The Human Side of Productivity

Preliminary results on skills with a special focus on Portugal

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OECD Global Forum on Productivity

Joint with *Chiara Criscuolo, Timo Leidecker and Giuseppe Nicoletti* and supported by researchers from participating institutions

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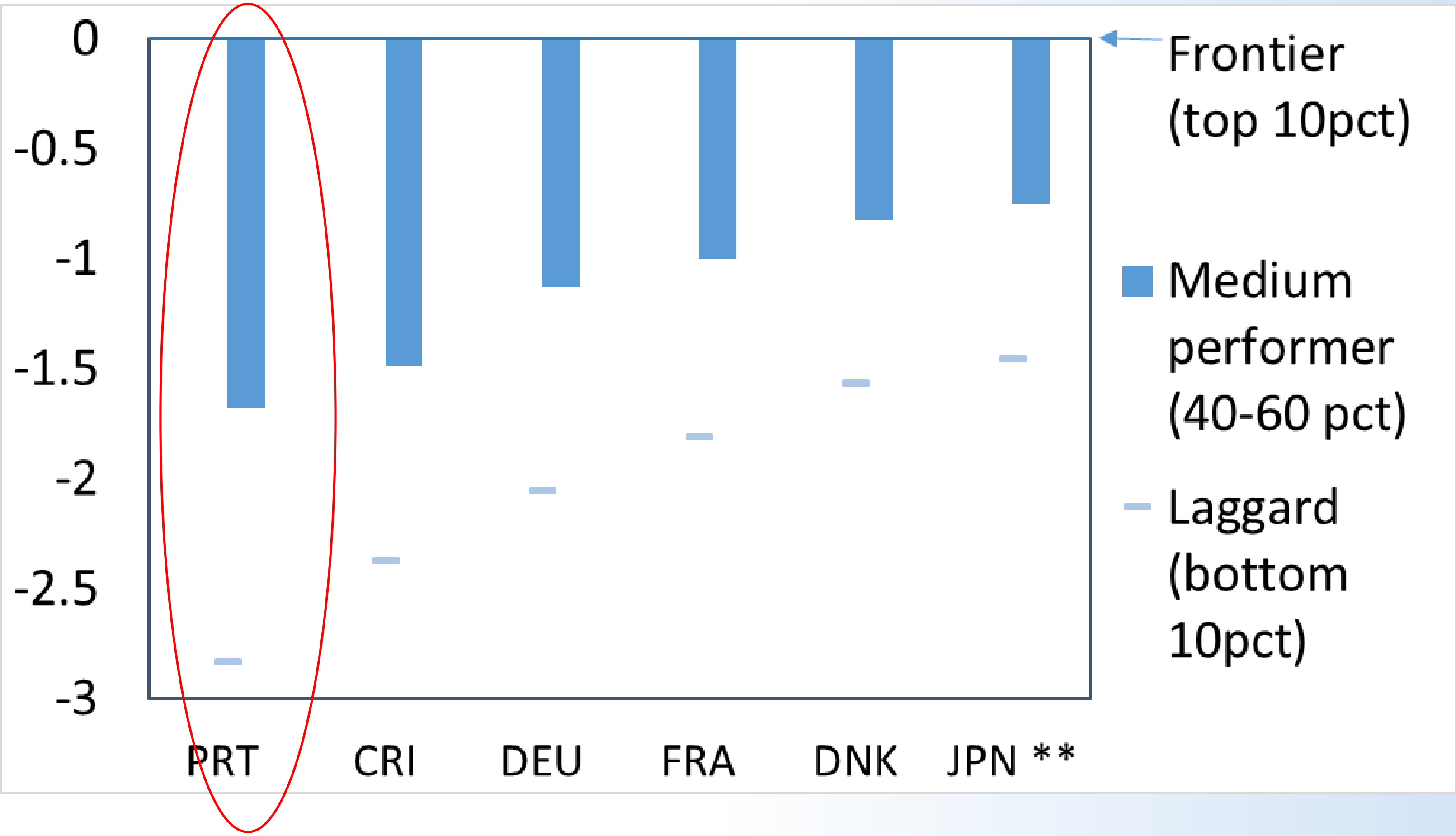
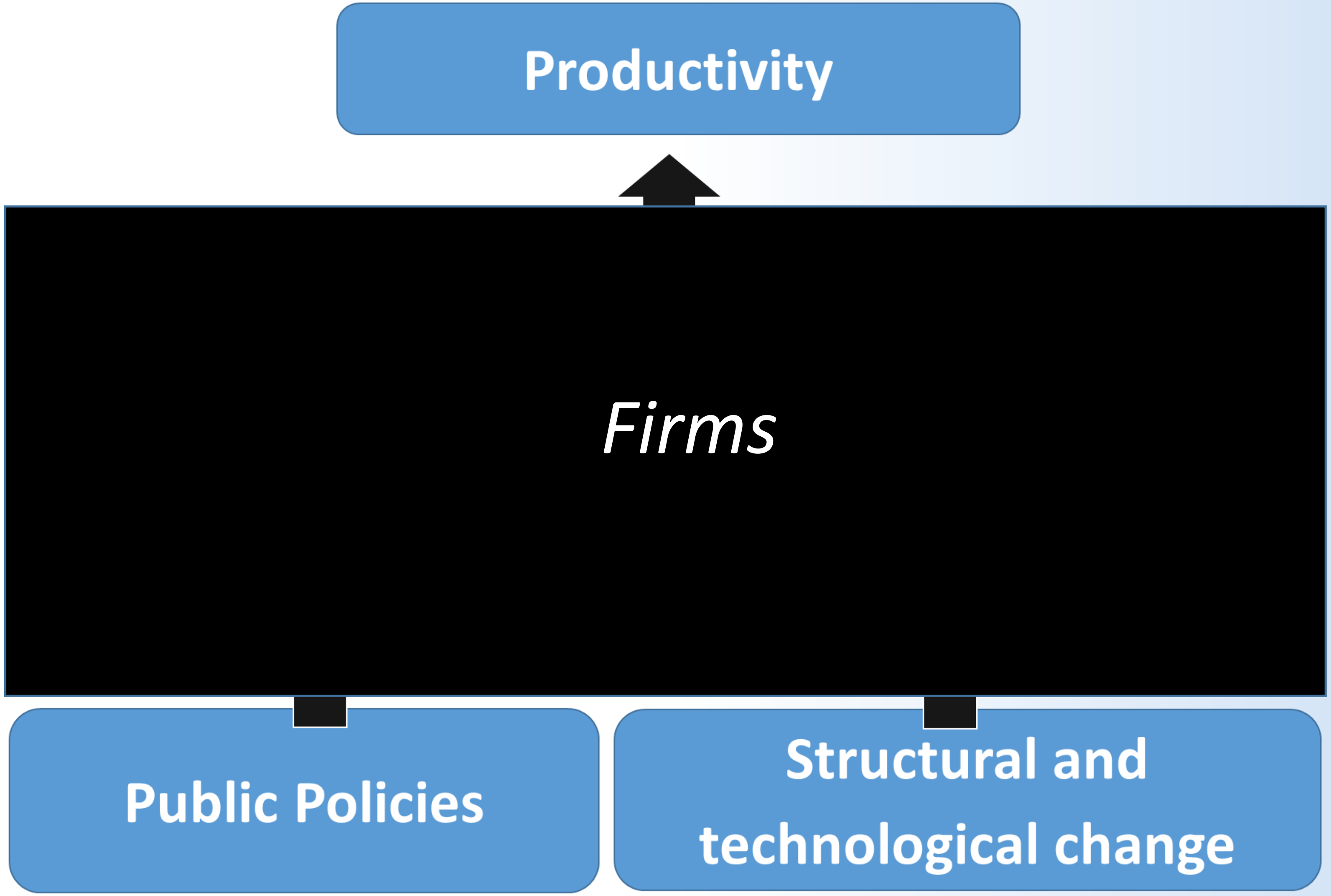
The productivity of a typical firm lags way behind the frontier…
even within the same country & industry

Log-differences from the top 10% of firms with the highest productivity levels (VA/L)
within detailed industries



- These differences are **persistent** and present in **manufacturing** and **services** alike
- See **previous GFP** and OECD work: *Andrews et al (2015, 2016); Berlingieri et al (2017)*
- … and academic literature focusing on the US *Bartelsman and Doms (2001); Syverson (2011);*

How do productive firms look like in terms of their *human side*?



By looking at workers and managers, we learn about

1. **Skills** (of managers and workers)
2. **Diversity** (gender, age, cultural background)
3. **Organisation** (management layers, diversification of tasks, wage structure, work arrangements)

How to measure *the Human Side of Productivity?*

Challenge: representative microdata is usually confidential and not fully harmonised across countries

➔ Use a *Distributed Microdata approach*

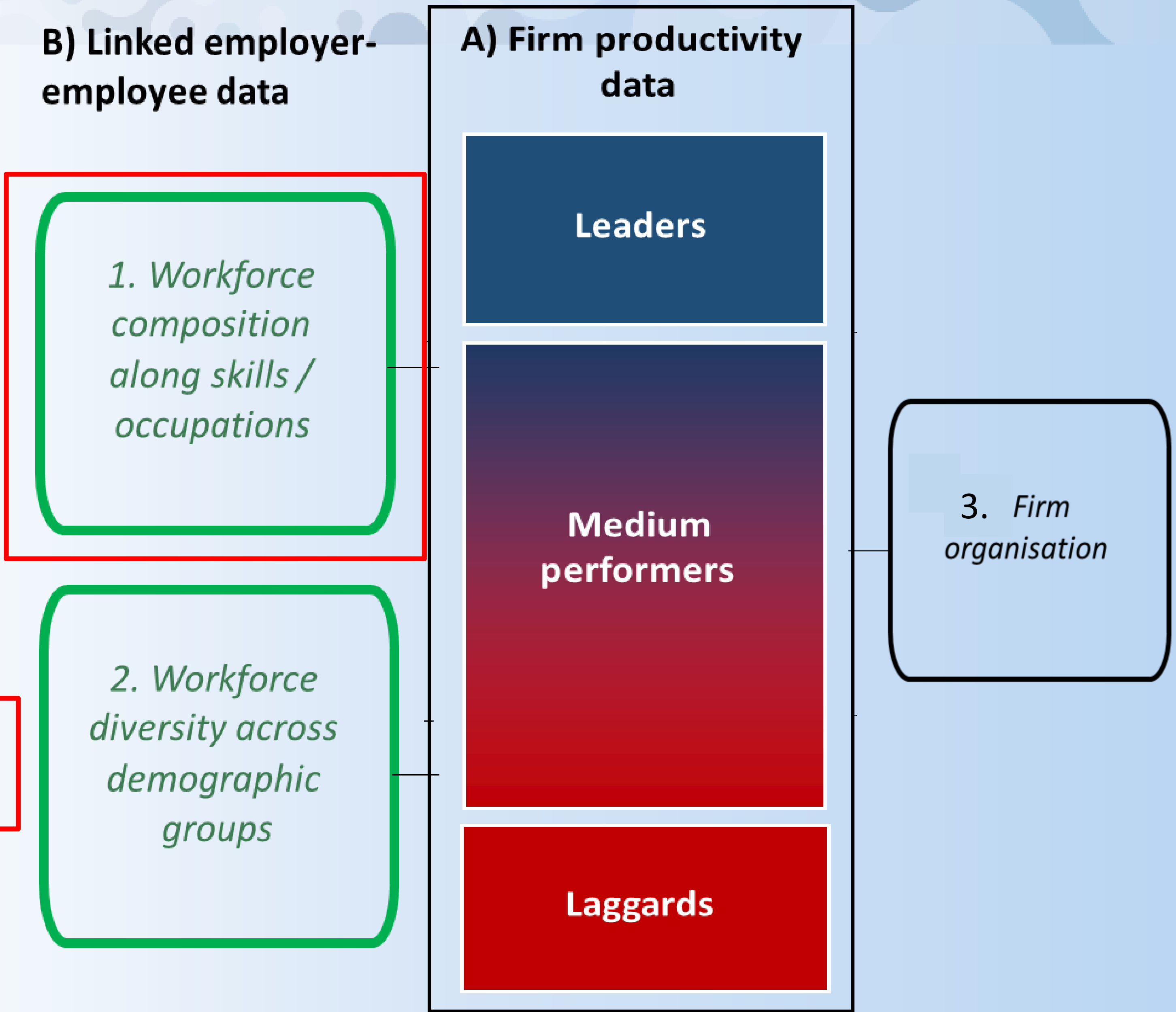
➔ Pose a simple question:

How do more productive firms differ from others…?

1. along workforce skills;

2. along workforce diversity;

3. in terms of firm organisation



Relying on micro data about millions of firms and employees from several countries

- Universe or **large representative sample of >10** employee firms in 54 private non-farm non-financial industries; from the 2000s until latest year
- Deriving two types of output:

1. Aggregated **summary statistics** by detailed cells:

   country x industry x year x productivity-segment

2. **Coefficient estimates** from regressions that include several factors jointly

Building on **previous OECD experience with *DMD***

- DynEmp (Criscuolo, Gal, Menon, 2014, 2015; Calvino, Crisuolo, Menon, 2016; Calvino, Criscuolo, 2019)
- MultiProd (Berlingieri et al, 2017; 2018; 2020)

\+ Complementary to ongoing work at the **industry-level** (Cammeraat, Samek and Squicciarini, 2020)

Implementation in collaboration with our partner countries in the Global Forum

Data and results available				**Data available** *Results coming soon*	**Data being prepared** *Access is in progress*
Country	Output	Labour input	Worker info		
1. Costa Rica	GO, VA	L	Occ, edu	**8. Belgium**	**11. Brazil**
2. Denmark	GO, VA	L, H	Occ, edu	**9. Hungary**	**12. Ireland**
3. France	GO, VA	L, H	Occ	**10. Sweden**	**13. New Zealand**
4. Germany *	GO, VA	L	Occ, edu		**14. Spain**
5. Japan **	GO, VA	L, H	edu		**+ Italy (ISTAT)**
6. Portugal	GO, VA	L, H	Occ, edu		
[7. Italy (INAPP)*]	GO, VA	L	Occ, edu		

Sample for our analysis: universe of firms and workers with **at least 10 employees**.

Exceptions: * Representative sample, not universe ** Firms with at least 50 employees

Implementation in collaboration with our partner countries in the Global Forum

Data and results available				Coverage over time																	
Country	Output	Labour input	Worker info	2000	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	2017
1. Costa Rica	GO, VA	L	Occ, edu							x	x	x	x	x	x	x	x	x	x	x	x
2. Denmark	GO, VA	L, H	Occ, edu									x	x	x	x	x	x	x	x	x	x
3. France	GO, VA	L, H	Occ			x	x	x	x	x	x	x	x	x	x	x	x	x	x		
4. Germany *	GO, VA	L	Occ, edu	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
5. Japan **	GO, VA	L, H	edu	x	x	x	x	x	x	x	x	x	x	x	x	x	x				
6. Portugal	GO, VA	L, H	Occ, edu			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
[7. Italy (INAPP)*]	GO, VA	L	Occ, edu																		

Sample for our analysis: universe of firms and workers with **at least 10 employees**.

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Skill measures
Definitions

- Relying on <u>occupations</u>
  - As in Acemoglu and Autor (2011, Handbook Chapter) and Goos, Manning, Salomons (2014, AER)
  - But building on the OECD Survey of Adult Skills (PIAAC) to measure abilities and the nature of tasks

- Ranking occupations along several dimensions:
  1. <u>Cognitive ability</u> as a general skills measure
     = average of *literacy, numeracy* and *problem solving* scores from PIAAC
  2. "*Soft-skills*" or "*social skills*": <u>Self-organisation and communications</u>
     Identified through factor analysis from PIAAC responses about the nature of tasks
     by Grundke, Jamet, Kalamova, Keslair, Squicciarini (2017)
  3. "*Hard-skills*": <u>ICT intensity</u>
     Nedelkoska and Quintini (2018)

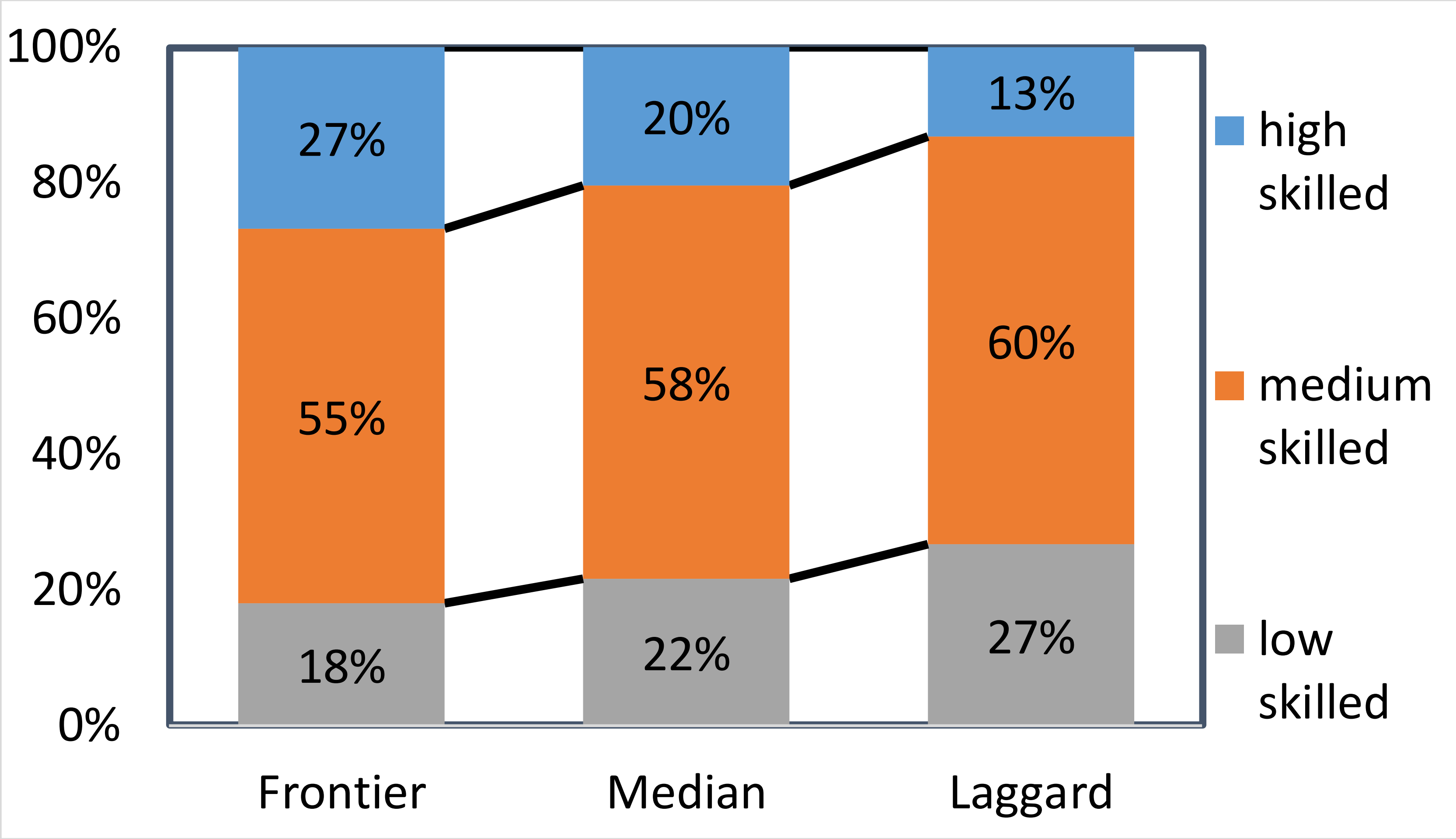
- Top / bottom quartile of occupations = High / low skilled segments
  → More exogenous than measures based on market outcomes (e.g. wages)

- We also use <u>educational attainment</u> as an alternative measure

- PRELIMINARY RESULTS -

The skill composition varies systematically along the firm productivity distribution

The skill composition of firms
at different segments of the **productivity distribution***



*Based on **VA / L** :

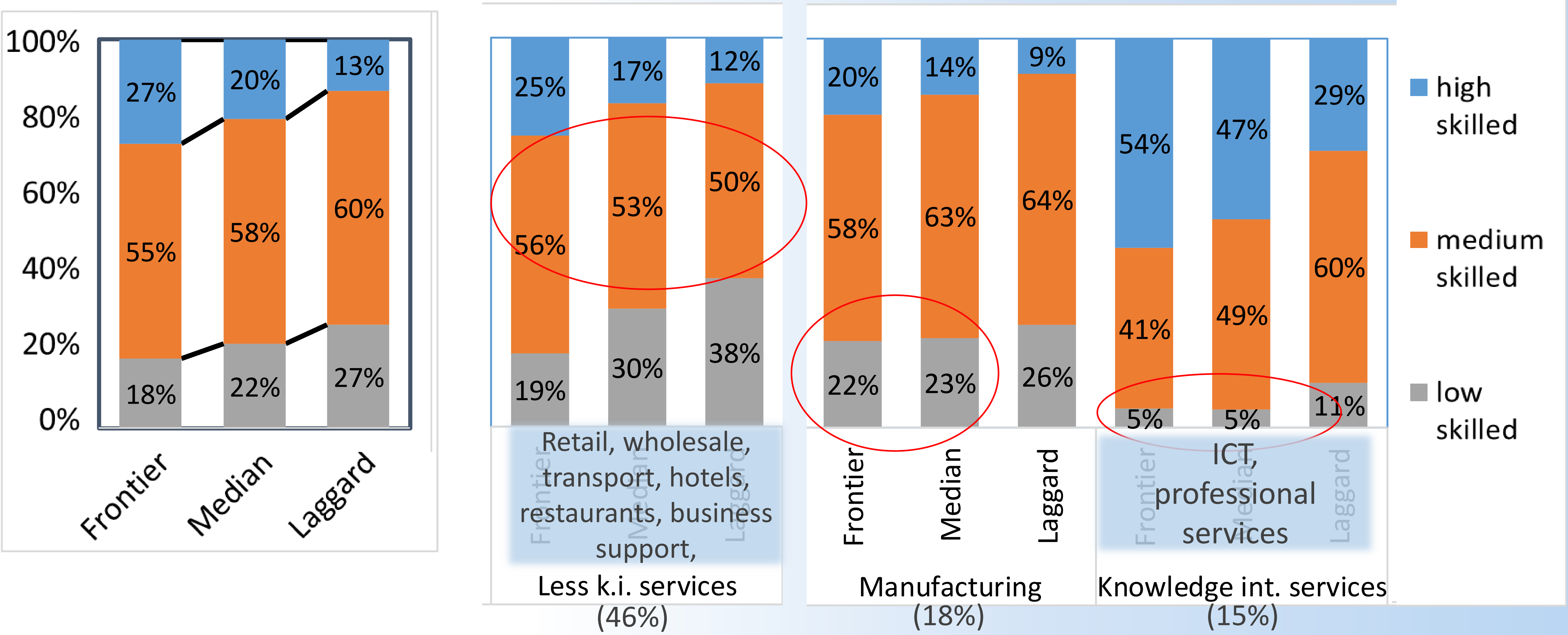
- Frontier: top 10%;
- Medium: 40^{th}-60^{th} percentile;
- Laggards: bottom 10%;

Within *2-digit industry x year x country* cells, averaged across all cells

The skill composition varies systematically along the firm productivity distribution

with key differences across sectors

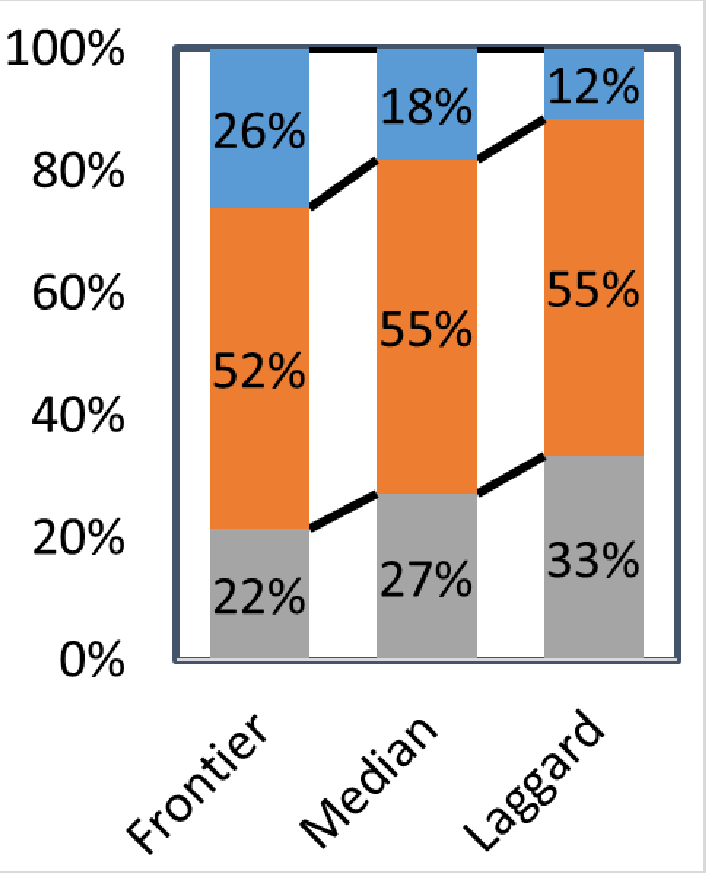
Skill composition at different segment of the productivity distribution

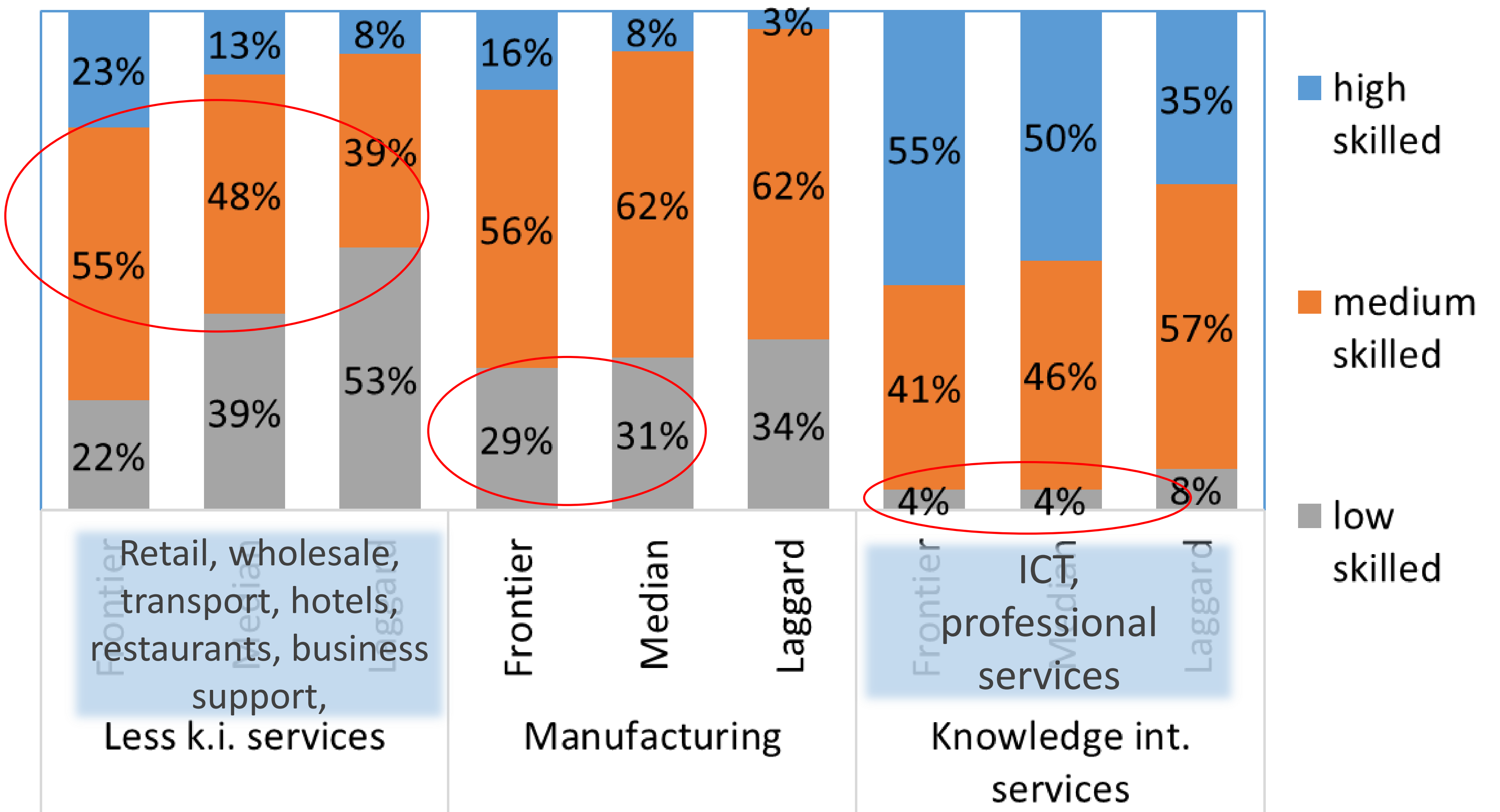


The skill composition varies systematically along the firm productivity distribution

with key differences across sectors in Portugal as well

Skill composition at different segment of the productivity distribution

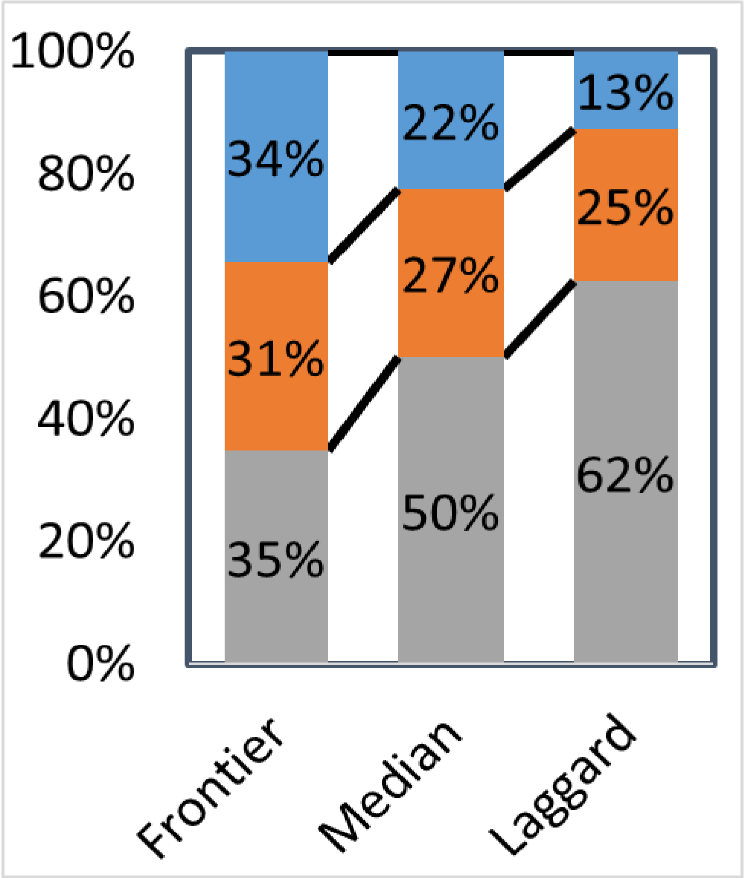


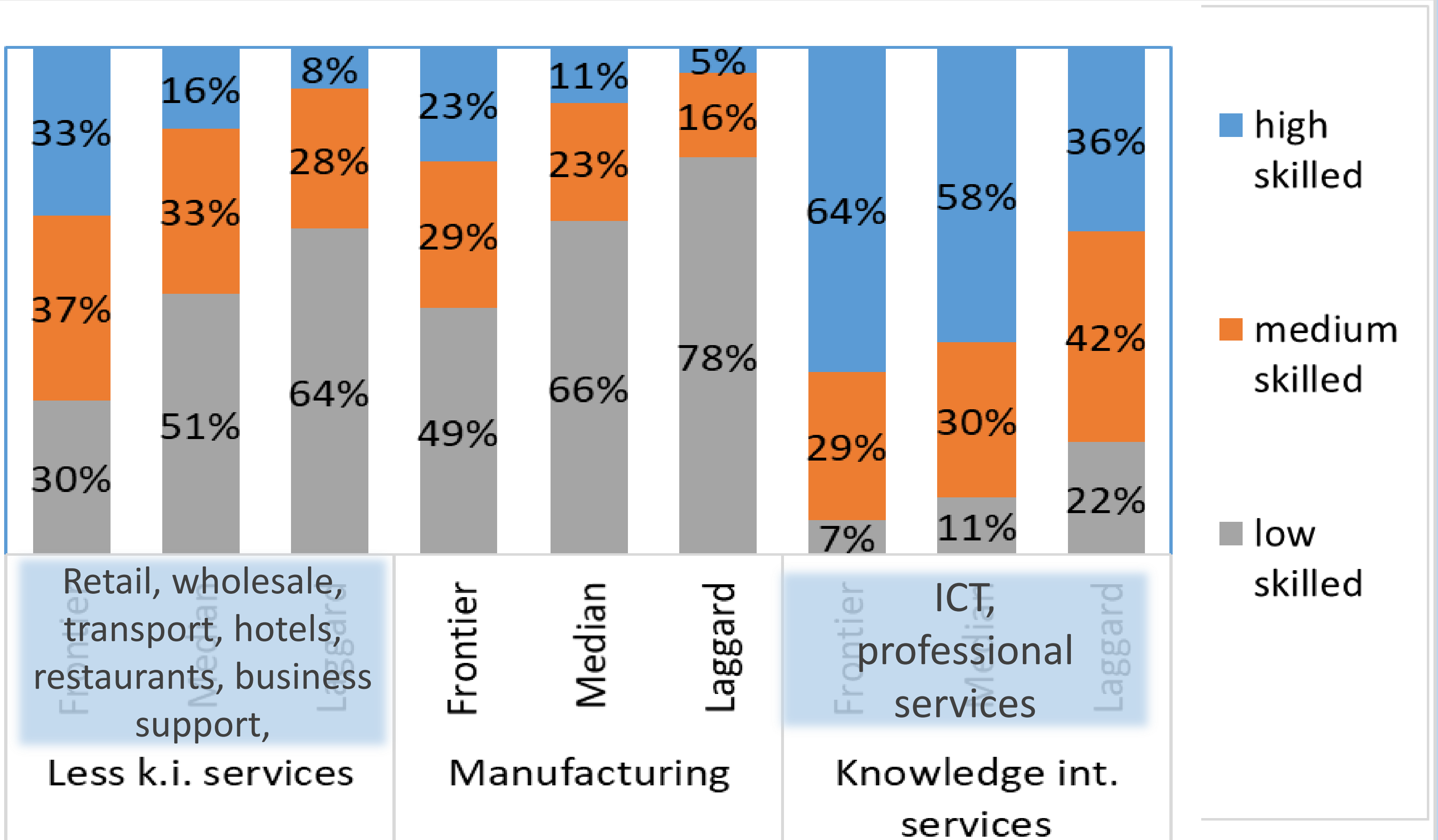


The educational composition varies systematically along the firm productivity distribution in Portugal

with key differences across sectors

Skill composition at different segment of the productivity distribution





Zooming in at *frontier vs typical* (median) firm
How the frontier differs in terms of skills?

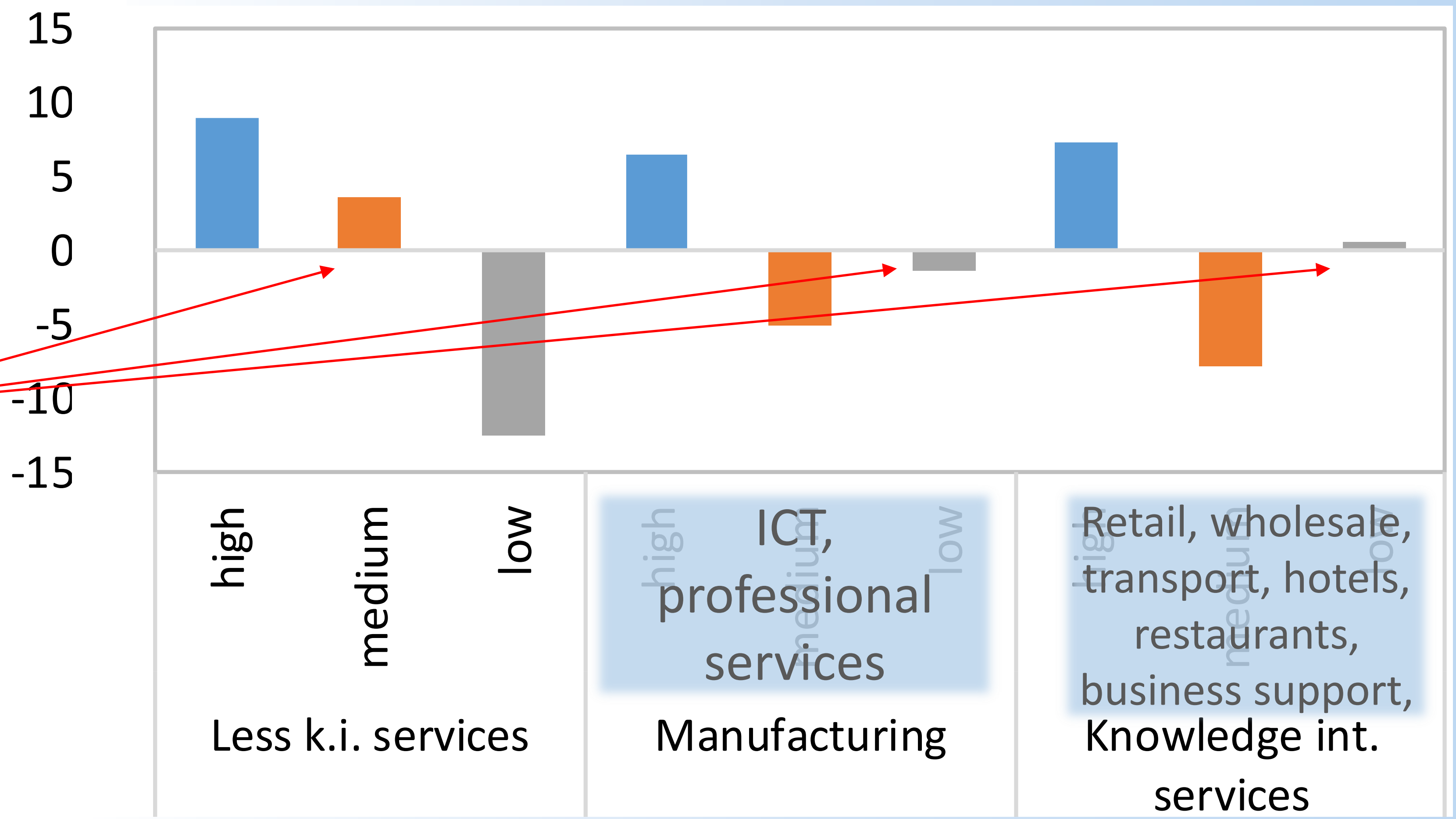
Deviation of the **frontier** from a typical **medium performer*** by skill groups

In percentage points

High skills at the frontier are crucial in each sector

But the use of low / medium skilled varies:

More innovative sectors have **relatively more** low skilled in top firms



*of the same sector

Zooming in at *frontier vs typical* (median) firm

How the frontier differs in terms of skills by sector in Portugal?

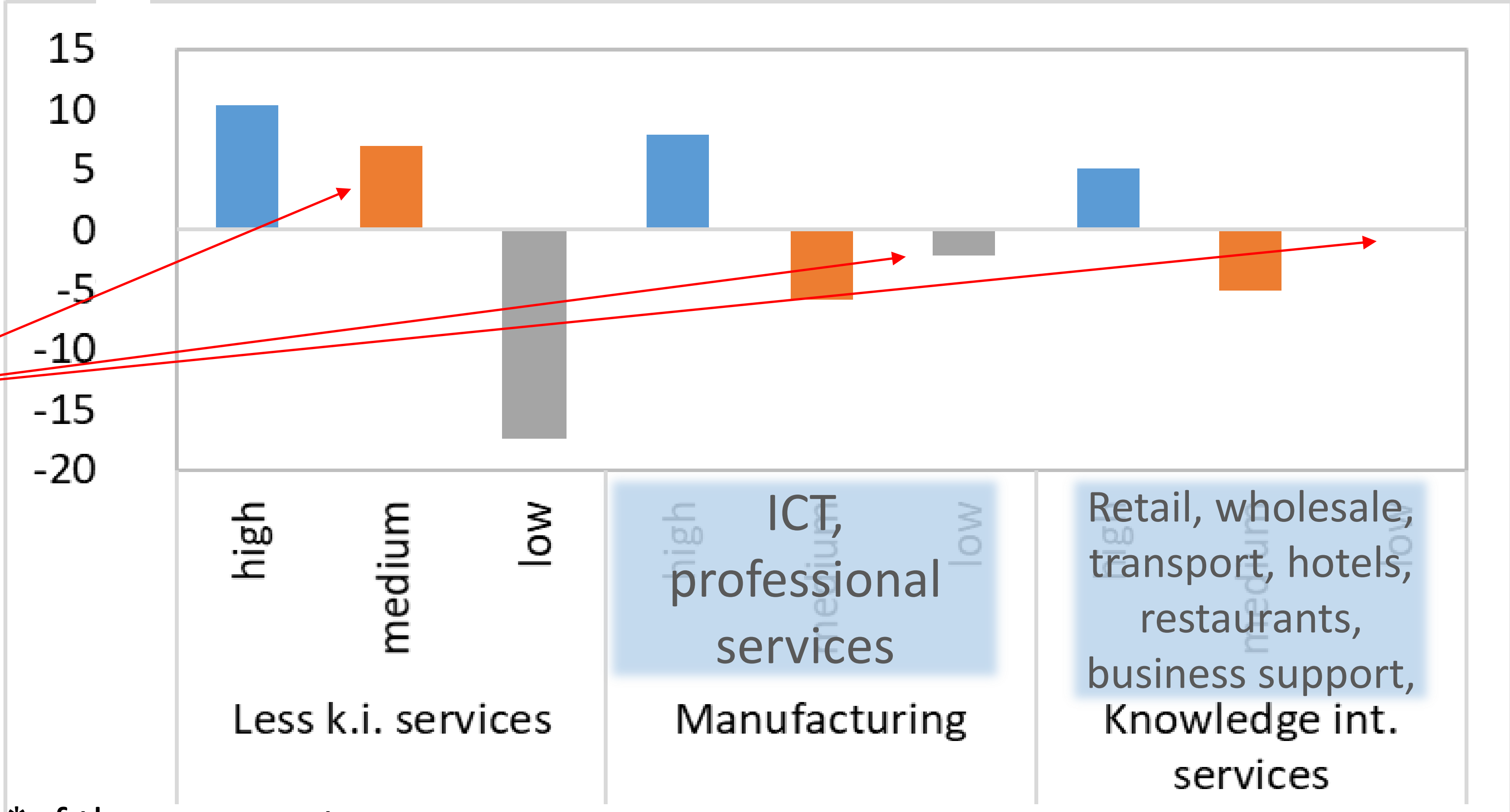
Deviation of the **frontier** from a typical **medium performer*** by skill groups

In percentage points

High skills at the frontier are crucial in each sector

But the use of low / medium skilled varies:

The most productive Portuguese firms rely relatively less on low skilled workers

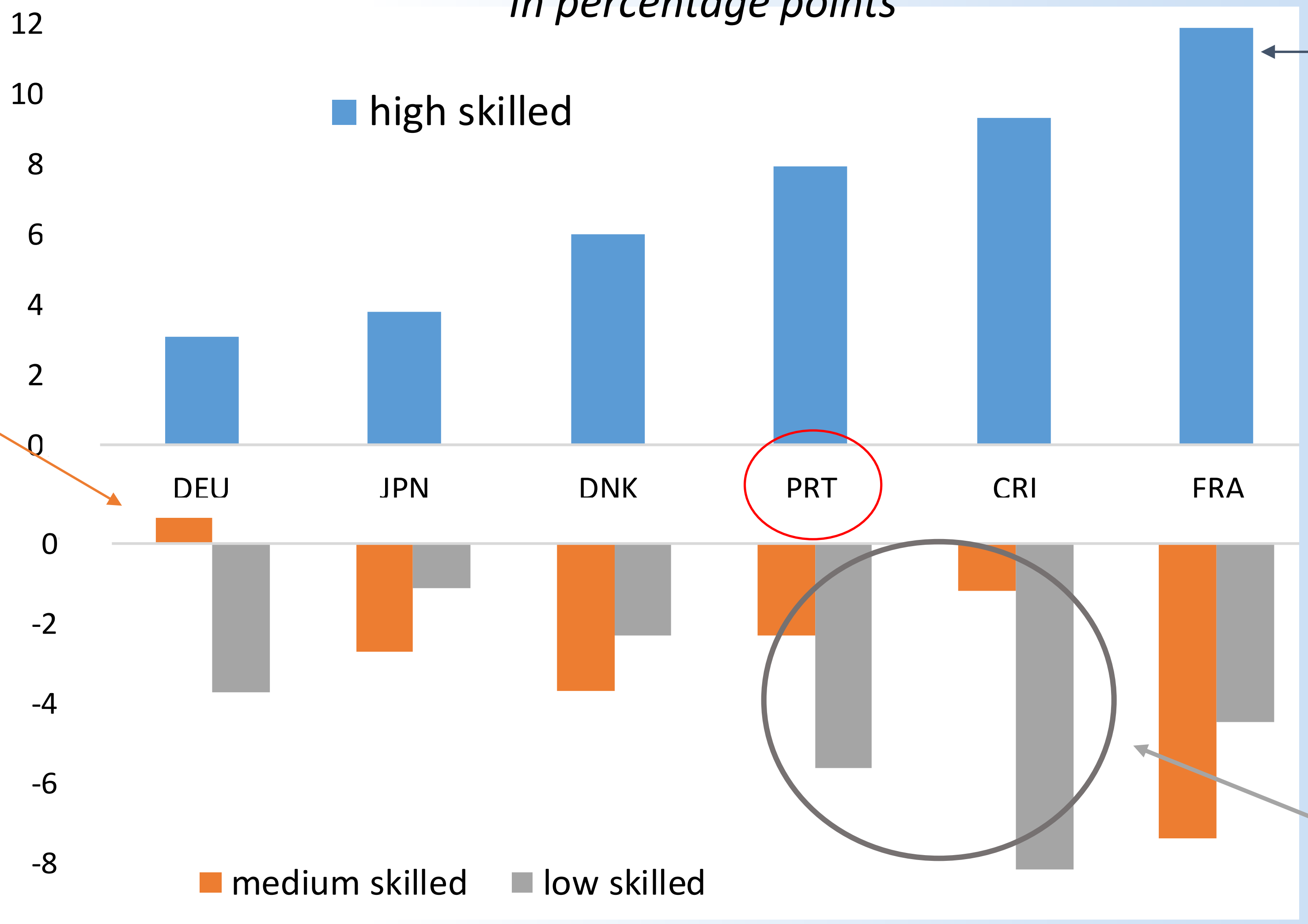


*of the same sector

Zooming in at *frontier vs typical* (median) firm
Strong country-specific features

Deviation of the **frontier** from a typical **medium performer**

In percentage points



High skilled workers are most critical for top performing firms in France

Medium skilled workers are relatively more important for German top performers

Low skilled workers used the least in top firms in Costa Rica and Portugal

Note: these are unweighted averages across all detailed industries and years by country

More skilled workforce a positive and robust correlate across all countries & conditional on many controls

Firm-level regressions of **log labour productivity (VA/L)** on **skill group** shares
omitted group: *medium skilled*

More high (& less medium) always positive

more so than more medium (& less low)

but often with decreasing returns

and with complementarities with medium

Variables / Countries	CRI	DEU	DNK	FRA	JPN[1]	PRT
Share of high skilled	1.017***	1.094***	.42***	.626***	.551***	1.265***
	(.104)	(.167)	(.038)	(.015)	(.044)	(.045)
Share of low skilled	-.295***	-.103**	.037***	-.292***	.115	-.213***
	(.034)	(.046)	(.014)	(.005)	(.182)	(.011)
High x high	-.245	-1.13***	-.568***	-.303***	-.368**	-1.335***
	(.193)	(.232)	(.061)	(.027)	(.155)	(.071)
High x low	-.492	.314	-.334**	-.983***	.858	-.876***
	(.329)	(.534)	(.132)	(.045)	(.64)	(.125)
Controls	Manager and worker demographics (share of old, young; share of women; share of foreign); share of part-time [2]; occupation diversity (Herfindahl); manager/worker relative wage					
Industry x year FE	YES	YES	YES	YES	YES	YES
Firm size categories	YES	YES	YES	YES	YES	YES
R-squared	.503	.368	.689	.526	.418	.465
No. of observations	49,927	25,483	115,852	1,356,840	13,376	256,161

Note: Standard errors clustered at the firm level
(1) Education based skill groups
(2) Not available in Costa Rica

More skilled workforce a positive and robust correlate with several variations and checks **in Portugal**

Firm-level regressions of **log labour productivity** on **skill group** shares (omitted : *medium skilled)*

Productivity	(1) VA/L	(2) VA/L	(3) VA/H	(4) VA/L	(5) VA/L
Skill	Baseline	Baseline	Baseline	Baseline	Education
Variables					
Share of high skilled	1.265***	1.211***	1.072***	0.871***	1.115***
	(.045)	(0.0277)	(0.0426)	(0.0528)	(0.0389)
Share of low skilled	-.213***	-0.262***	-0.166***	-0.226***	-0.480***
	(.011)	(0.0103)	(0.0109)	(0.0128)	(0.0141)
High x high	-1.335***		-1.157***	-1.010***	-0.608***
	(.071)		(0.0690)	(0.0836)	(0.0649)
High x low	-.876***		-0.935***	-1.613***	-0.312***
	(.125)		(0.121)	(0.150)	(0.0772)
Controls	Baseline	None	Baseline	Baseline + capital intensity	Baseline
Industry x year FE	YES	YES	YES	YES	YES
Firm size categories	YES	YES	YES	YES	YES
R-squared	0.465	0.342	0.451	0.506	0.51
Within R-squared	0.292	0.137	0.278	0.380	0.358
No. of observations	256,161	256,161	256,134	107,895	256,069

Note: Standard errors clustered at the firm level

Firm level regressions confirm a major role for skills
Key takeaways

The ***human factors*** are crucial for productivity:

1. Skills + demographics + work organisation explain about <u>30%</u> of the total cross-firm labour productivity dispersion within industries

2. Controlling for <u>capital intensity</u> (K/L) raises this to <u>40%</u>

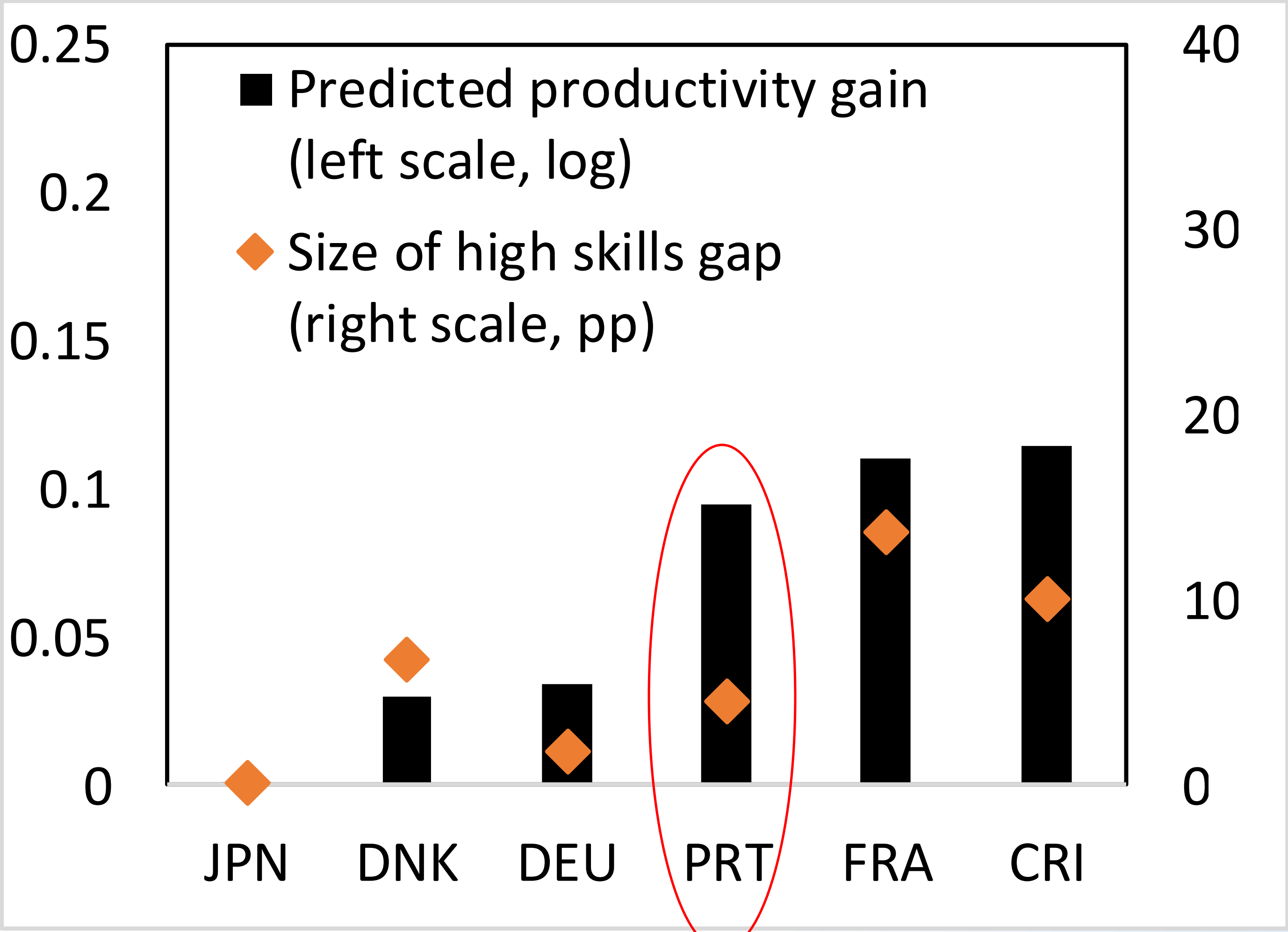
   Without affecting much the coefficients on skills

   → *To investigate further how this varies by sector & country & time*

   → *… and whether manager skills play a different role*

Productivity gains from upskilling
A counterfactual: "imitating" the frontier

Counterfactual productivity increases (in logs) from changing the skill composition of a **medium performer** firm to match that of a firm at the **frontier**



How can such upskilling occur?

(i) By raising the skills of **existing workers** at the firm (ie by training);

(ii) Reconcile **skills needs with education policies**

(iii) Enabling/incentivising **stronger labour force participation** (eg high skilled women)

(iv) Encouraging **mobility** across firms (helps with spillovers)

➔ ***Policies should aim for a combination of these***

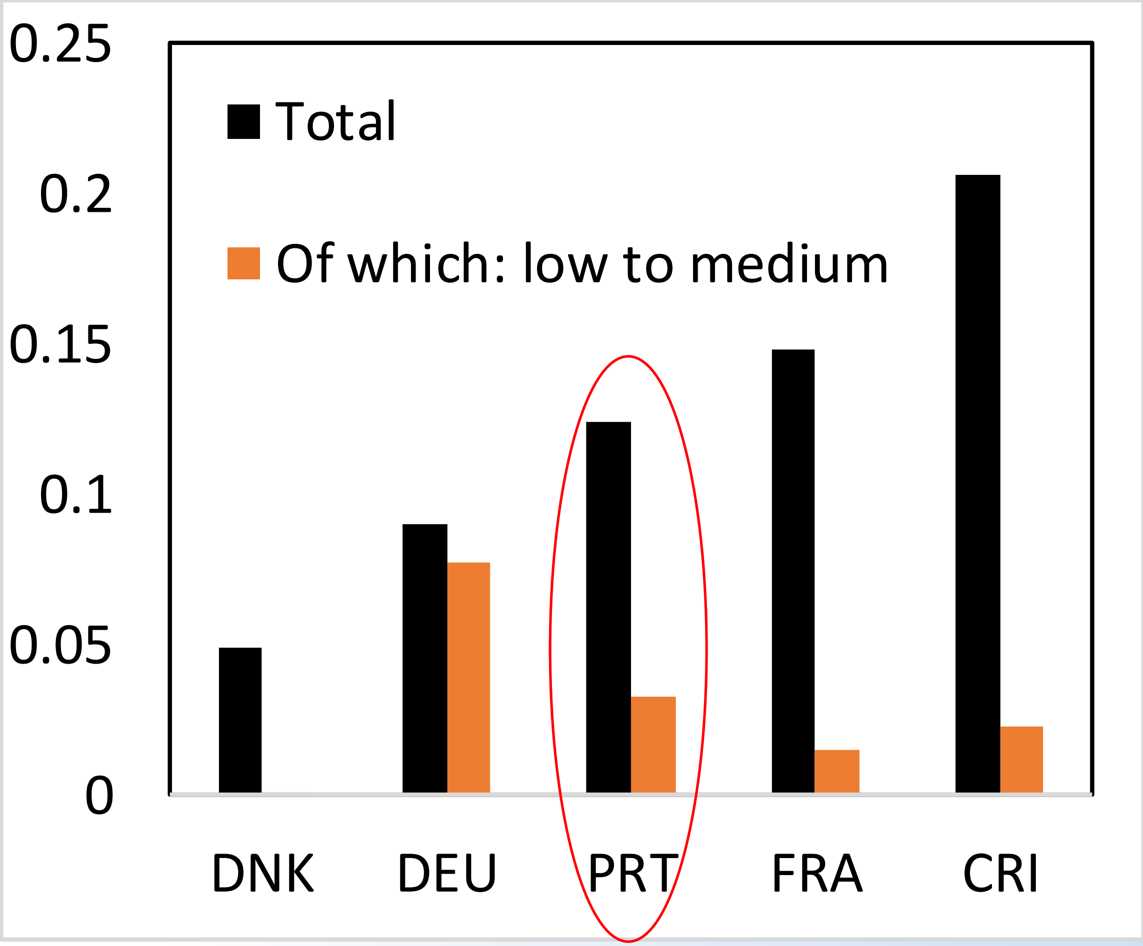
Productivity gains from upskilling

A counterfactual: "imitating" the frontier

Counterfactual productivity increases (in logs) from changing the skill composition of a **medium performer** firm to match that of a firm at the **frontier**

In **less knowledge intensive services**, larger gains

… of which **upskilling from low to medium** is a substantial part in Germany



➔ Note that this is the ***largest segment of the economy***, with big potential gains from skills

Productivity gains from upskilling
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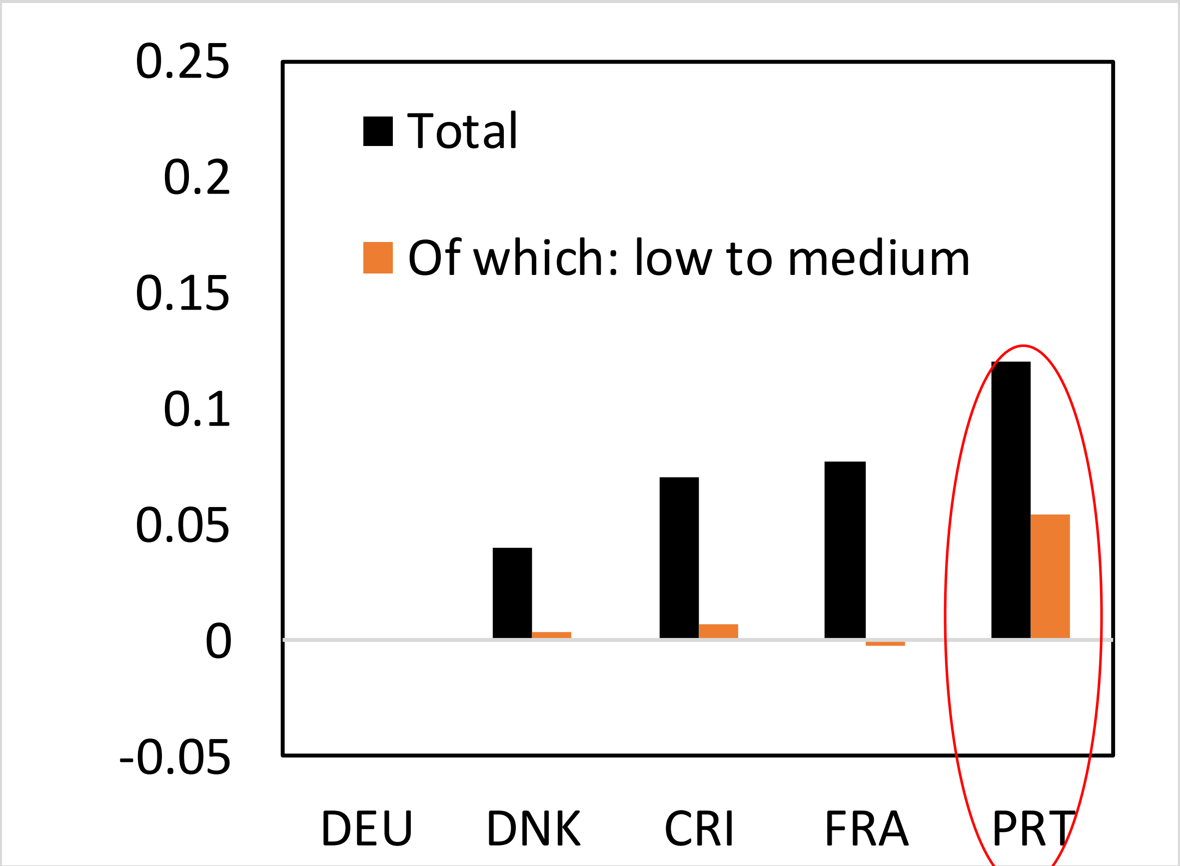
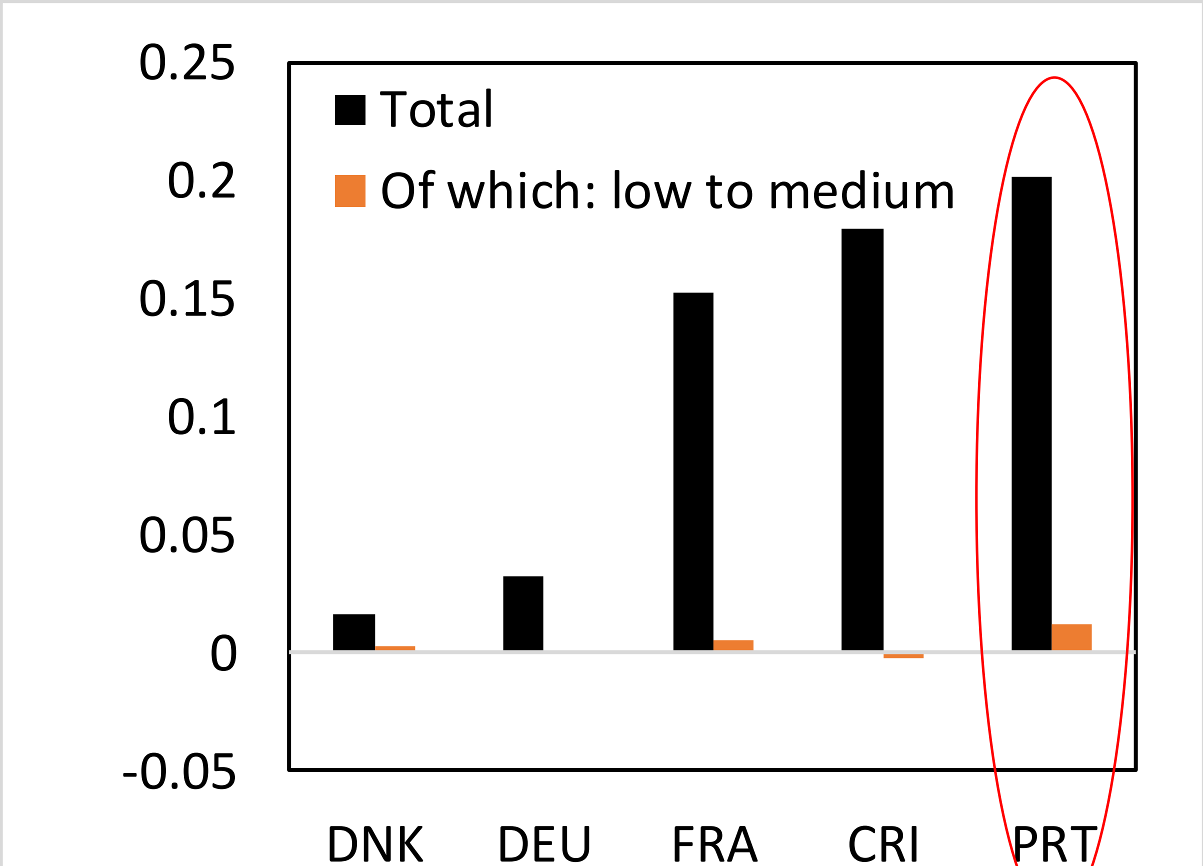
Counterfactual productivity increases (in logs) from changing the skill composition of a **medium performer** firm to match that of a firm at the **frontier**

Knowledge intensive services

(ICT, prof. services, etc.)



Manufacturing



Summary and next steps

Summary

- We confirm **skills** play a crucial role for the productivity of firms
- With key differences by **sectors** and **skill** levels
  - **Medium** skilled segment crucial for <u>less knowledge intensive services</u>
  - In <u>more innovative sectors</u>, it's mainly **High + Low** skills
- **Portugal** stands out in terms of the weak use of low skilled in most productive firms

Next steps

- **More countries & link with national policy settings**
- **Diversity:**
  - Gender / Age / Cultural background
  - Their interaction with skills
- **Workforce organisation**
  - Pay structure
  - Managerial structure
  - Flexible work arrangements (part time & work from home)

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PRODUCTIVITY

Thank you

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Defining skill measures

A few examples from the general <u>cognitive</u> measure

High skilled

Science and Engineering Professionals

Chief Executives, Senior Officials

Legal, Social and Cultural Professionals

Medium skilled

Specialized Services Managers

Business and Admin. Associate Professionals (eg secretaries)

Process control technicians

Low skilled

Drivers

Cleaners

Food Processing, Woodworking

DEU

FRA

FRA

DEU

Information and Communication technicians

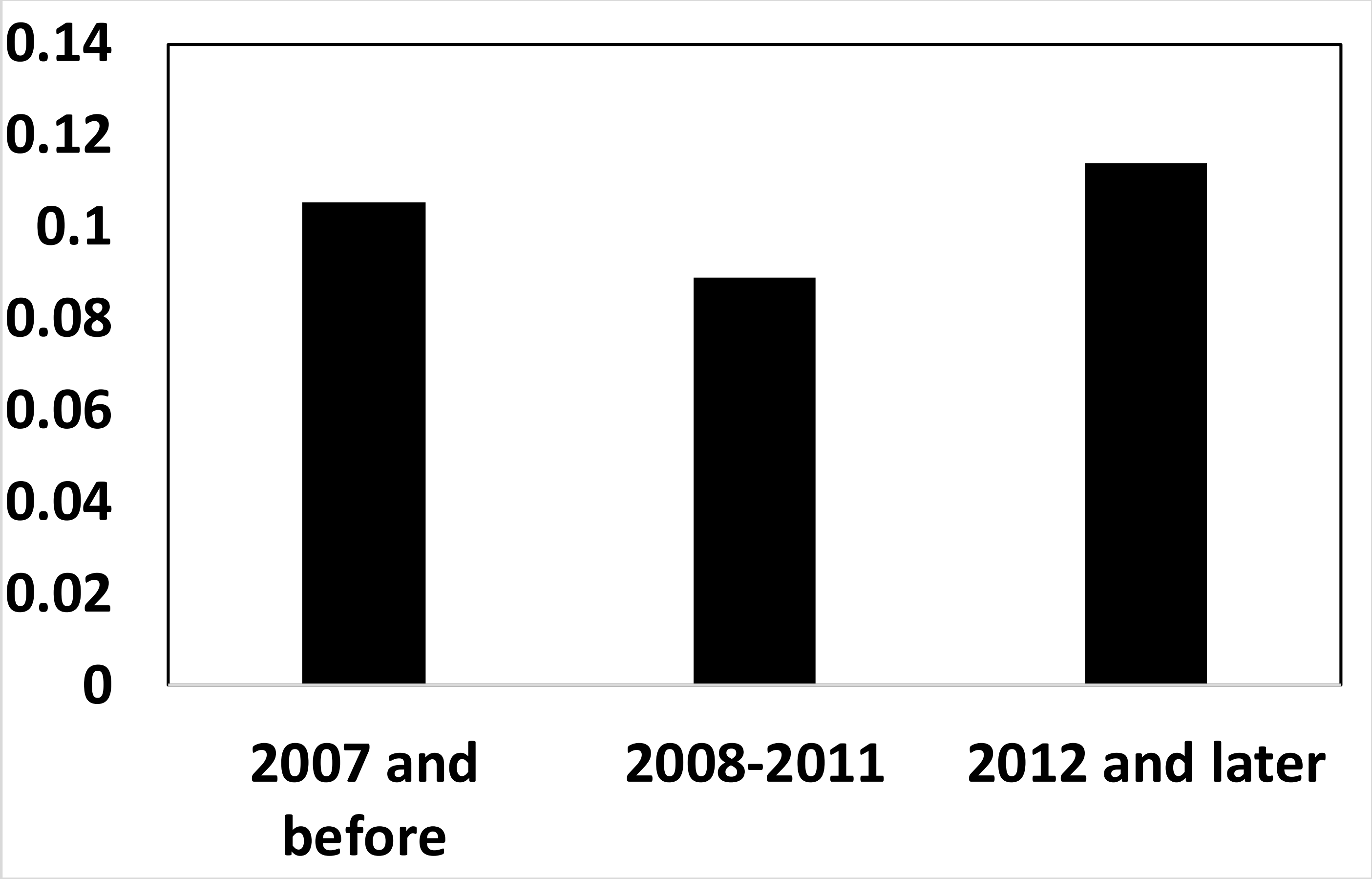
Sales workers

Measure is country specific

Productivity gains from upskilling
A counterfactual: “imitating” the frontier

Counterfactual productivity increases (in logs) from changing the skill composition of a **medium performer** firm to match that of a firm at the **frontier**

No important *trend* over time, but seems somewhat *procyclical*



To the extent that top firms are becoming larger (*Autor et al 2020*), this can be still compatible with increasing *skill concentration (Harrigan et al 2020)*

Average across countries where all three periods are available (DEU, FRA, PRT) and applying *the average skills gap over time* as the counterfactual.