THE GLOBAL PRODUCTIVITY SLOWDOWN, TECHNOLOGY DIVERGENCE AND PUBLIC POLICY: *A FIRM LEVEL PERSPECTIVE*

Dan Andrews†, Chiara Criscuolo†† & Peter N. Gal †

† Economics Department

†† Directorate for Science, Technology and Innovation

Slow Growth in Productivity: Causes, Consequences and Policies

Brookings Institution | 8 September 2016

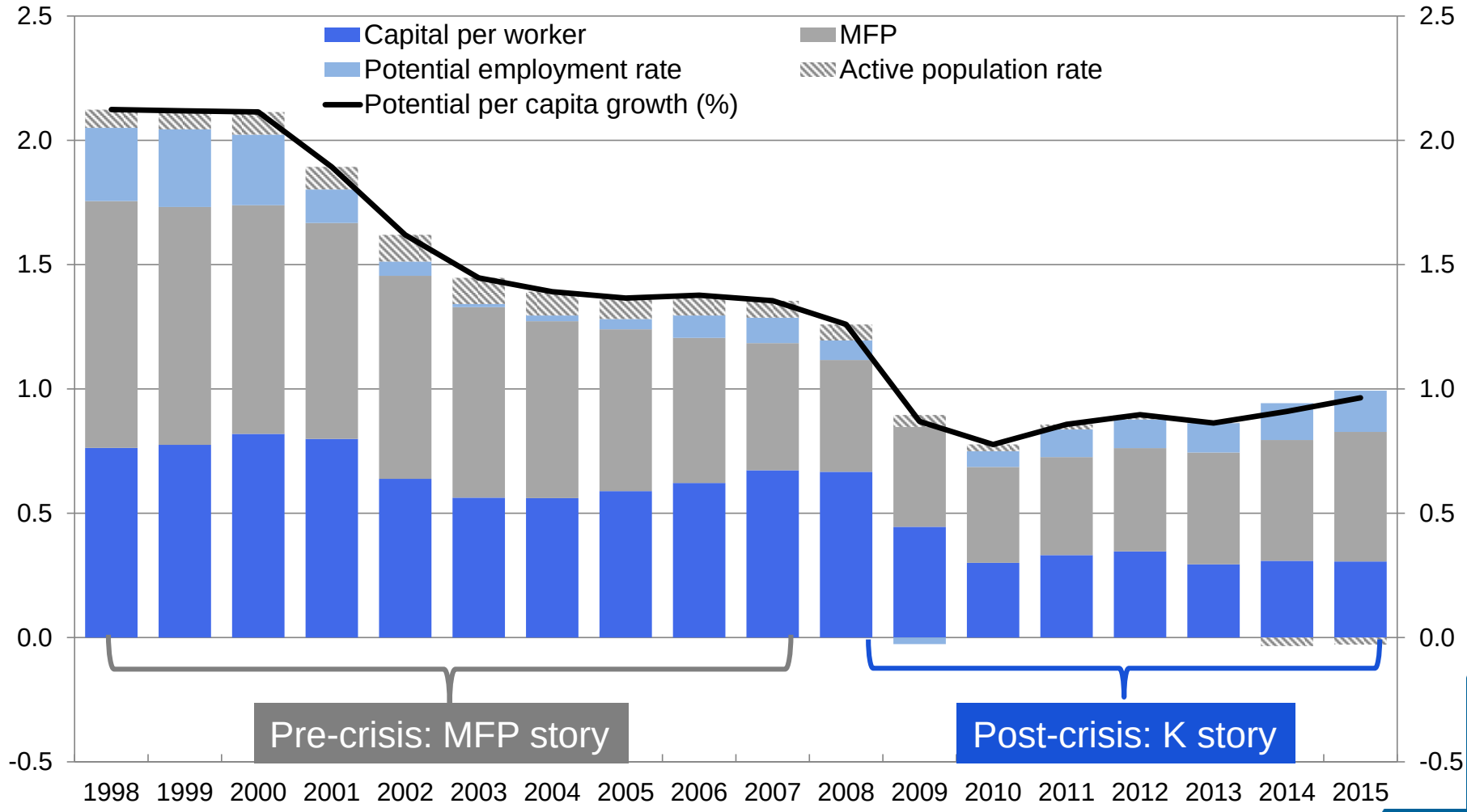
GLOBAL FORUM ON PRODUCTIVITY

OECD

BETTER POLICIES FOR BETTER LIVES

Weak labour productivity underpins the collapse in OECD potential growth

Contribution to potential per capita output growth (% pts unless otherwise noted)



Source: OECD Economic Outlook 2016, Volume 1.

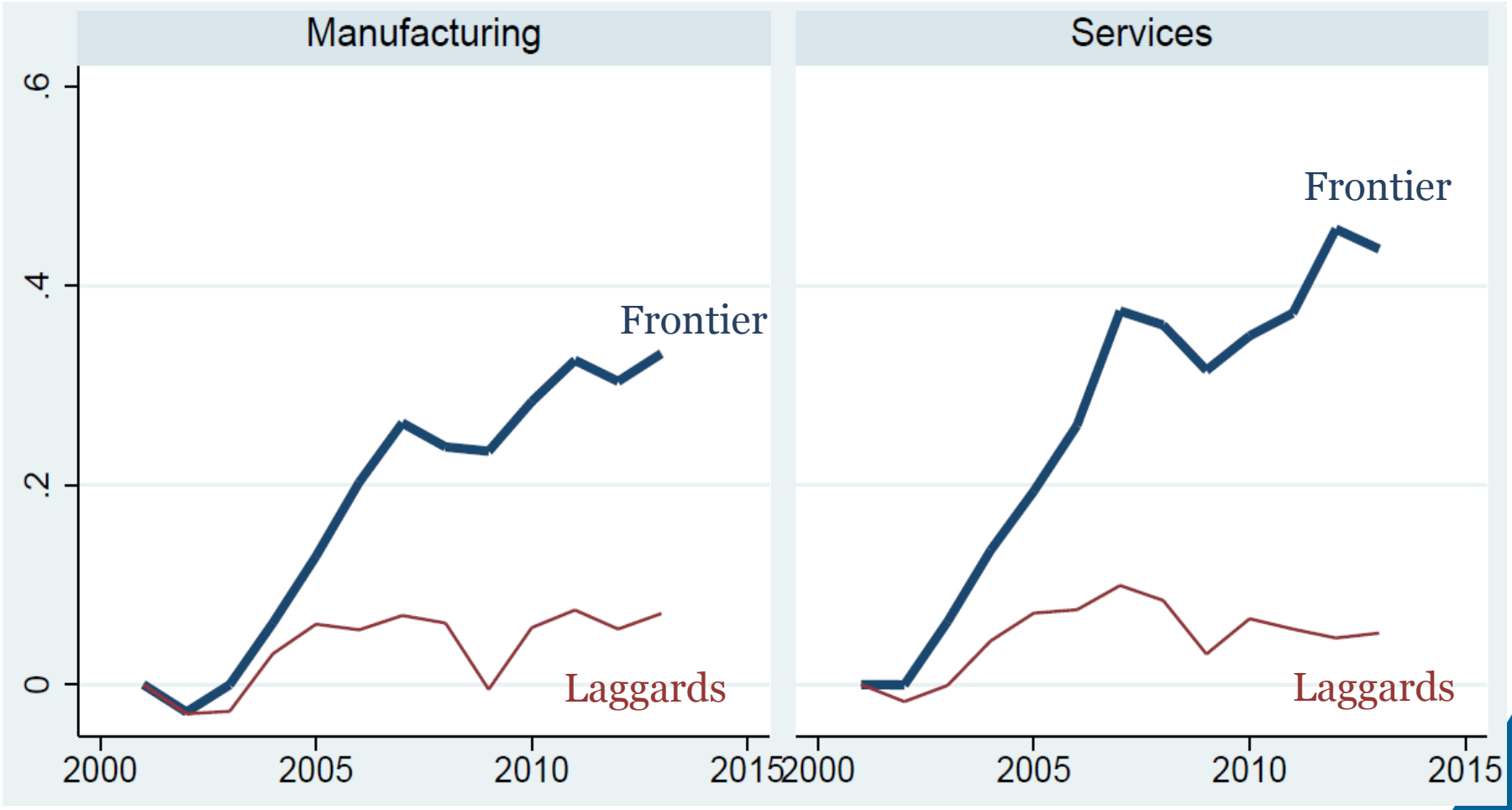
Our contribution: *bringing micro evidence to a largely macro debate*

- The debate (e.g. Gordon *vs* Brynjolfsson) has centred on innovation prospects at the global frontier (GF) but we know little about GF firms.
- Our **firm level** analysis suggests:
  - Labour productivity (LP) at GF remained robust but laggard firms increasingly fell behind.
  - LP divergence reflects MFPR divergence and possibly technological divergence, broadly defined (i.e. intangibles).
  - Some explanations: “winner takes all” dynamics and stalling diffusion.
  - Policy weakness potentially amplified MFPR divergence and the aggregate productivity slowdown.

PRODUCTIVITY DIVERGENCE: *NEW FIRM LEVEL EVIDENCE FROM 24 COUNTRIES*

Rising labour productivity gap between global frontier and laggards

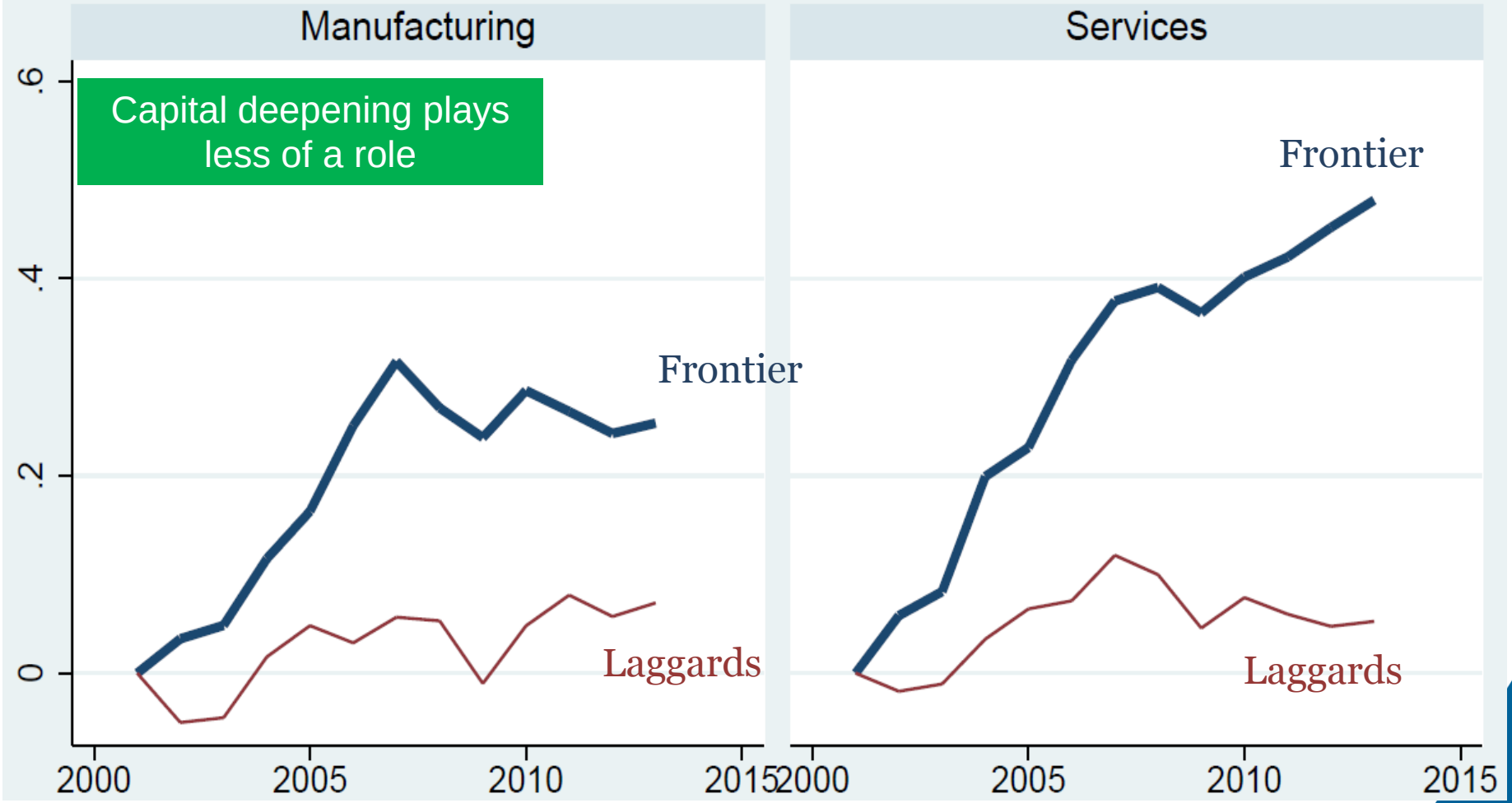
Average of labour productivity across each 2-digit sector (log, 2001=0)



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

... largely reflects MFPR divergence

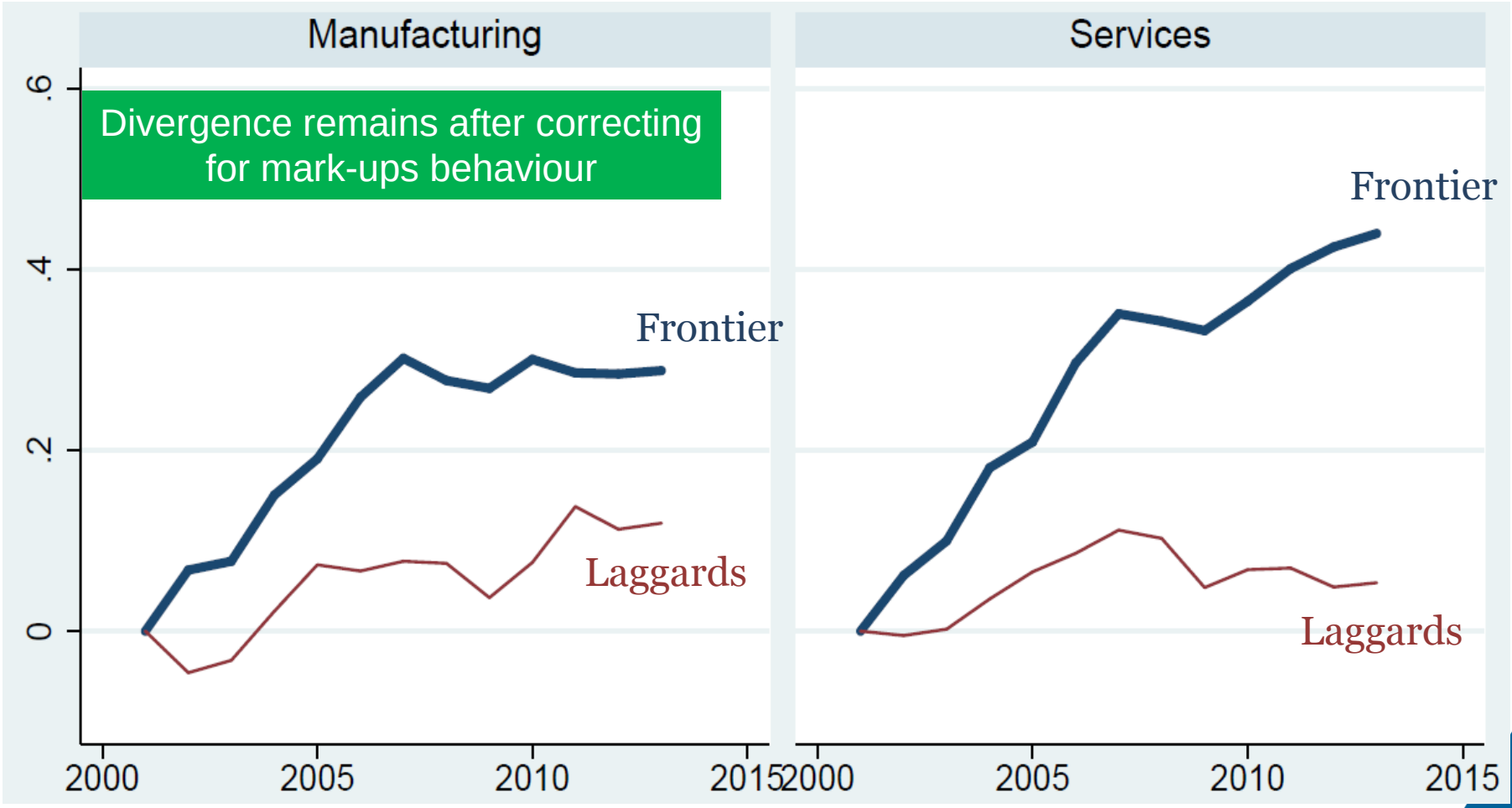
Average of MFPR (Wooldridge) across each 2-digit sector (log, 2001=0)



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

... which may reflect technological divergence

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



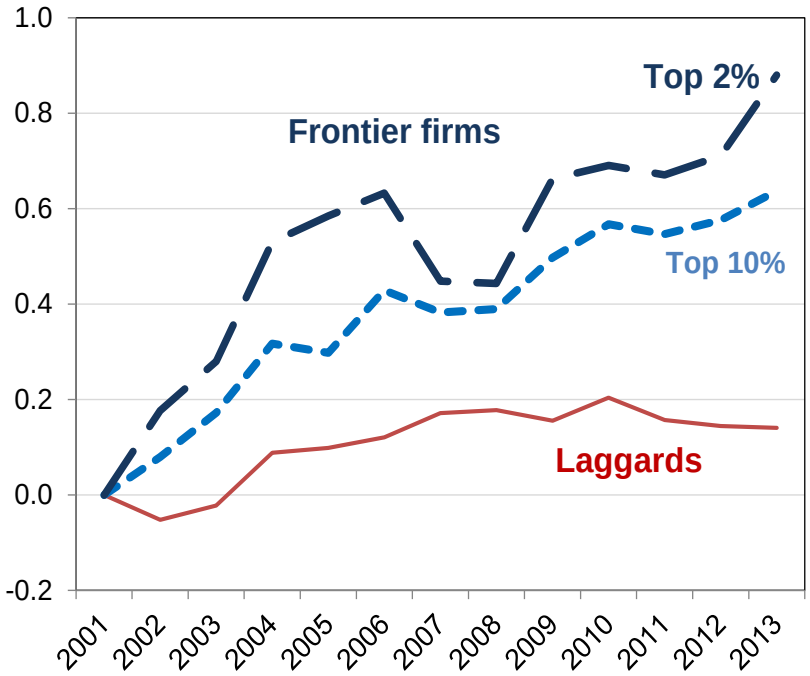
Source: Andrews, D. C. Criscuolo and P. Gal (2016), "The Global Productivity Slowdown, Technology Divergence and Public Policy: a Firm Level Perspective", *forthcoming.*

PRODUCTIVITY DIVERGENCE: *STRUCTURAL DRIVERS*

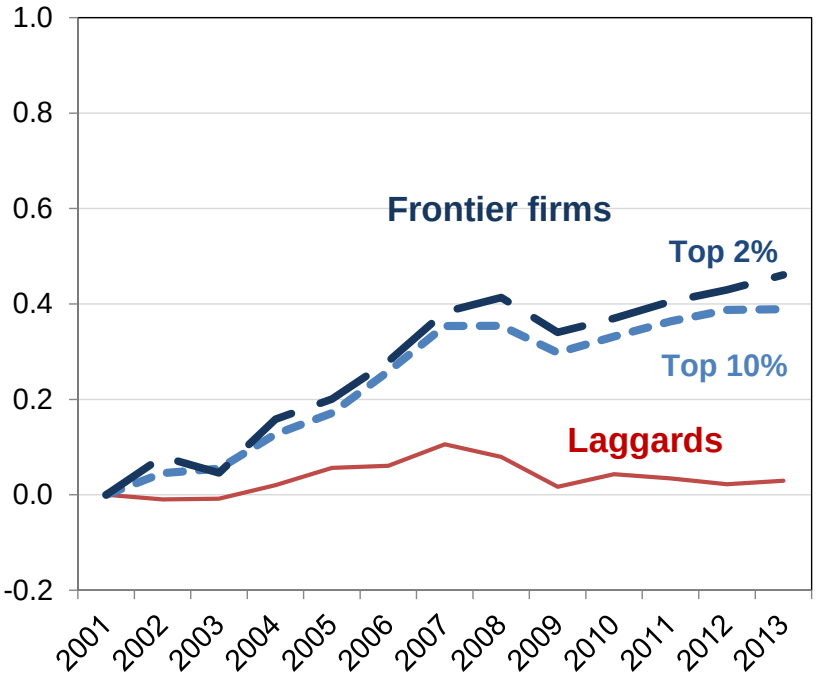
Technological divergence: *winner takes all dynamics?*

MFPR

ICT-intensive services



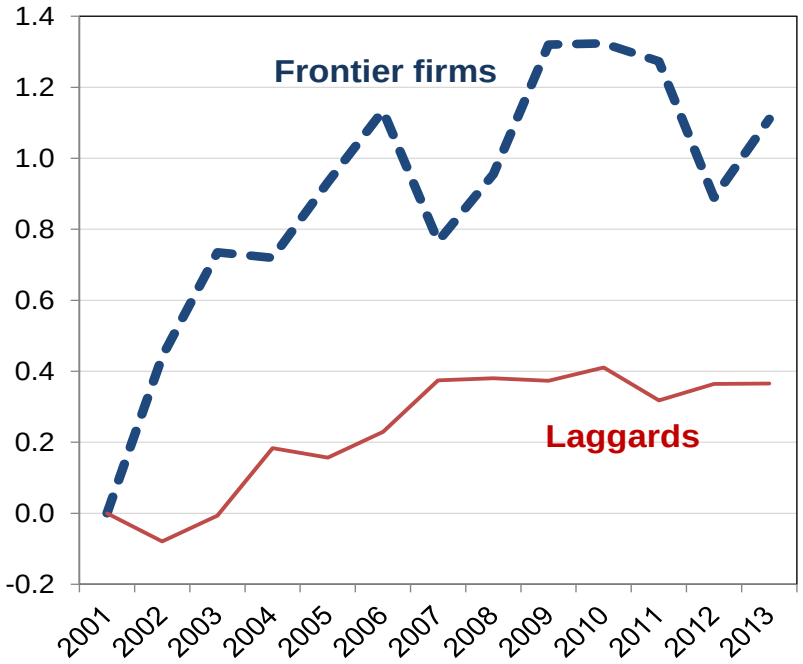
Non ICT-intensive services



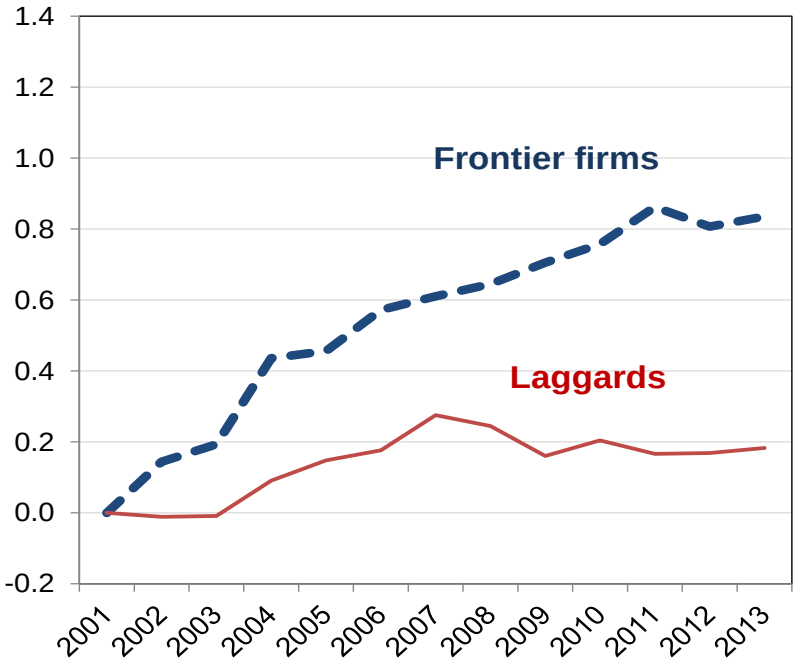
Technological divergence: *winner takes all dynamics?*

Sales

ICT-intensive services



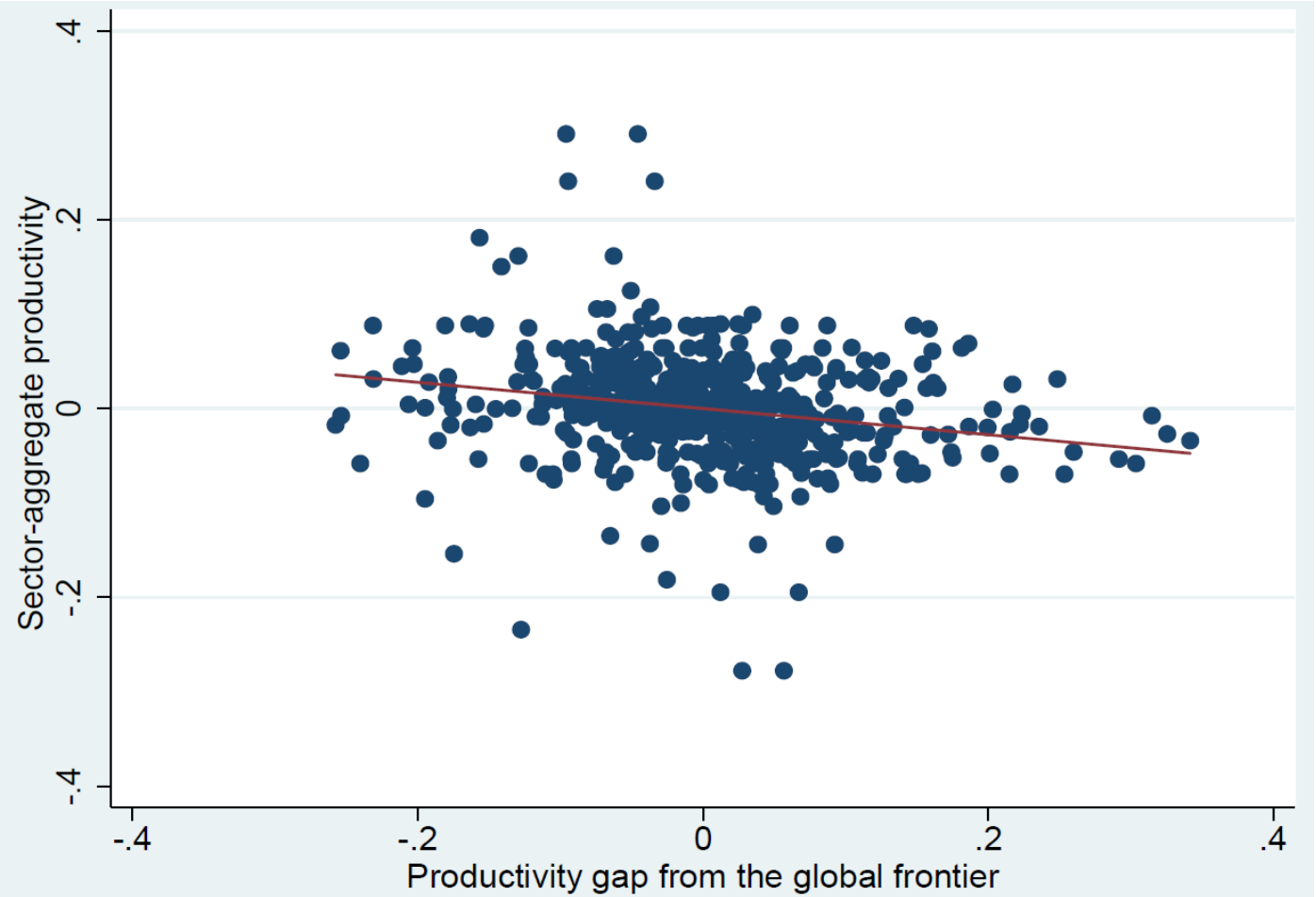
Non ICT-intensive services



Higher MFPR divergence, weaker aggregate MFP performance

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

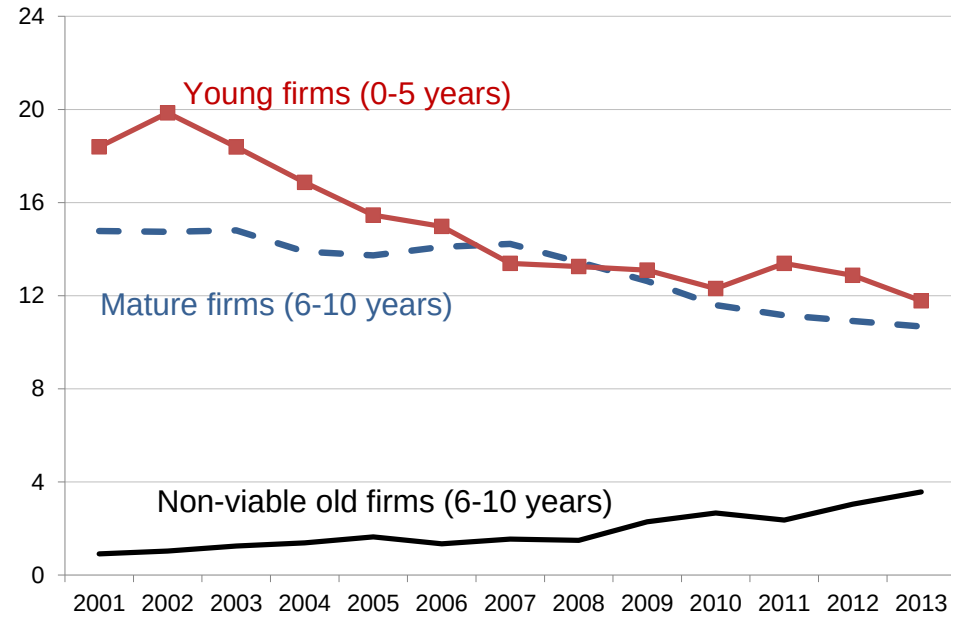
Data averaged across 12 OECD countries and purged of industry and year fixed effects



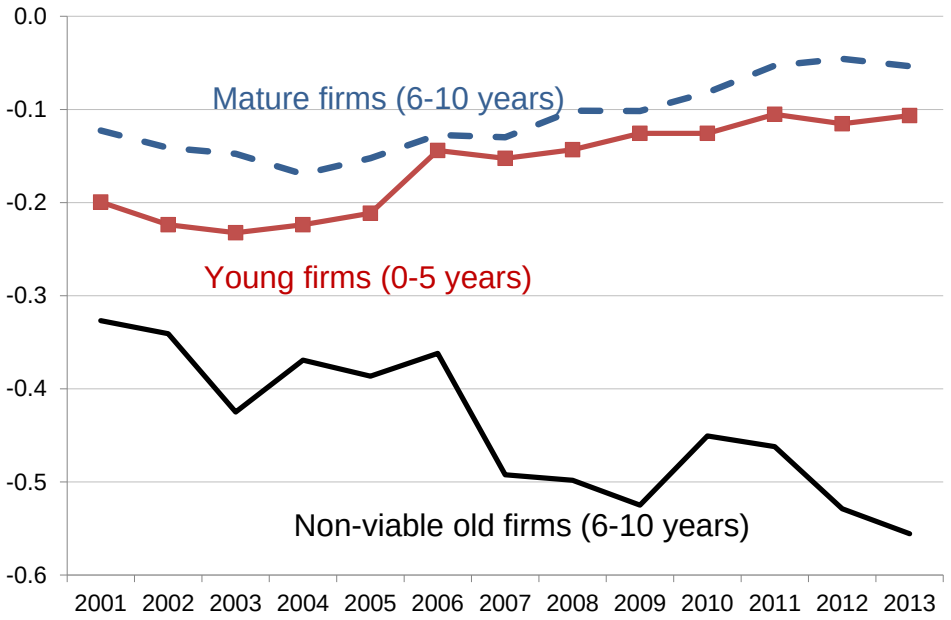
Source: EU KLEMS and authors calculations based on ORBIS data

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

Share of firms
Per cent



MFPR relative to viable old firms
Log point differential



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

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

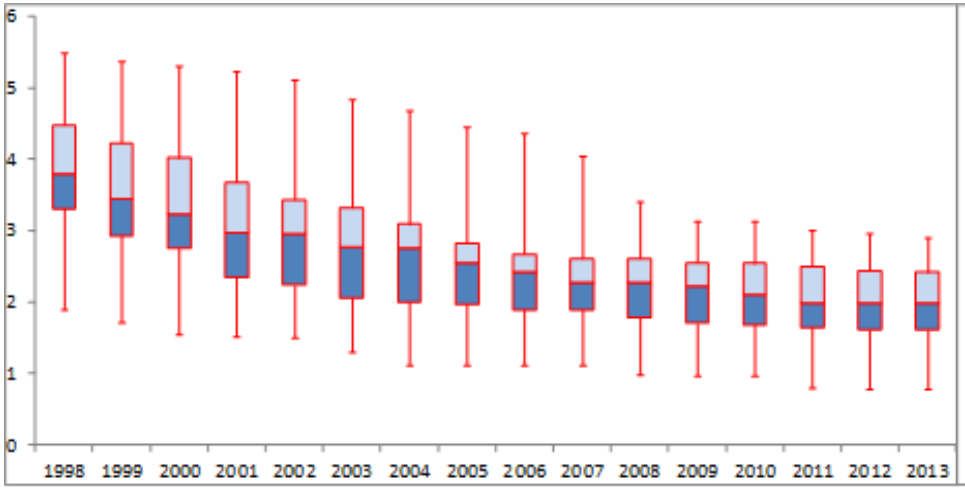
Notes: Non-viable old firms are those older than 10 years that record negative profits over at least two consecutive years. The omitted group are firms older than 10 years that do not record negative profits over at least two consecutive years (viable old firms).

PRODUCTIVITY DIVERGENCE:
ROLE OF POLICY

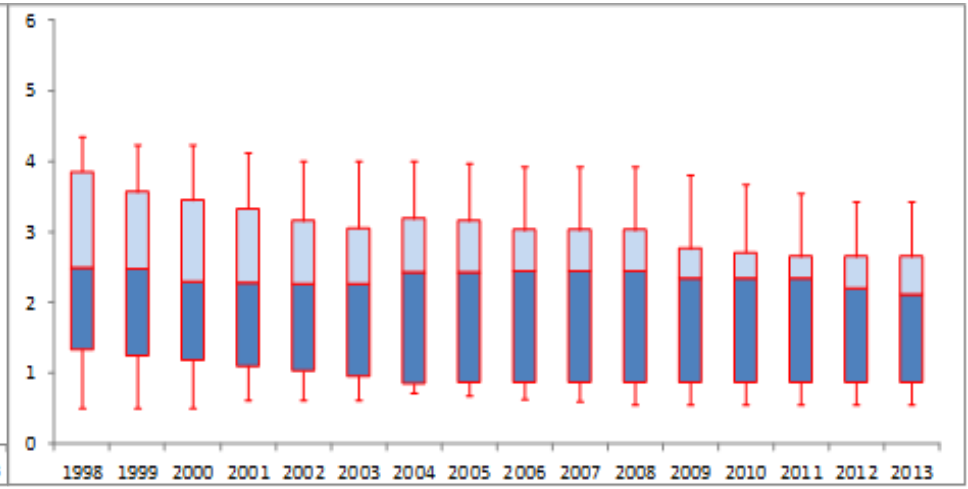
The pace of market reform in services has slowed over time

The restrictiveness of product market regulations

A: Network industries



B: Professional Services



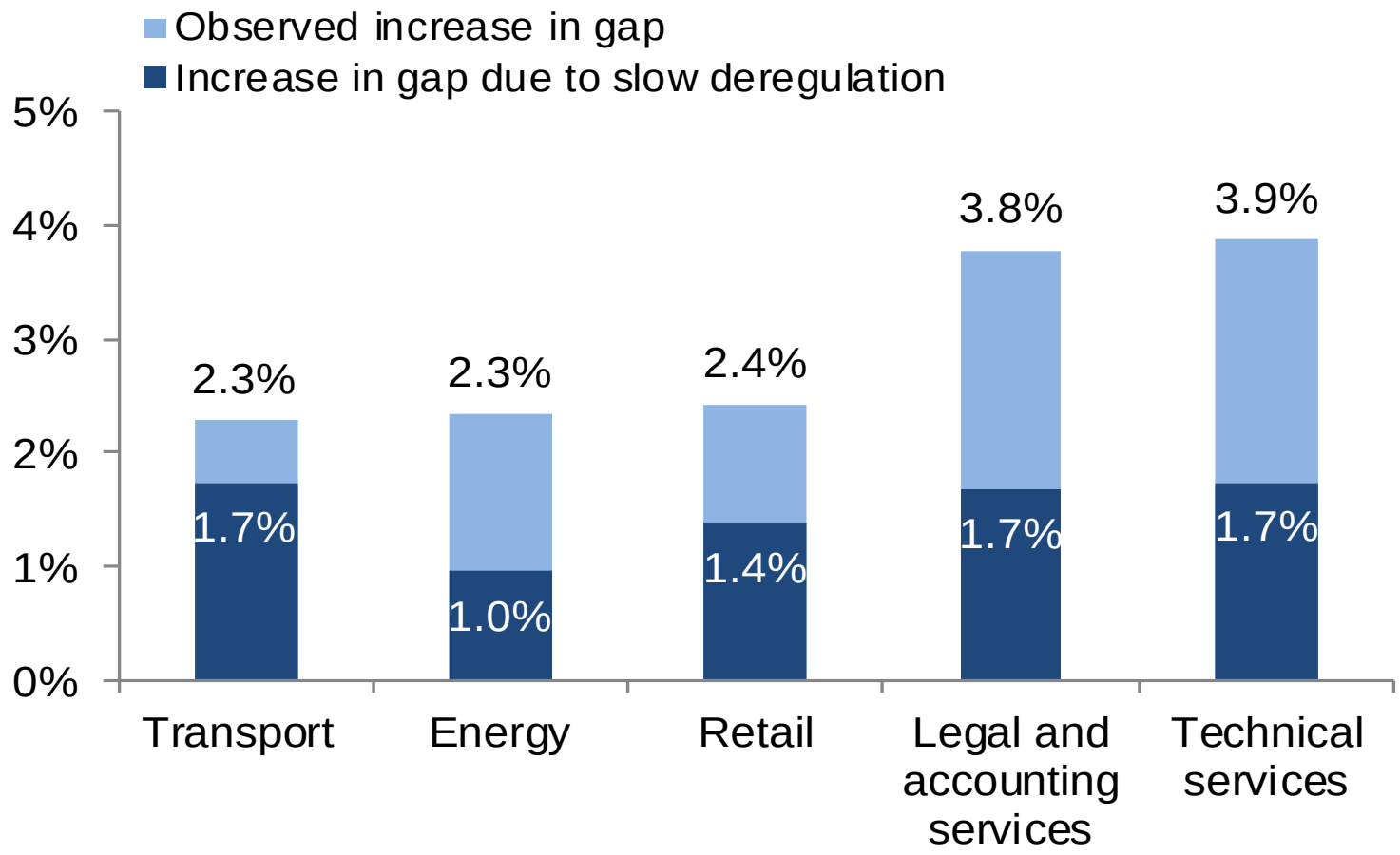
A large literature links competitive pressures to within-firm productivity growth and technology adoption

MFP divergence greatest in sectors where reform lagged.

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.

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

SPARES

A1. Characteristics of the global frontier

A2. Divergence: robustness

A3. Divergence: capital deepening

A4. Divergence: mark-ups

A5. Divergence: sales

A6. Divergence: comparisons with industry data

A7. Divergence: longer term evidence from industry data

A8. Entrenchment at the global frontier

A9. Slowing convergence to the frontier

A10. Divergence & market reform in services: descriptives

A11. Divergence & market reform in services: econometrics

A1. The globally most productive firms: *Who are they?*

A: Labour productivity based frontier definition

	Sector: manufacturing							Sector: services						
	Laggard firms			Frontier-firms			Difference	Laggard firms			Frontier-firms			Difference
Variables	Mean	St.dev.	N	Mean	St.dev.	N		Mean	St.dev.	N	Mean	St.dev.	N	
Productivity	10.7	0.6	21,191	12.0	0.4	825	1.3 ***	10.4	0.7	22,053	11.9	0.7	627	1.5 ***
Employees	49.3	52.1	21,191	45.1	33.8	825	-4.2 ***	59.5	156.6	22,053	38.0	24.8	627	-21.6 ***
Capital-labour ratio[1]	86.1	115.3	21,191	274.5	425.5	825	188.4 ***	76.4	214.0	22,053	677.5	2,071.1	627	601.1 ***
Revenues[2]	11.8	21.6	21,191	39.0	58.8	825	27.3 ***	14.8	54.0	22,053	57.9	133.0	627	43.1 ***
Markup (log)	0.1	0.4	21,191	0.1	0.4	825	0.05 ***	0.1	0.4	22,053	0.3	0.5	627	0.19 ***
Wages[1]	34.2	16.7	21,191	54.6	20.1	825	20.4 ***	34.5	16.7	22,053	56.6	23.4	627	22.1 ***

B: MFPR based frontier definition

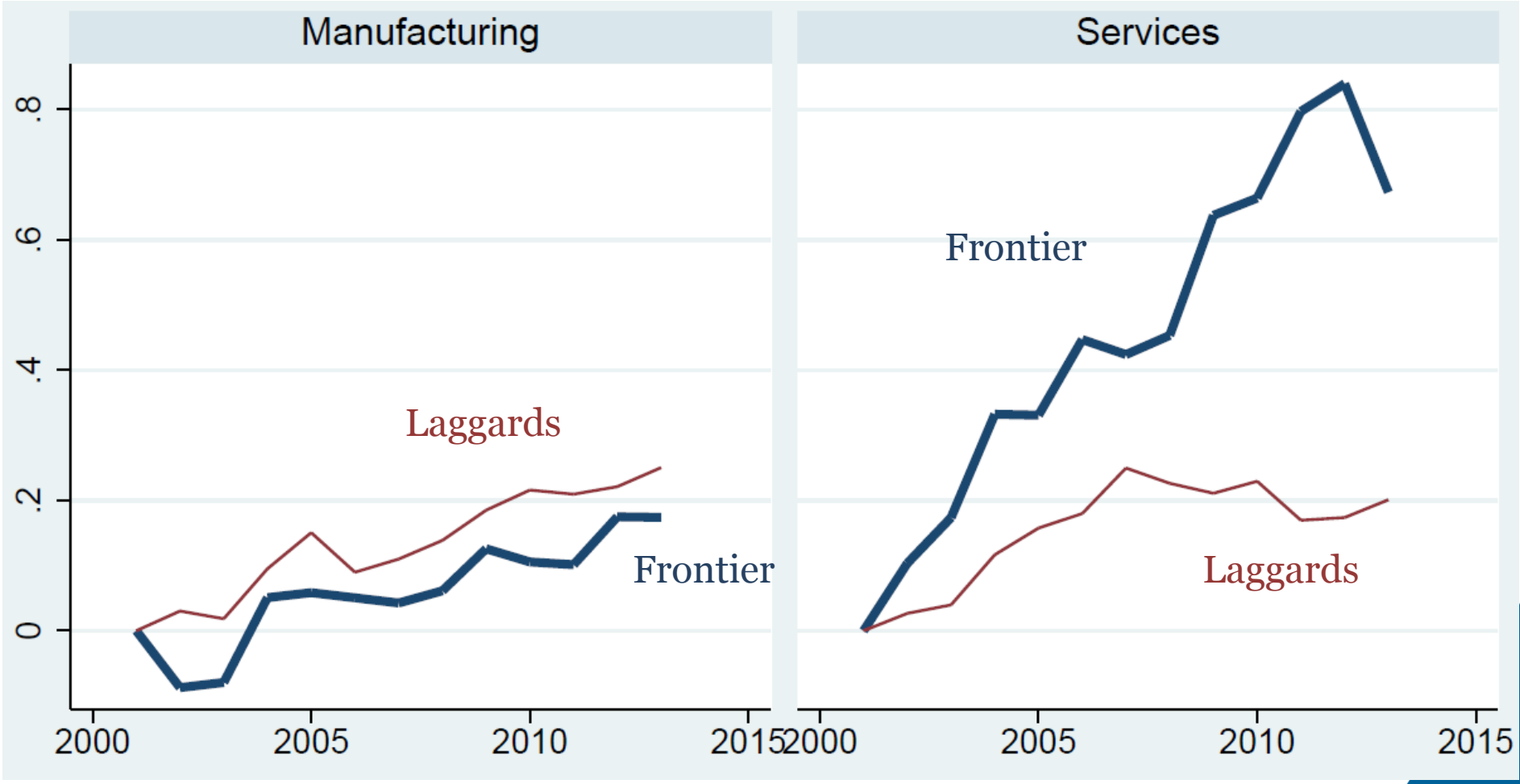
	Sector: manufacturing							Sector: services						
	Laggard firms			Frontier-firms			Difference	Laggard firms			Frontier-firms			Difference
Variables	Mean	St.dev.	N	Mean	St.dev.	N		Mean	St.dev.	N	Mean	St.dev.	N	
Productivity	10.4	0.6	21,317	11.6	0.4	706	1.3 ***	10.3	0.7	22,147	11.7	0.7	538	1.4 ***
Employees	48.3	46.8	21,317	73.7	126.0	706	25.4 ***	59.1	155.3	22,147	53.4	115.6	538	-5.6
Capital-labour ratio[1]	89.3	125.1	21,317	214.3	406.0	706	125.1 ***	81.1	245.5	22,147	579.6	2,131.7	538	498.5 ***
Revenues[2]	11.5	19.9	21,317	50.5	74.1	706	39.0 ***	14.4	40.1	22,147	80.2	268.0	538	65.7 ***
Markup (log)	0.1	0.4	21,317	0.0	0.4	706	-0.02	0.1	0.4	22,147	0.2	0.5	538	0.12 ***
Wages[1]	34.3	16.7	21,317	56.3	18.9	706	22.0 ***	34.6	16.8	22,147	56.8	23.9	538	22.2 ***

A2. Productivity divergence is robust to:

- Productivity measure: LP, MFP
- Frontier definition: Top 50, 100, 5%
- Robustness to different time periods
- More narrowly defined industries (3 and 4 digit)
- Robustness to retaining only HQ-s (their consolidated accounts, i.e. everything is at the group level) and standalone firms (not part of any group)
- Industry-level analysis from 1985 shows a bigger divergence from the early 2000s

A3. How much is it a capital deepening story?

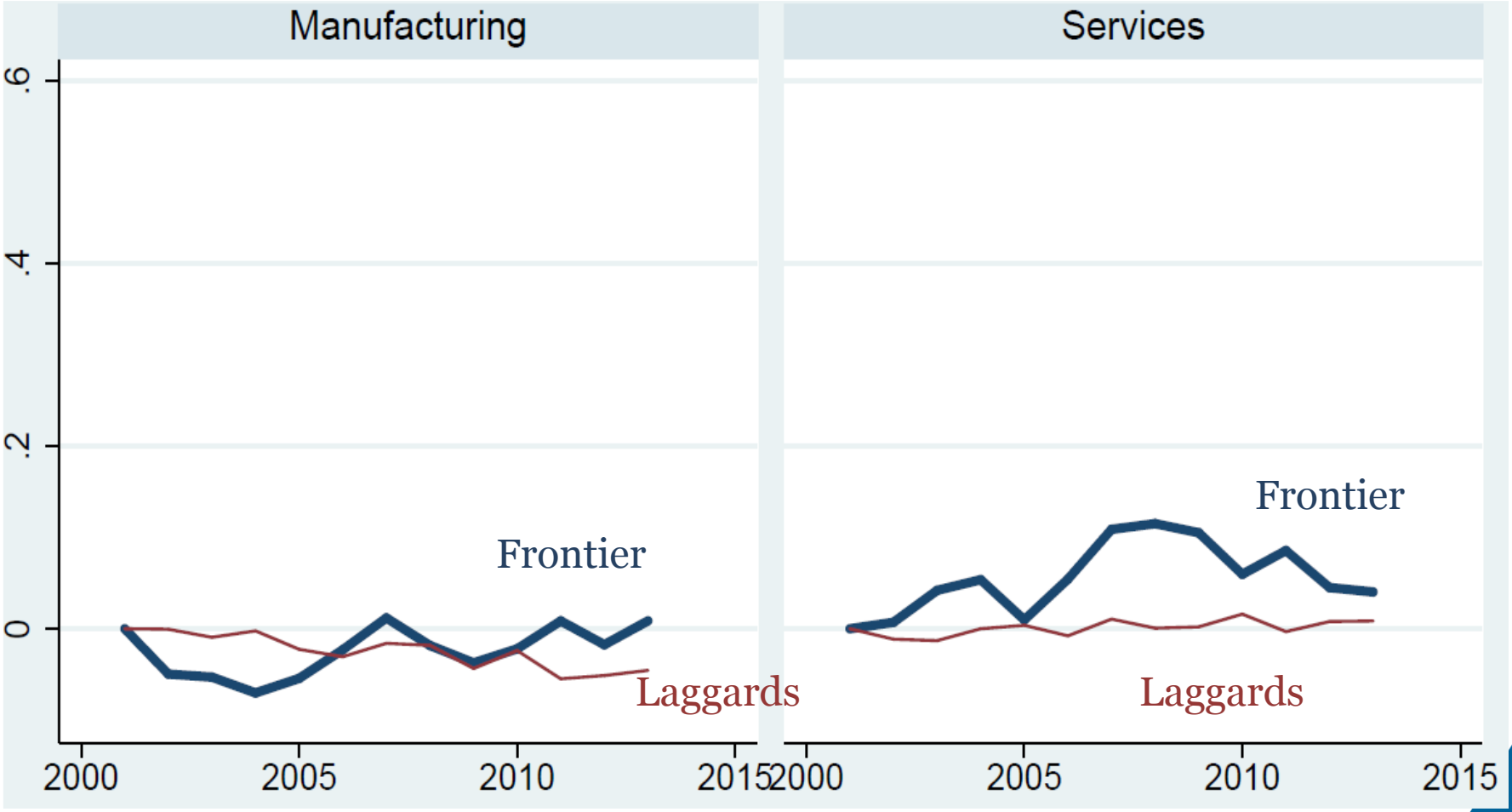
Average capital deepening across each 2-digit sector (log, 2001=0)



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

A4. 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)

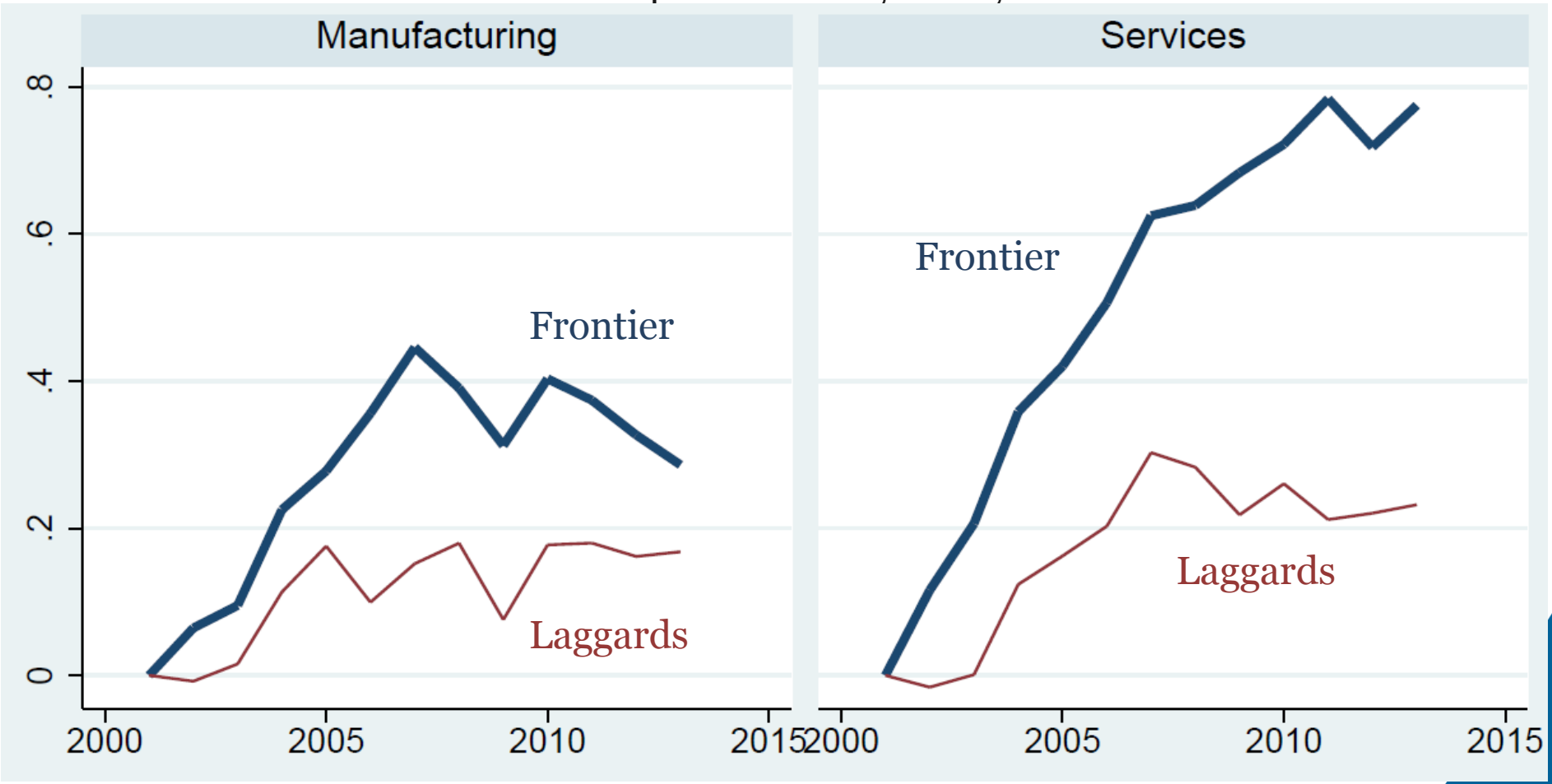


Source: Andrews, D. C. Criscuolo and P. Gal (2016), "The Global Productivity Slowdown, Technology Divergence and Public Policy: a Firm Level Perspective", *forthcoming.*

A5. Frontier firms are *getting larger in terms of sales!*

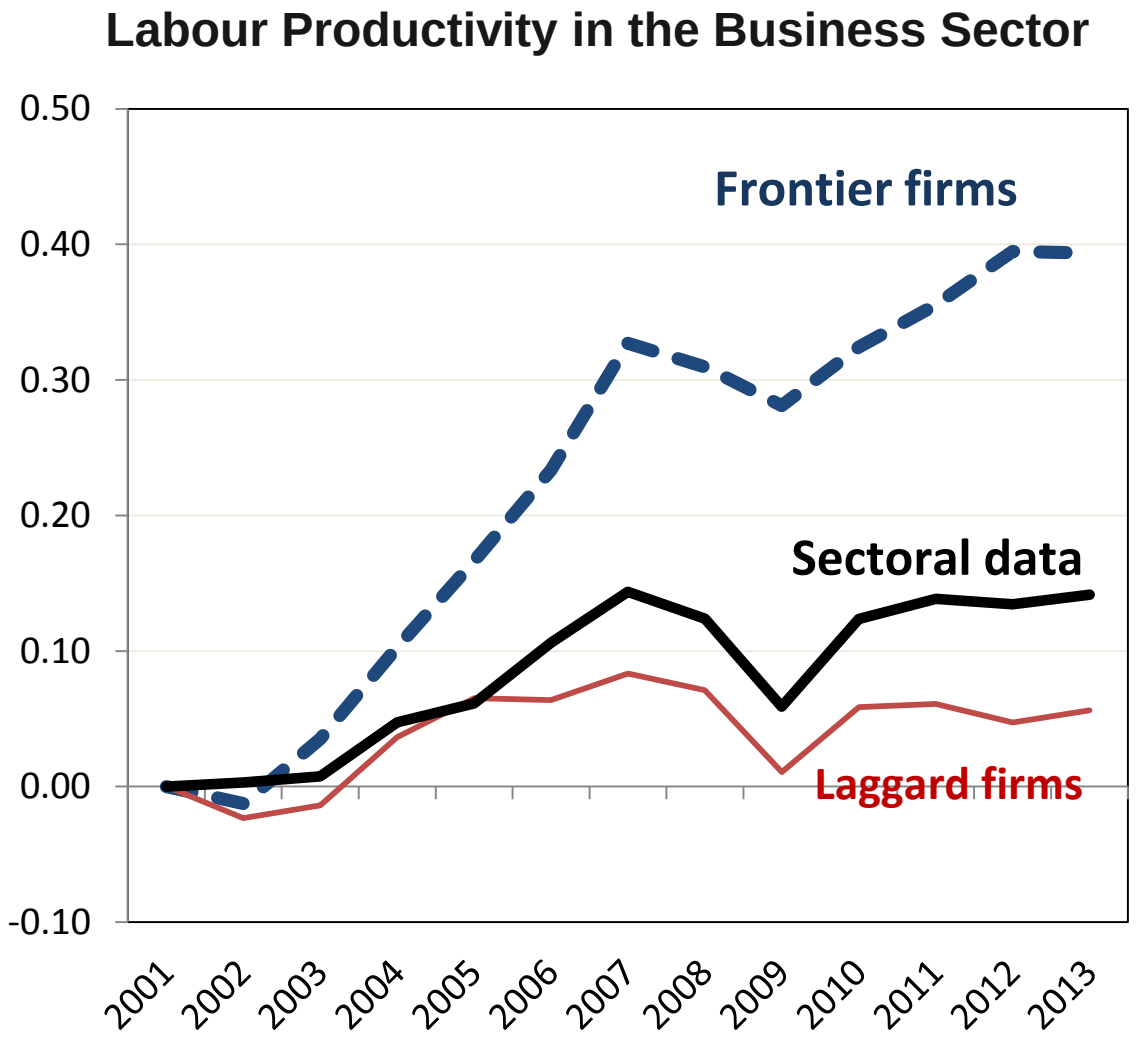
Average of log sales for global frontier firms and the rest

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



Source: Andrews, D. C. Criscuolo and P. Gal (2015), "The Global Productivity Slowdown, Technology Divergence and Public Policy: a Firm Level Perspective", *forthcoming.*

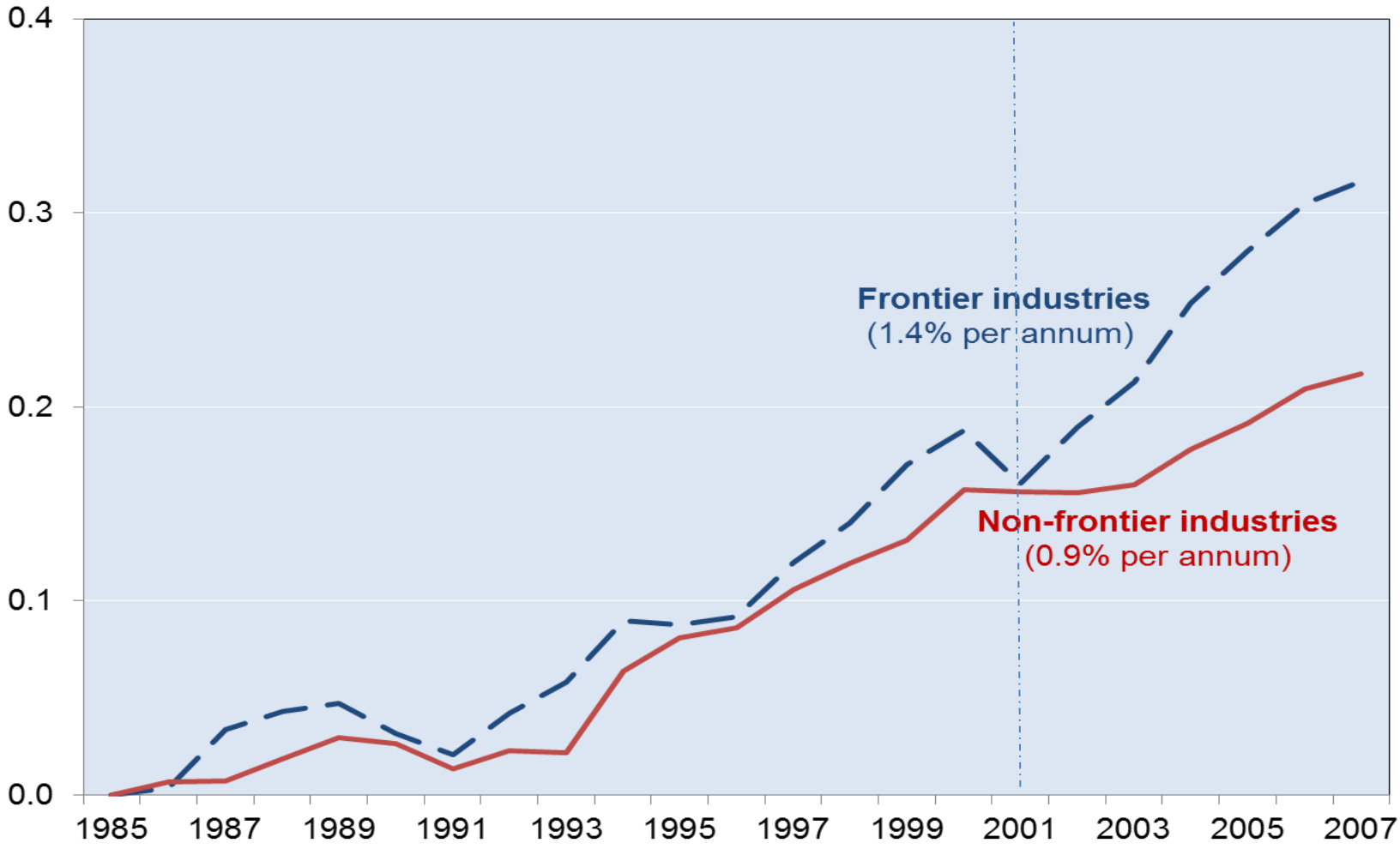
A6. Firm-level patterns *vs* average industry level productivity



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

A7. Industry-level data show bigger divergence from early 2000s

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

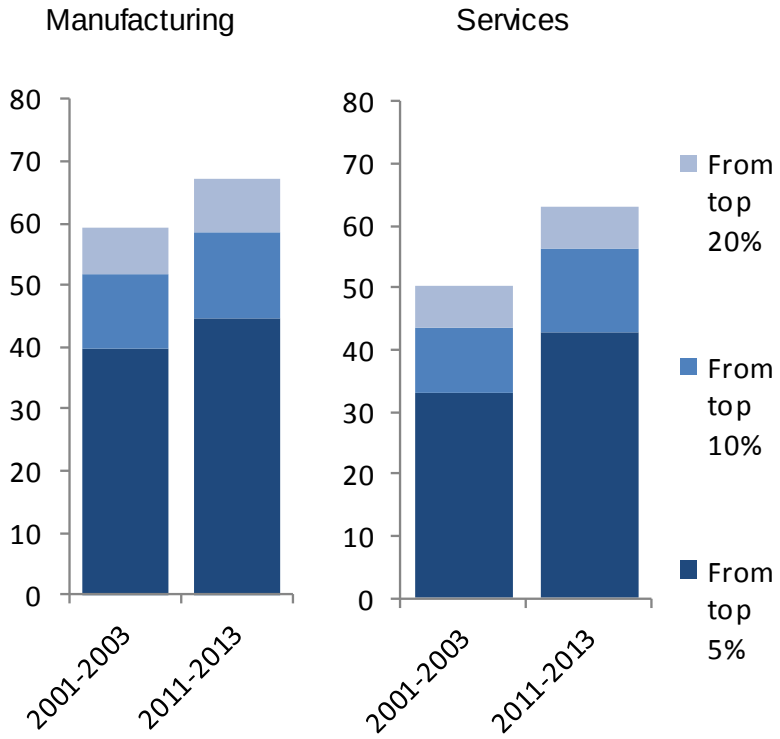


Source: OECD calculations based on Bourles et al (2013) dataset.

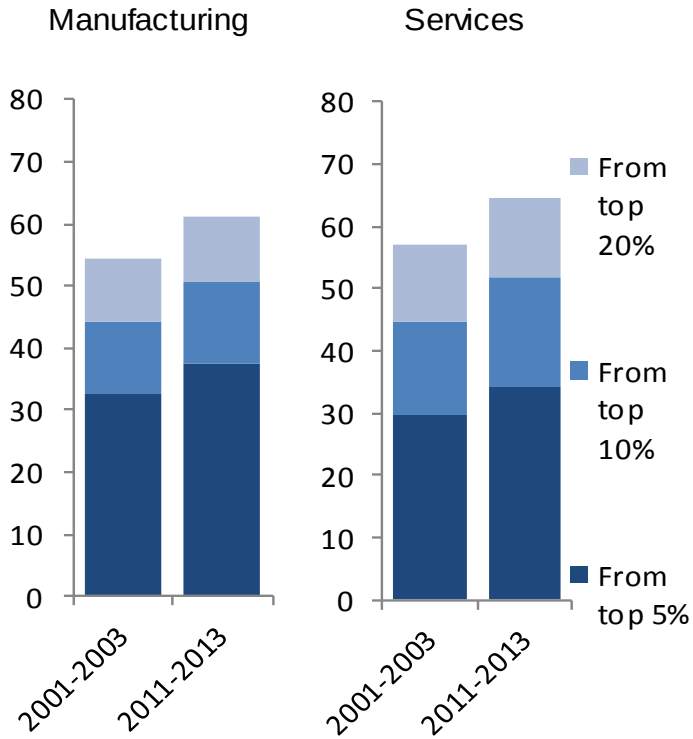
A8. Entry into the global frontier has become more entrenched amongst top quintile firms

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

A: MFPR



B: Mark-up corrected MFPR

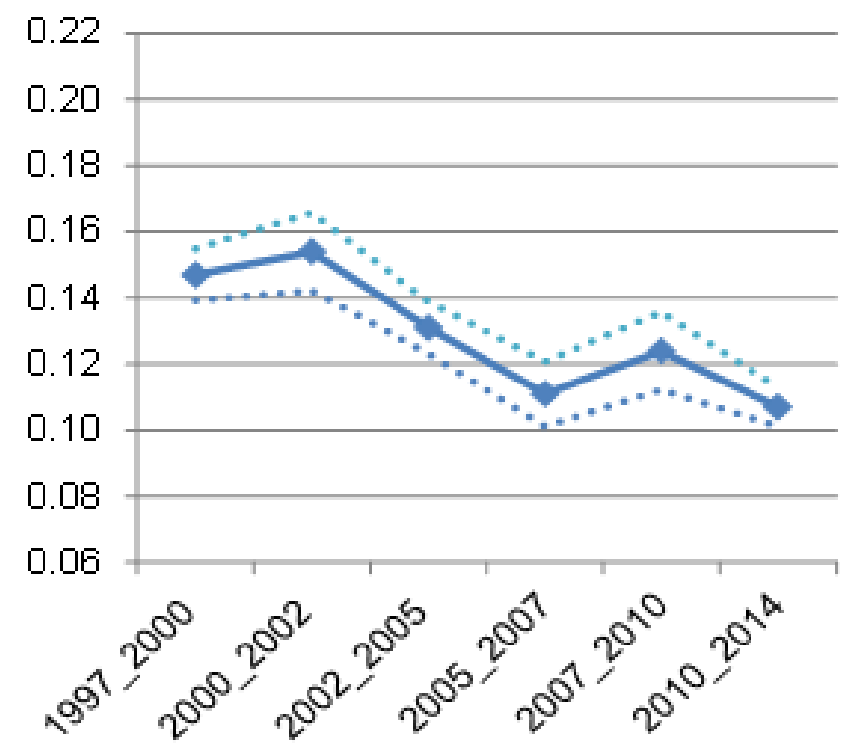


A9. The speed of convergence to the frontier slowed, even before the crisis

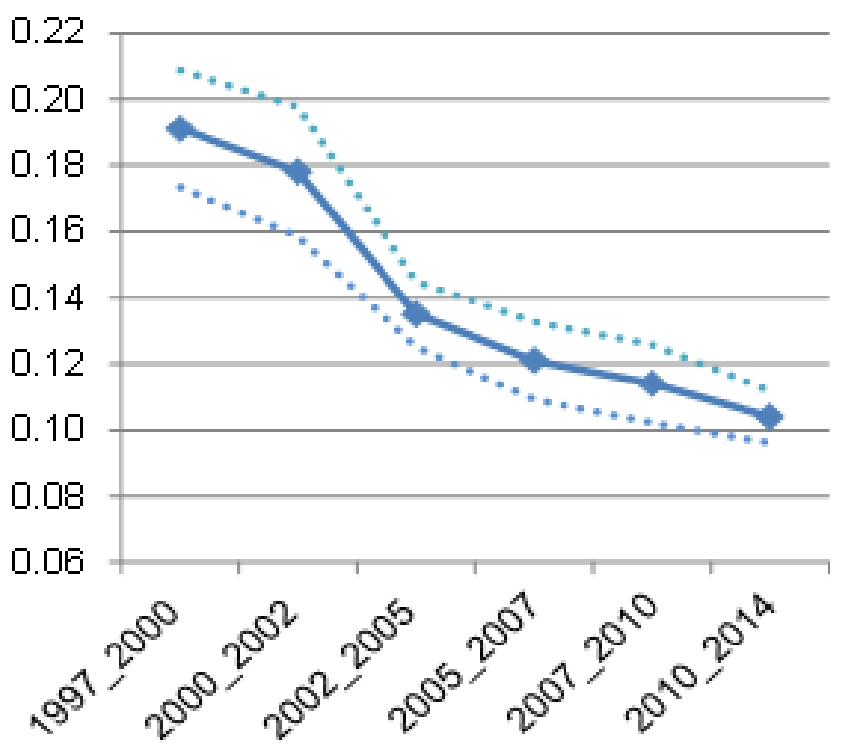
Estimated convergence parameter from neo-Schumpeterian model

Dotted line: 95% confidence intervals

A: MFPR



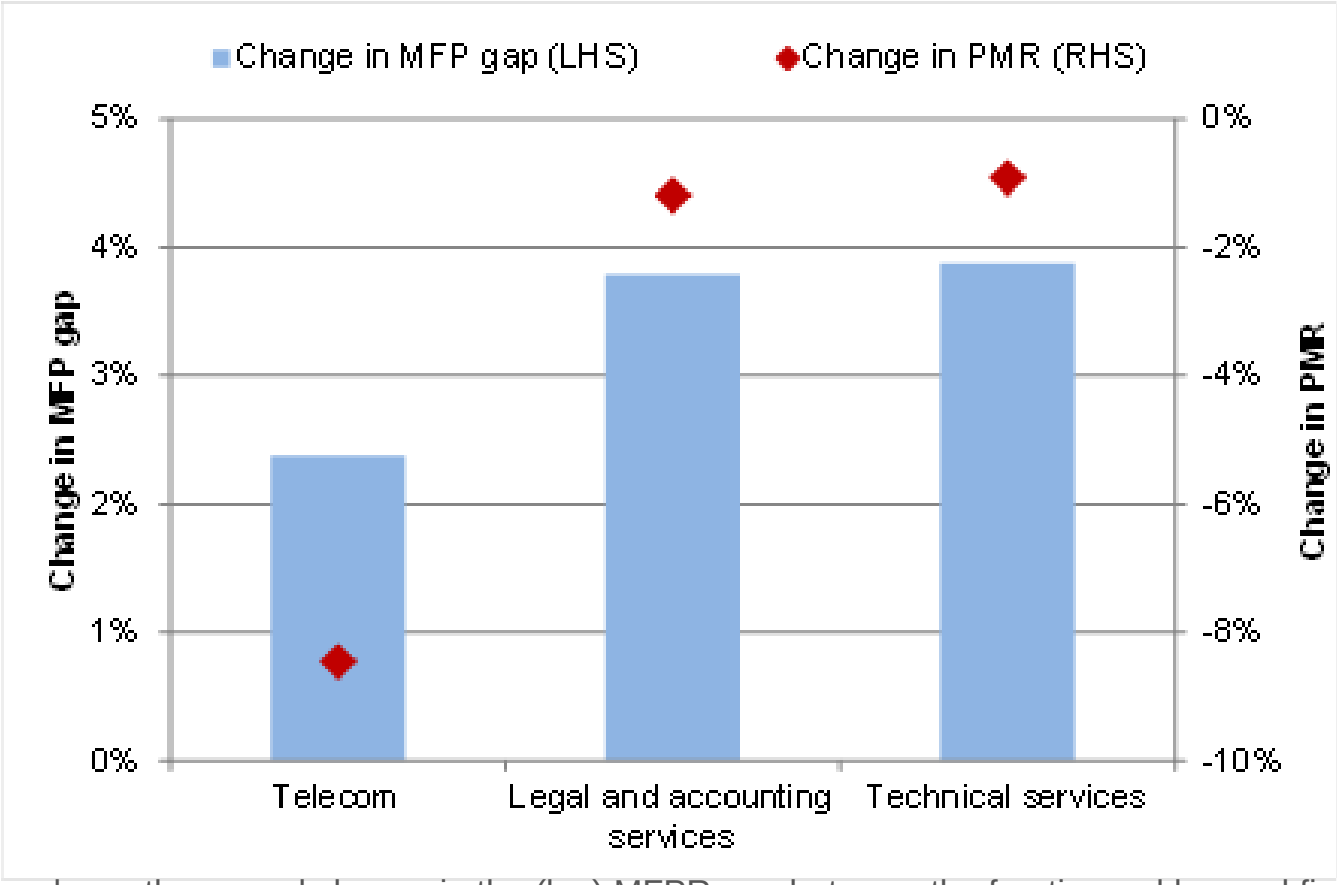
B: Mark-up adjusted MFPR



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

A10. Slower product market reform, a larger increase in the MFP 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.

Source: Andrews, D. C. Criscuolo and P. Gal (2015), "The Global Productivity Slowdown, Technology Divergence and Public Policy: a Firm Level Perspective", *forthcoming.*

A11. Higher MFP divergence when market reforms in services lagged

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.

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