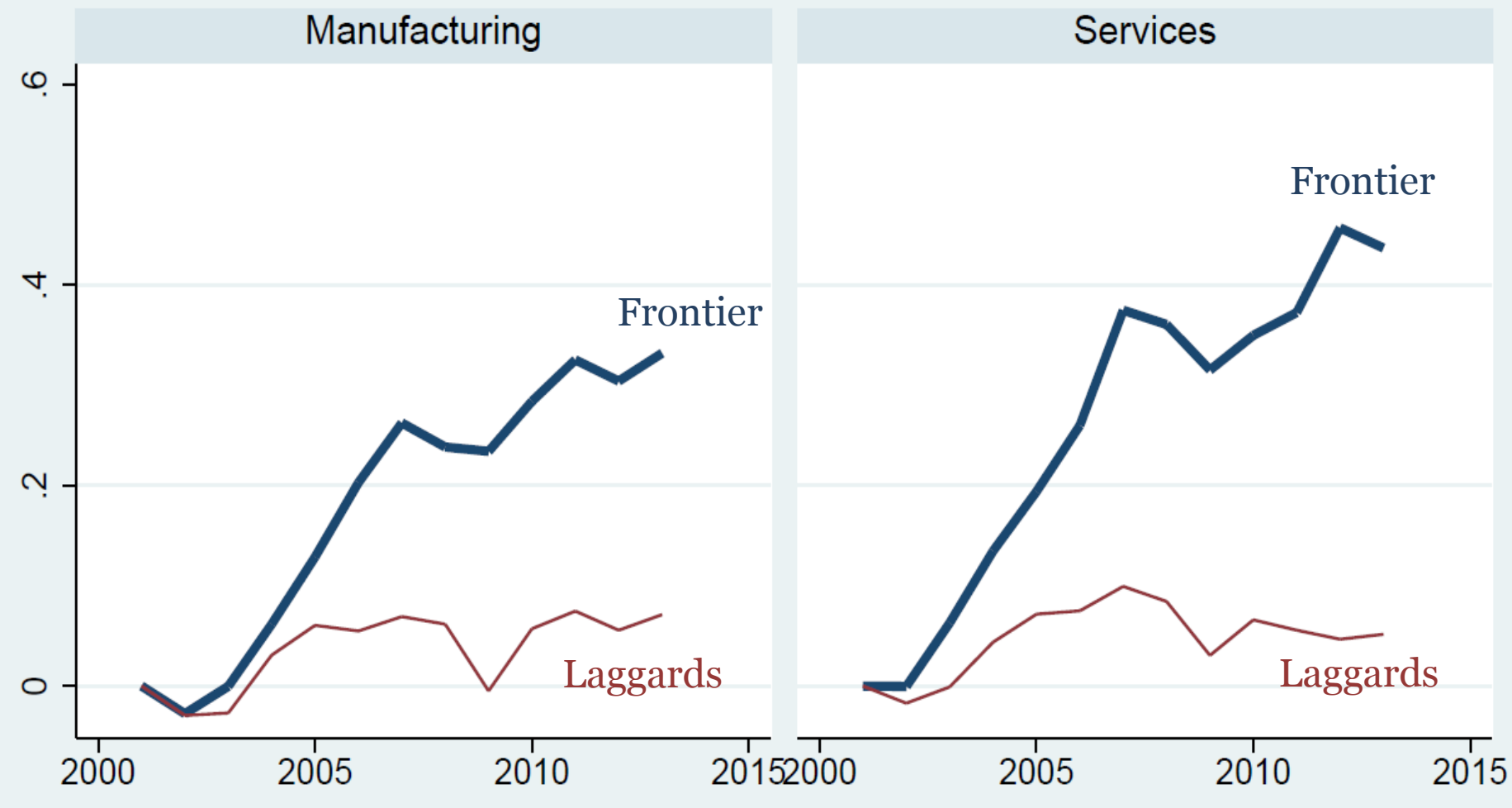
Some of the policy questions that can be answered

- 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?)

"The Best vs. the Rest"

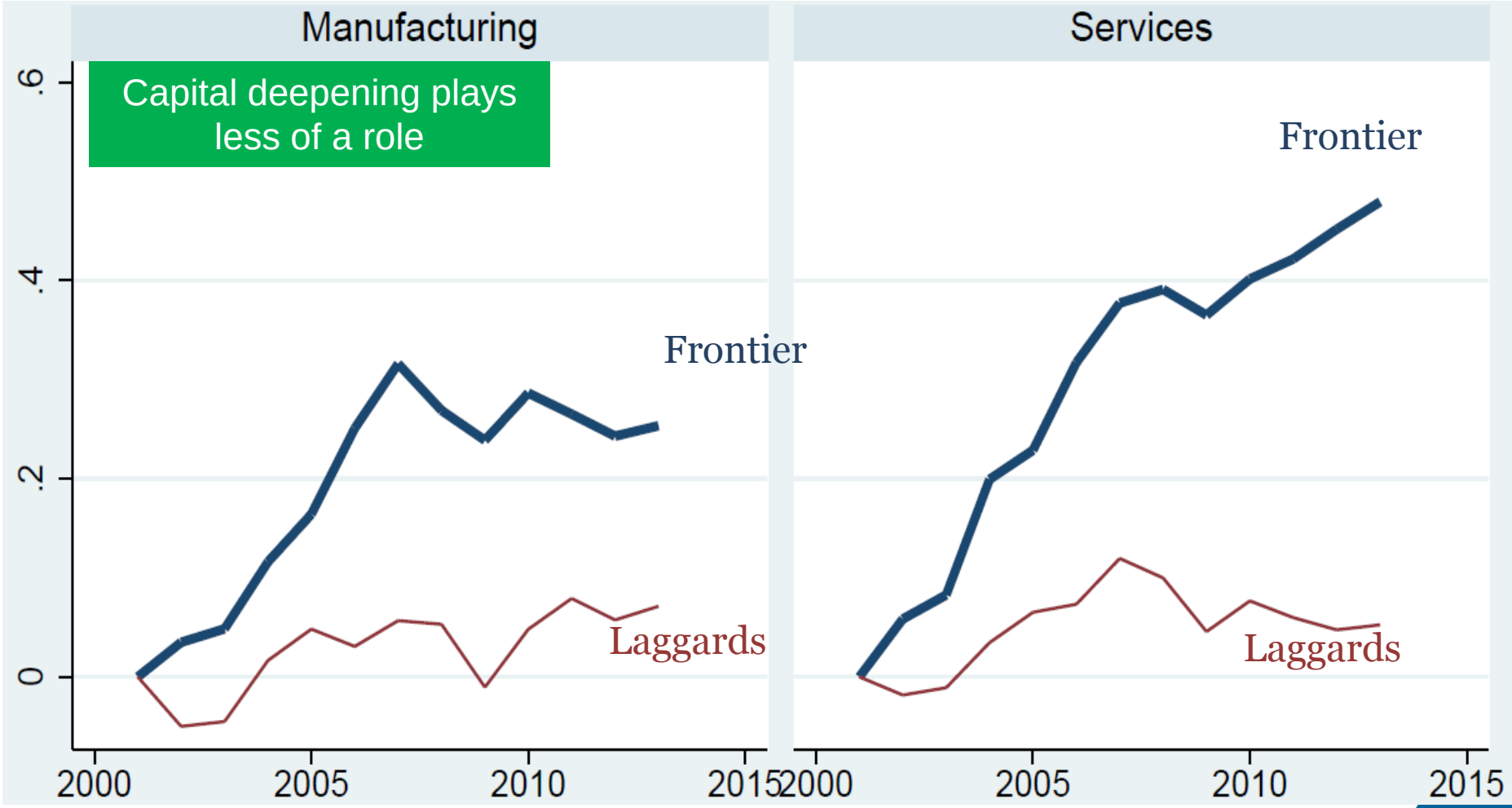
Rising labour productivity gap between global frontier and laggards

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)



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

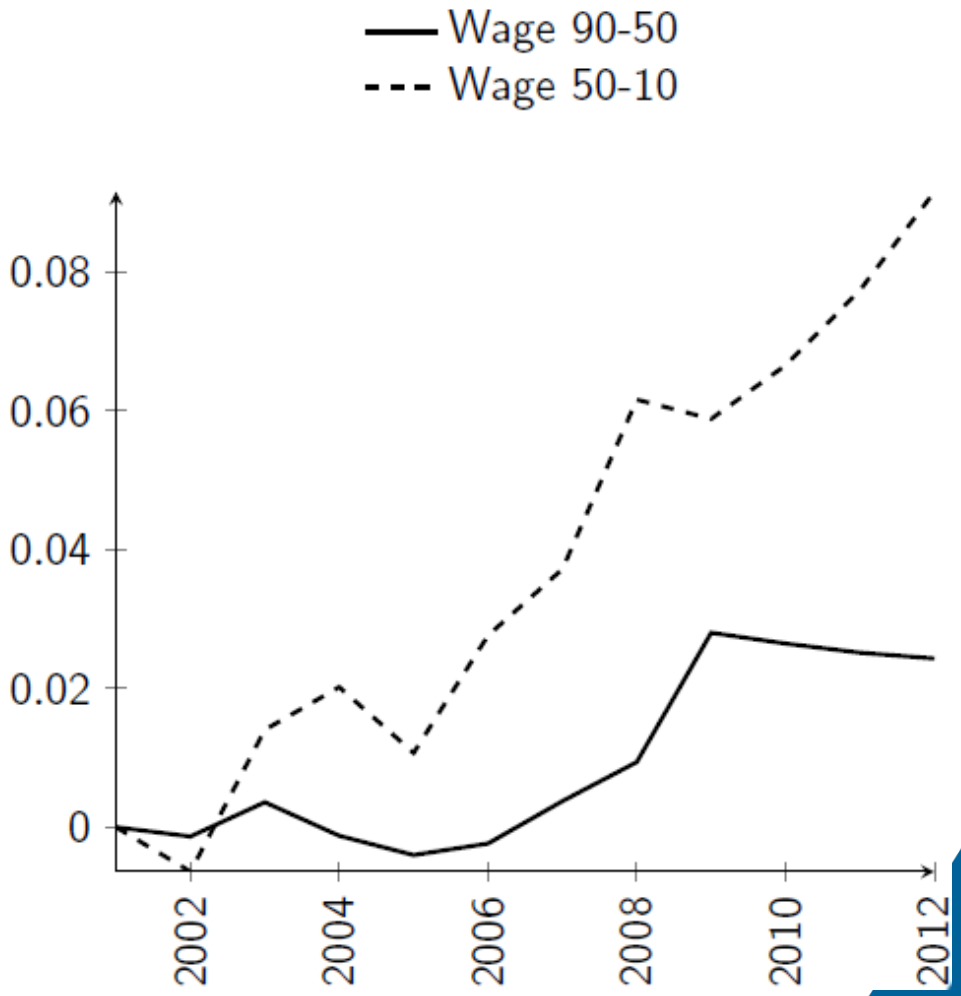
…driven by the bottom of the distribution, too…

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

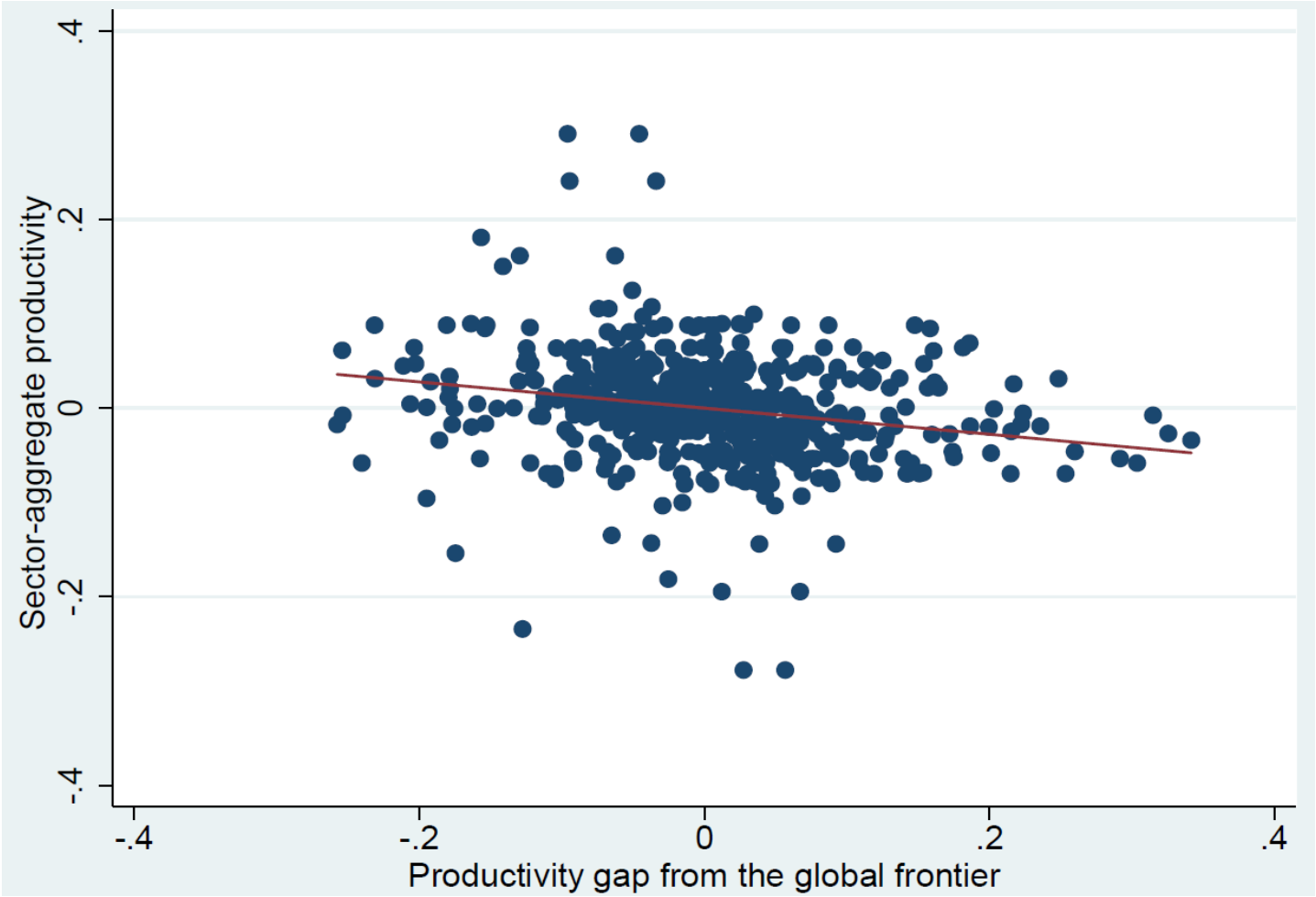
	(1) Log Wage (90-10)	(2) Log Wage (90-10)	(3) Log Wage (90-10)
Log LP (90-10)	0.358***		
	(0.019)		
Log MFP_W (90-10)		0.224***	
		(0.016)	
Log MFP_SW (90-10)			0.047***
			(0.014)
N.	3,739	3,624	3,712
Adjusted R-square	0.988	0.988	0.988
Year FE	YES	YES	YES
Country-sector FE	YES	YES	YES
Nb. Sectors	22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

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

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

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

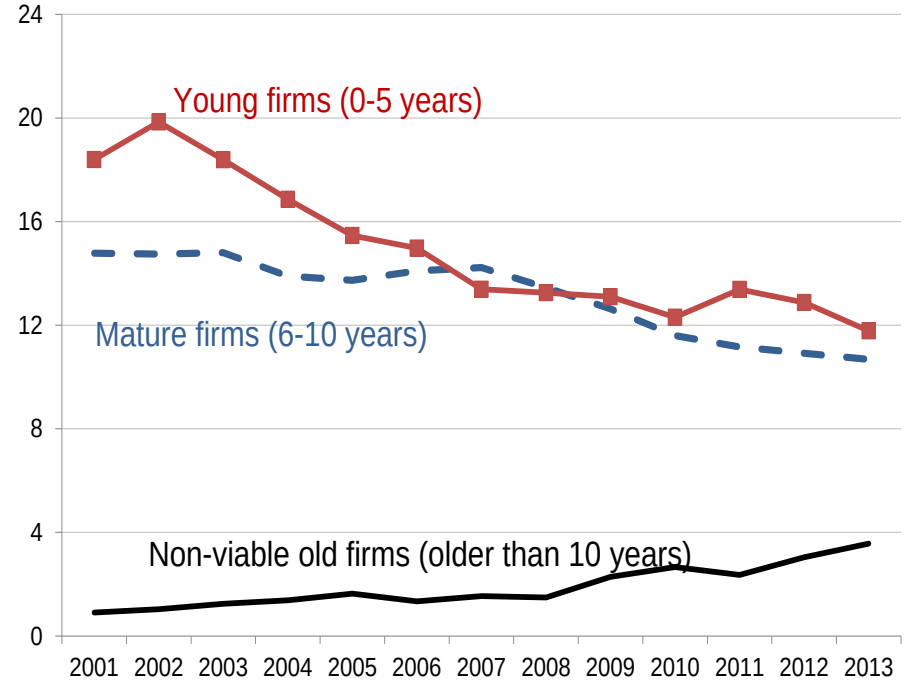
where

- $\Delta Pcjq,t+5$ 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

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

Share of firms

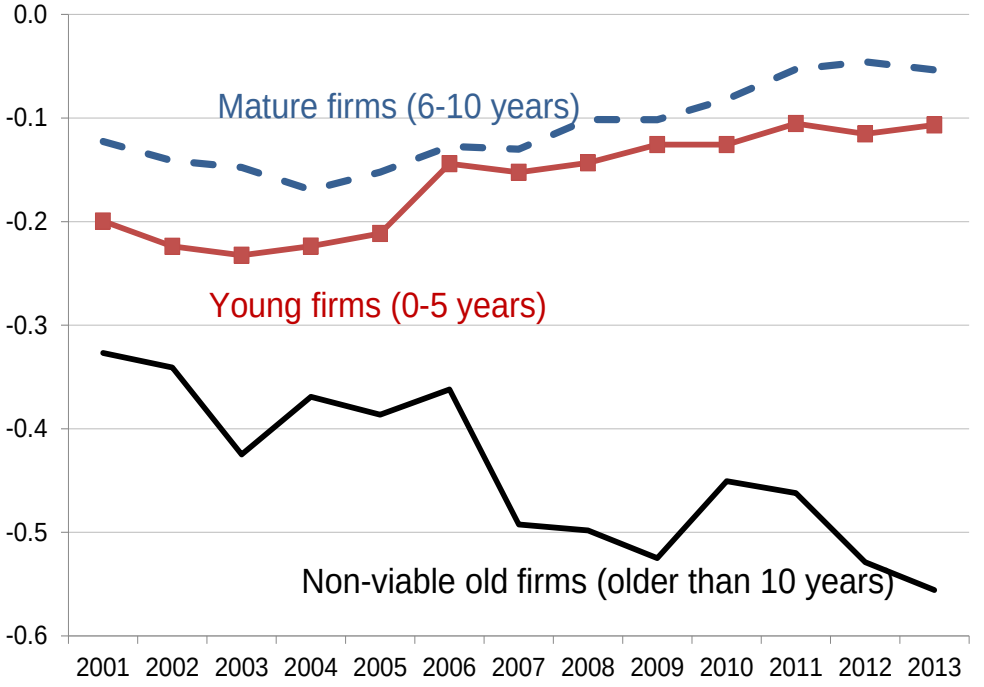
Percent



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

MFPR relative to viable old firms

Log point differential



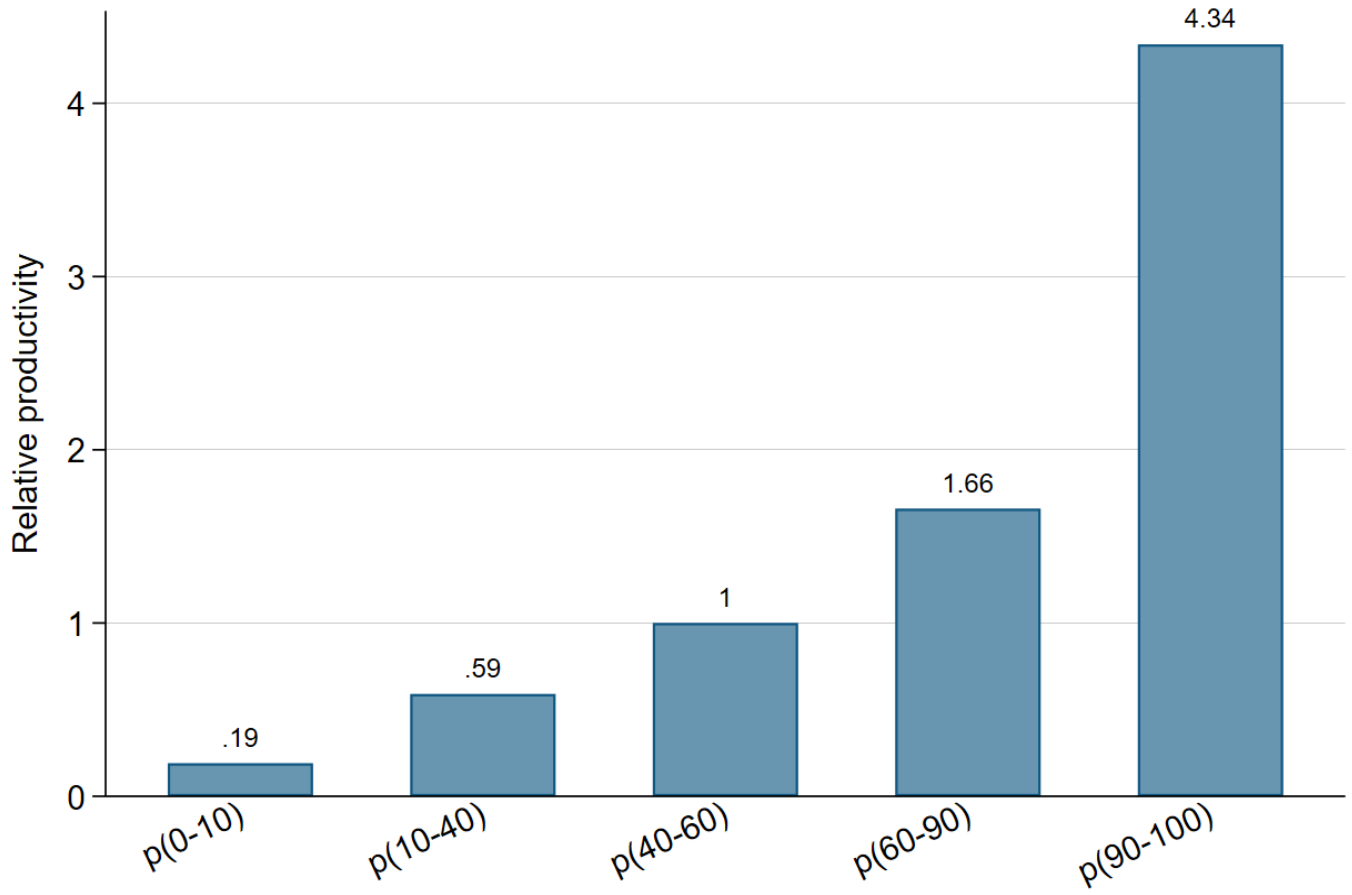
A higher productivity threshold for entry, while marginal firms survive despite a collapse in their MFPR

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).

Bottom not keeping up?

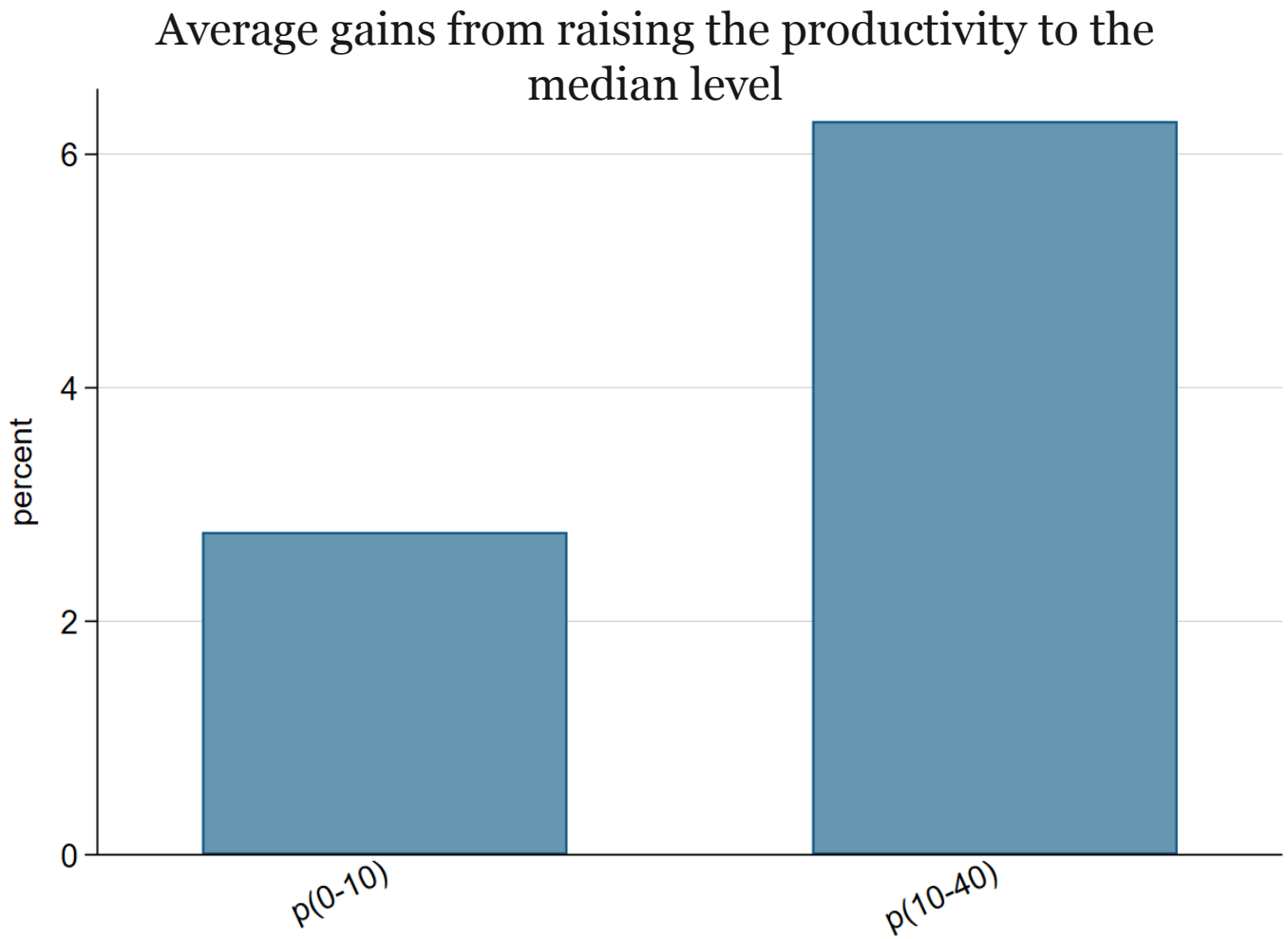
Problems at the ***bottom***: low productivity

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.

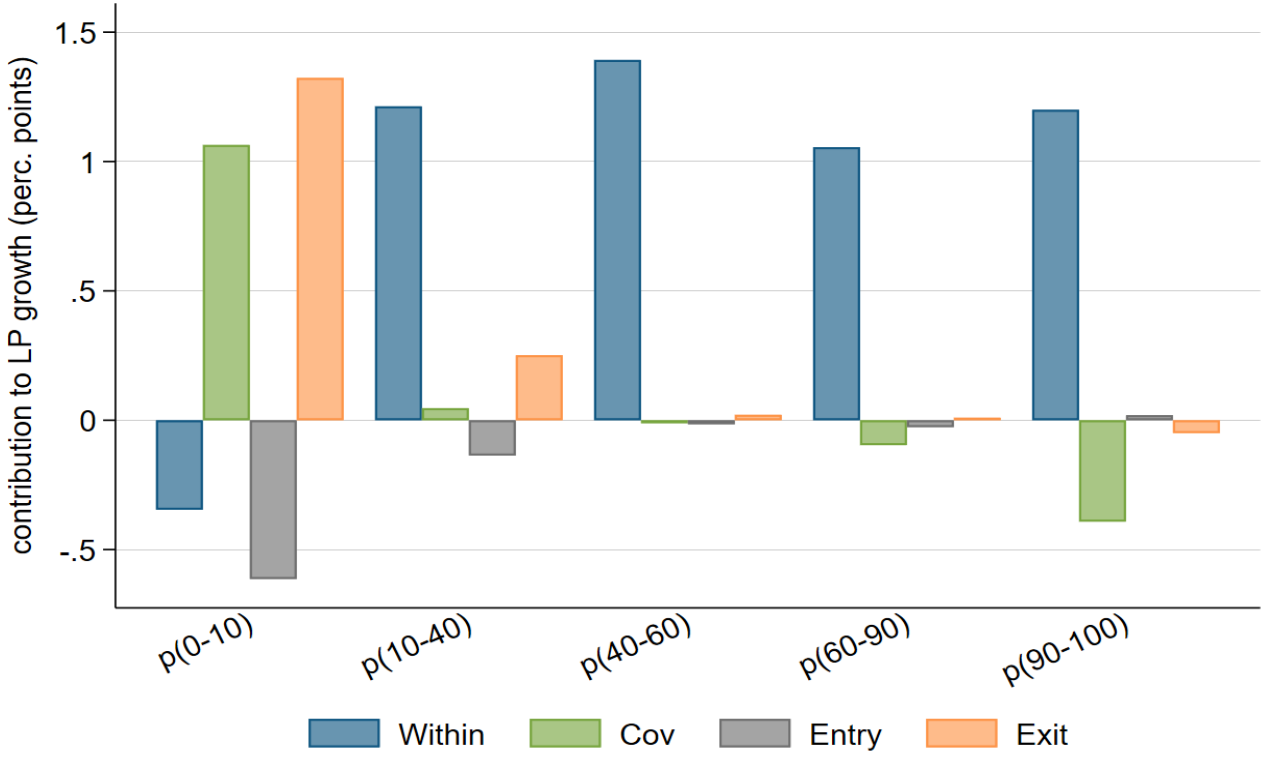
…hence there are sizeable gains from bringing them up to the median



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.

Among laggards, much higher rate of entry, exit and reallocation of resources

Figure: Melitz and Polanec decomposition by productivity LP groups



Note: The figure plots the Meliz and Polanec decomposition in different groups of the productivity distribution. Manufacturing and non-financial market services only. Countries included: AUS, AUT, BEL, CAN, CHL, FIN, FRA, HUN, IRL, ITA, NOR, PRT, SWE.

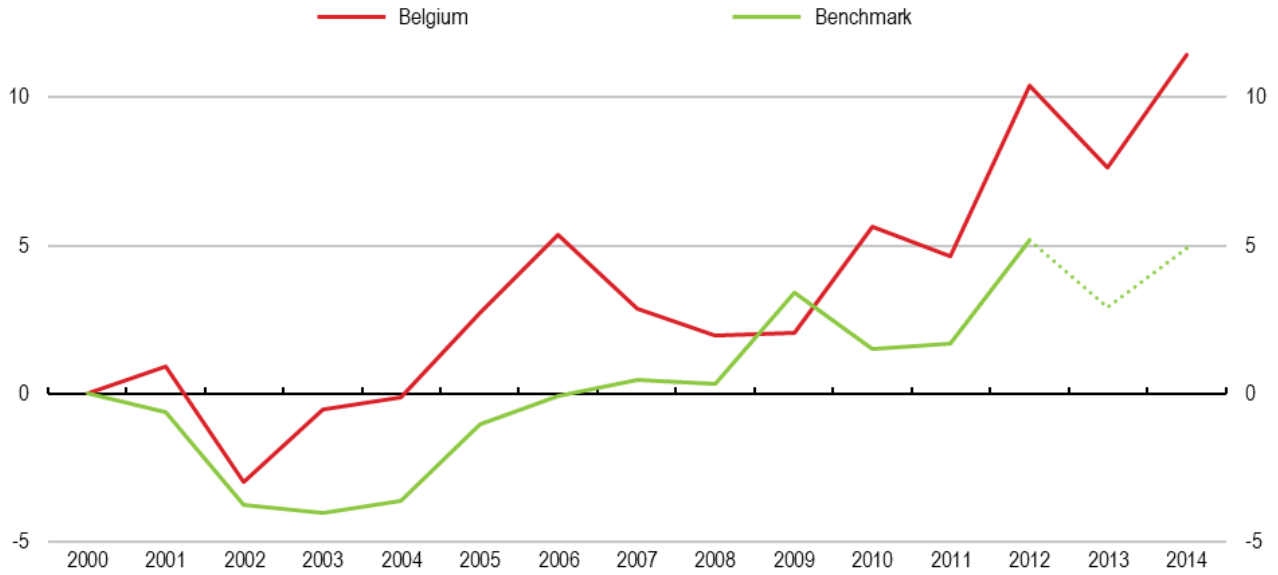
→ When focusing on laggards, a dynamic analysis that goes beyond the "representative firm" is required.

Figure 2.1. The productivity gap between laggards and the domestic frontier has increased more in Belgium than in the benchmark

Cumulative change in the productivity gap between laggards and the national frontier, within industries

Manufacturing and non-financial market services

Belgium vs benchmark, 2000-2014



Note: This figure reports the estimated year dummies of a panel data regression of the average labour productivity gap between laggards and the domestic productivity frontier within industry-productivity performance group pairs in Belgium, and within country-industry-productivity performance group triplets in the set of benchmark countries. Laggards are firms belonging either to the bottom decile of the productivity distribution (0^{th} to 10^{th} percentile) or to the medium-low performance group (10^{th} to 40^{th} percentile). The domestic productivity frontier is defined as the top 10% of the productivity distribution in each country-industry-year triplet. The labour productivity gap is defined as the distance between (log) labour productivity in each country-industry-productivity performance group-year among laggards and (log) LP of the domestic frontier in the corresponding country-industry-year. The first year is taken as the baseline. Results are estimated for manufacturing and non-financial market services based on detailed industries, following the SNA A38 classification (see Desnoyers-James, Calvino and Calligaris, (2019[10]). Benchmark countries include Denmark, Finland, France, Hungary, Ireland, Italy, Norway, Portugal and Sweden. The period considered is 2000-2014. The dashed line for the benchmark after 2012 indicates that the estimates are based on a smaller number of countries (see Box 2.5).

Source: MultiProd Database, February 2019.

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.

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)

The global frontier: Who are they?
Basic descriptives

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

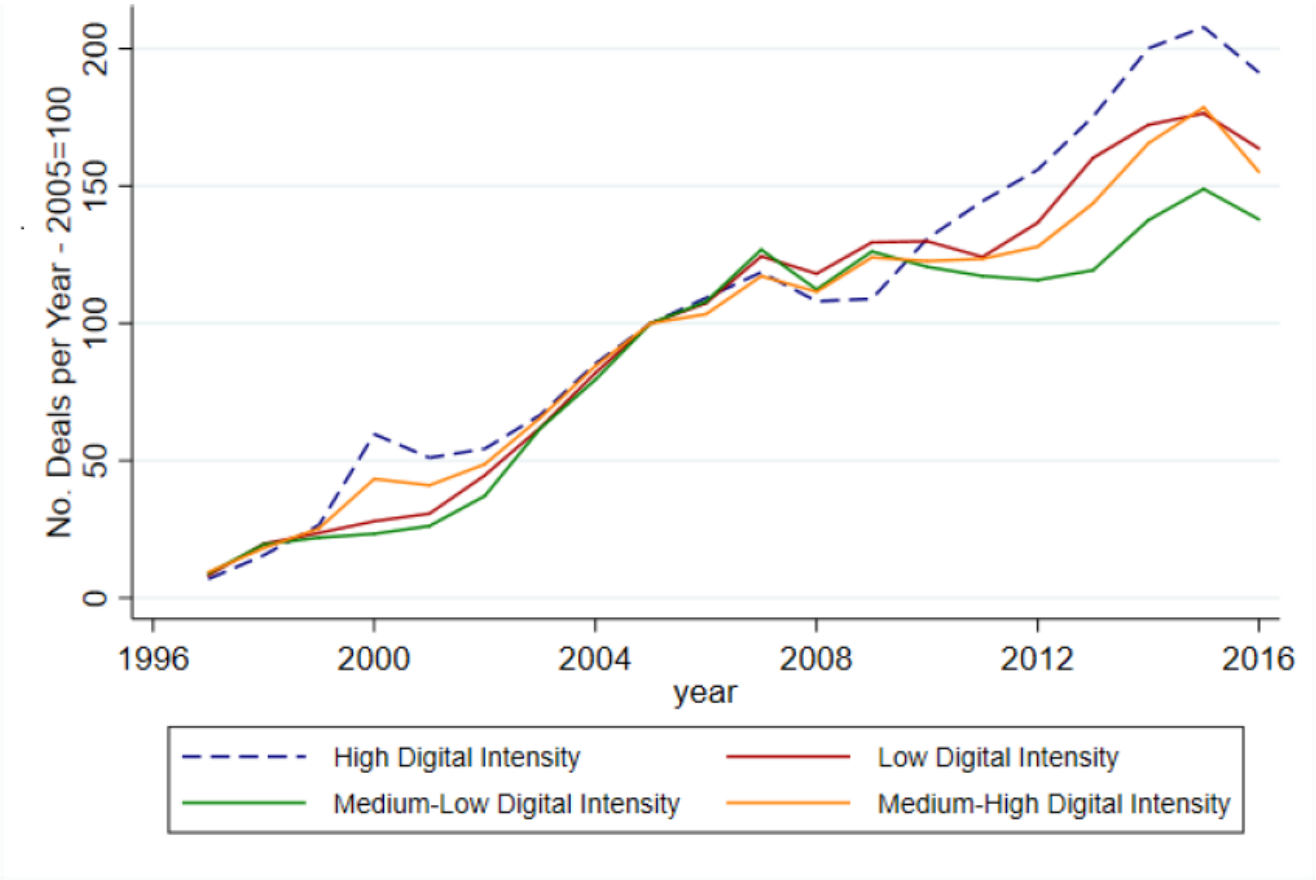
… More so in services than in manuf.

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	

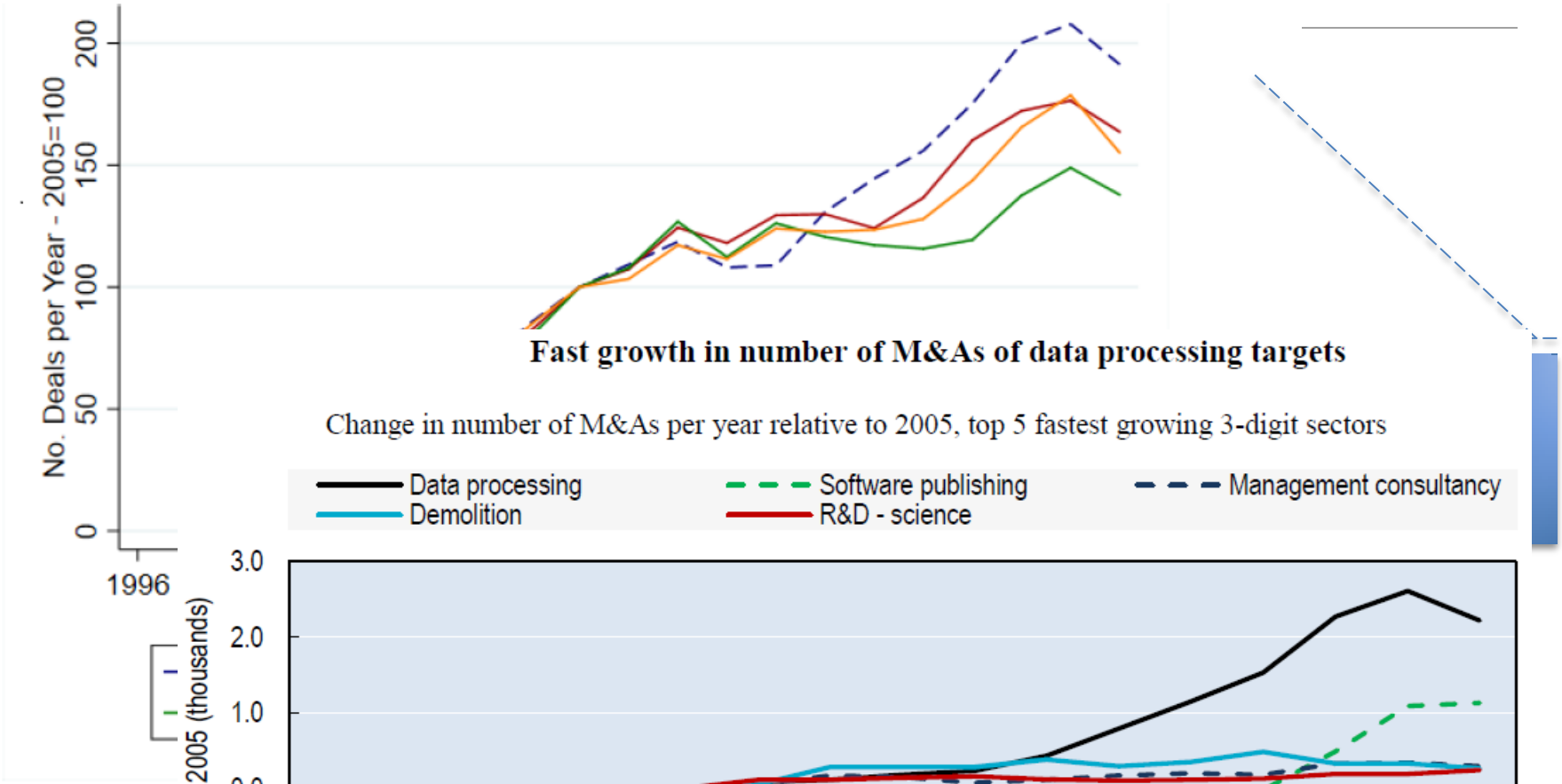
Number of M&As per Year by Digital Intensity of the Target Firm Industry



Note: The digital intensity of sectors is defined using the industry of the target firm and the STAN A38 global digital intensity indicator of 2013-15 constructed by (Calvino et al., 2017). The M&A data reflects the annual total number of acquisitions (i.e. result in a majority stake), purchasing minority stakes and issuing of new share capital involving target firms in the non-farm non-financial business sector (i.e. NACE rev.2 codes 10-82, excluding 64-66). Note M&A data has global coverage from 2003 onwards, statistics before that point should be interpreted cautiously.

Source: Zephyr M&A database.

Number of M&As per Year by Digital Intensity of the Target Firm Industry

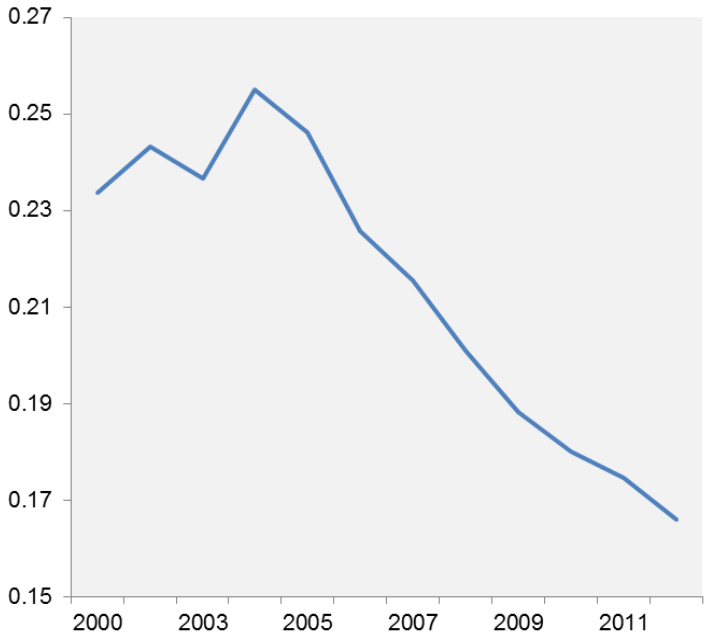


Fast growth in number of M&As of data processing targets

Note: The digital inte
digital intensity indic
total number of acqui
capital involving tar
excluding 64-66). No
interpreted cautiously
Source: Zephyr M&A

Note: Industry reflects the primary NACE rev.2 industry of the target firm. Show for the top 5 3 digit industries with the fastest growth in number of deals over 2005-2016.
Source: BvD Zephyr M&A Database.

Share of entrants in total output



Contribution of entrants to aggregate productivity growth

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

Slowing business dynamism leads to a declining contribution of new firms to productivity growth

Source: OECD; MultiProd project, May 2017. Data refer to manufacturing and non-financial business services.