The Human Side of Productivity

Preliminary results on skills
with a special focus on Portugal

Peter Gal
OECD Global Forum on Productivity

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

Portugal NPB webinar | 2 February 2021
## Acknowledgements

<table>
<thead>
<tr>
<th>Country</th>
<th>Institution</th>
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<tr>
<td>Belgium</td>
<td>Central Bank</td>
<td>Emmanuel Dhyne, Gert Bijnens</td>
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<td>Alonso Alfaro Urena, Catalina Sandoval Alvarado, Evelyn Munoz</td>
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<td>Søren Gaard, Katrine Bagge Thorball, Magnus Skafte-Larsen, Louis Konstantyner</td>
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<td>Alfred Garloff</td>
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<td>Hungary</td>
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<td>Peter Toth, Istvan Szabo, Andras Svraka, Katalin Horvath, Balint Van, Tibor Keresztely</td>
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<td>Italy</td>
<td>INAPP and University of Milan</td>
<td>Giorgio Barba Navareti, Anna Rosso, Camilla Andretta</td>
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<td>Institute of Economic Research, Hitotsubashi University</td>
<td>Ryo Kambayashi</td>
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<td>Sweden</td>
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<td>OECD colleagues</td>
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<td>Patrick Lenain, Alexander Hijzen, Mariagrazia Squicciarini, Lea Samek, Glenda Quintini, Oliver Denk, Wouter Zwysen</td>
</tr>
</tbody>
</table>
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
- ... 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

**A) Firm productivity data**
- Leaders
- Medium performers
- Laggards

**B) Linked employer-employee data**
1. Workforce composition along skills / occupations
2. Workforce diversity across demographic groups
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, Criscuolo, 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

<table>
<thead>
<tr>
<th>Country</th>
<th>Output</th>
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<th>Worker info</th>
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<td>Occ, edu</td>
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<td></td>
<td>14. Spain</td>
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<tr>
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<td>L, H</td>
<td>edu</td>
<td></td>
<td></td>
<td>+ Italy (ISTAT)</td>
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<td>L, H</td>
<td>Occ, edu</td>
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<td>Occ, edu</td>
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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

<table>
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<td>Occ, edu</td>
<td>x x x x x x x x x x x x x</td>
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<tr>
<td>5. Japan **</td>
<td>GO, VA</td>
<td>L, H</td>
<td>edu</td>
<td>x x x x x x x x x x x x x</td>
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<td>Occ, edu</td>
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<tr>
<td>[7. Italy (INAPP)*]</td>
<td>GO, VA</td>
<td>L</td>
<td>Occ, edu</td>
<td>x x x x x x x x x x x x x</td>
</tr>
</tbody>
</table>

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
Skill measures
Definitions

• Relying on occupations
  • 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. Cognitive ability as a general skills measure
     = average of literacy, numeracy and problem solving scores from PIAAC
  2. “Soft-skills” or “social skills”: Self-organisation and communications
     Identified through factor analysis from PIAAC responses about the nature of tasks by Grundke, Jamet, Kalamova, Keslair, Squicciarini (2017)
  3. “Hard-skills”: ICT intensity
     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 educational attainment 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: 40th-60th 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:

1. Frontier (19%): Retail, wholesale, transport, hotels, restaurants, business support, Less k.i. services (46%)
2. Median (30%): ICT, professional services
3. Laggard (38%): Manufacturing (18%), Knowledge int. services (15%)
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 segments of the productivity distribution:

- **Frontier**
  - Retail, wholesale, transport, hotels, restaurants, business support, Less k.i. services: 33% high skilled, 16% medium skilled, 51% low skilled
  - Manufacturing: 29% high skilled, 23% medium skilled, 49% low skilled
  - ICT, professional services: 64% high skilled, 11% medium skilled, 22% low skilled

- **Median**
  - Retail, wholesale, transport, hotels, restaurants, business support, Less k.i. services: 33% high skilled, 33% medium skilled, 51% low skilled
  - Manufacturing: 29% high skilled, 23% medium skilled, 49% low skilled
  - ICT, professional services: 64% high skilled, 11% medium skilled, 22% low skilled

- **Laggard**
  - Retail, wholesale, transport, hotels, restaurants, business support, Less k.i. services: 33% high skilled, 28% medium skilled, 49% low skilled
  - Manufacturing: 29% high skilled, 23% medium skilled, 49% low skilled
  - ICT, professional services: 64% high skilled, 11% medium skilled, 22% low skilled
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?

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

Medium skilled workers are relatively more important for **German top performers**

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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Countries</th>
<th>CRI</th>
<th>DEU</th>
<th>DNK</th>
<th>FRA</th>
<th>JPN(1)</th>
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<tbody>
<tr>
<td>Share of high skilled</td>
<td>1.017***</td>
<td>1.094***</td>
<td>.42***</td>
<td>.626***</td>
<td>.551***</td>
<td>1.265***</td>
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<tr>
<td></td>
<td>(.104)</td>
<td>(.167)</td>
<td>(.038)</td>
<td>(.015)</td>
<td>(.044)</td>
<td>(.045)</td>
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<tr>
<td>Share of low skilled</td>
<td>-.295***</td>
<td>-.103**</td>
<td>.037***</td>
<td>-.292***</td>
<td>.115</td>
<td>-.213***</td>
<td></td>
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<tr>
<td></td>
<td>(.034)</td>
<td>(.046)</td>
<td>(.014)</td>
<td>(.005)</td>
<td>(.182)</td>
<td>(.011)</td>
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<tr>
<td>High x high</td>
<td>-.245</td>
<td>-1.13***</td>
<td>-.568***</td>
<td>-.303***</td>
<td>-.368**</td>
<td>-1.335***</td>
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<tr>
<td></td>
<td>(.193)</td>
<td>(.232)</td>
<td>(.061)</td>
<td>(.027)</td>
<td>(.155)</td>
<td>(.071)</td>
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<tr>
<td>High x low</td>
<td>-.492</td>
<td>.314</td>
<td>-.334**</td>
<td>-.983***</td>
<td>.858</td>
<td>-.876***</td>
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<tr>
<td></td>
<td>(.329)</td>
<td>(.534)</td>
<td>(.132)</td>
<td>(.045)</td>
<td>(.64)</td>
<td>(.125)</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
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<tr>
<td>R-squared</td>
<td>.503</td>
<td>.368</td>
<td>.689</td>
<td>.526</td>
<td>.418</td>
<td>.465</td>
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<tr>
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<td>115,852</td>
<td>1,356,840</td>
<td>13,376</td>
<td>256,161</td>
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</tbody>
</table>

More high (& less medium) always positive

more so than more medium (& less low) but often with decreasing returns

and with complementarities with medium

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)

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<tr>
<td>Share of high skilled</td>
<td>1.265***</td>
<td>1.211***</td>
<td>1.072***</td>
<td>0.871***</td>
<td>1.115***</td>
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<td></td>
<td>(.045)</td>
<td>(.0277)</td>
<td>(.0426)</td>
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<td>Share of low skilled</td>
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<td></td>
<td>(.011)</td>
<td>(.0103)</td>
<td>(.0109)</td>
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<td>(.0141)</td>
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<tr>
<td>High x high</td>
<td>-1.335***</td>
<td>-1.157***</td>
<td>-1.010***</td>
<td>-0.608***</td>
<td>-0.608***</td>
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<tr>
<td></td>
<td>(.071)</td>
<td>(.0690)</td>
<td>(.0836)</td>
<td>(.0649)</td>
<td>(.0649)</td>
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<tr>
<td>High x low</td>
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<td>-0.935***</td>
<td>-1.613***</td>
<td>-0.312***</td>
<td>-0.312***</td>
</tr>
<tr>
<td></td>
<td>(.125)</td>
<td>(.121)</td>
<td>(.150)</td>
<td>(.0772)</td>
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**Controls**
- Baseline: Baseline
- None: Baseline
- Baseline + capital intensity: Baseline

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<th>YES</th>
<th>YES</th>
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<td>YES</td>
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<td>YES</td>
<td>YES</td>
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<tr>
<td>R-squared</td>
<td>0.465</td>
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<td>0.451</td>
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<td>0.51</td>
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<td>256,161</td>
<td>256,134</td>
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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 30% of the total cross-firm labour productivity dispersion within industries

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

Knowledge intensive services
(ICT, prof. services, etc.)

Manufacturing

![Graph showing productivity gains in Knowledge intensive services and Manufacturing.](image-url)
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 less knowledge intensive services
  • In **more innovative sectors**, 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)
Thank you

OE.CD/GFP
Productivity@OECD.org
Defining skill measures
A few examples from the general cognitive 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 (e.g. secretaries)
Process control technicians

Low skilled
Drivers
Cleaners
Food Processing, Woodworking

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.