Effect of demographic changes on labor market productivity in developing countries

Joana Silva
(World Bank, Human Development Chief Economist Office)

May, 2023
The structure of the labor force is changing

Figure 1: Formal workforce by age group over time, Brazil

▶ Ageing affects worker productivity which in turn affects firm’s decisions
▶ No easy solution. However, training and technology can help.

Source: Authors' calculations using RAIS
Outline

Workforce ageing

Effect on productivity: Age and wage-productivity gaps

What can be done about it?
Outline

Workforce ageing

Effect on productivity: Age and wage-productivity gaps

What can be done about it?
When it comes to population ageing, dependency ratios are a core concern.

Figure 2: Old-age dependency ratios for a selection of countries (1950-2100)

Source: United Nations 2017
But aging has also a large impact on the composition of the workforce.

Figure 3: Formal Workforce by Age in shares for Brazil

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 - 17</td>
<td>0.30</td>
<td>0.20</td>
</tr>
<tr>
<td>18 - 24</td>
<td>0.10</td>
<td>0.00</td>
</tr>
<tr>
<td>25 - 29</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>30 - 39</td>
<td>0.20</td>
<td>0.30</td>
</tr>
<tr>
<td>40 - 49</td>
<td>0.10</td>
<td>0.00</td>
</tr>
<tr>
<td>50 - 64</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>65 +</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Av. male age = 32.81; Av. female age = 31.55
Source: Rais 1986

Av. male age = 37.06; Av. female age = 36.78
Source: Rais 2017

<table>
<thead>
<tr>
<th></th>
<th>1986</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>32.8</td>
<td>37.1</td>
</tr>
<tr>
<td>Women</td>
<td>31.55</td>
<td>36.8</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations using RAIS

Workforce ageing  Effect on productivity: Age and wage-productivity gaps  What can be done about it?
Education change also occurred, but started in the 1980s (aging in the 2000s)

**Figure 4: Formal Workforce by Age and Education for Brazil**

<table>
<thead>
<tr>
<th>Year</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors’ calculations using RAIS
Outline

Workforce ageing

Effect on productivity: Age and wage-productivity gaps

What can be done about it?
As workers age, there is an increasing mismatch between worker’s productivity and earning profile.

Figure 5: Mismatch between worker’s productivity and earning profile.
Demographic changes can affect labor productivity

Aging affects worker-level productivity:

- Experience (Levhari and Sheshinski 1973; Caplin et al. 2022) and physical and cognitive abilities (Avolio and Waldman 1994; Skirbekk 2004)

- Skill depreciation and obsolescence (Dinerstein et al. 2022)

Age-productivity profiles

- Vary across occupations (Veen et al. 2008), industries (Gobel and Zwick 2012), and time (Galenson and Weinberg 2000)

- Tend to be inverted-U shaped due to lower accumulation of 'new' human capital and depreciation of 'accumulated' stock.
Age and wage-productivity gaps

Perfectly competitive labor market:
- Since compensation is determined solely by productivity, firms lack incentives to create a pay-productivity gap based on age.

With labor market imperfections:
- Pay-productivity gaps arise in some ages. Why?
  - Incentive-compatible models (Lazear 1979)
  - Human capital models (Becker 1964)
  - Imperfect labor-market models
    - Collective bargaining (Weiss 1985; Kuhn and Robert 1989)
    - Insurance (Malcomson 1999)
    - Worker preferences (Loewenstein and Sicherman 1991; Neumark 1995)

- Channels
  - **Sorting** (Young workers accept low paying jobs to be matched in high productive firms)
  - **Labor market rigidities** (firing cost increase with tenure)
  - **Firm-specific pay and retention** policies (anchor wages to aggregate productivity)
Wage productivity gaps are hard to estimate:
  - Need of *comprehensive data* to understand the dynamics
  - *Methodological* challenge.

Existing evidence remains limited
1. No wage-productivity gaps *(Aubert and Crépon 2007; Dostie 2011; Ours and Stoeldraijer 2011)*
2. Differences in productivity for old workers *(Hacgeland and Klette 1999; Ilmakunnas et al. 2004; Cardoso et al. 2011)*
Outline

Workforce ageing

Effect on productivity: Age and wage-productivity gaps

What can be done about it?
What can be done about it?

- Avoid skill obsolescence through job training?
- Enhance human capital accumulation at older ages through technological change?

Figure 6: Delay the tipping point after which productivity drops
Training and older workers

- Conceptual framework
  - **Ageing** can shape technological development through "directed technical change" and result in cross-country differences
  - Technology adoption can be an opportunity to **enhance the productivity** of the **ageing population**

- Technology adoption can have conflicting effects with age:
  1. **Experience** is likely to increase the potential returns on innovation;
  2. Older workers tend to be further away from the **human capital frontier**, as their education is often dated;
  3. Age-related decline in **adaptability** to new practices and technology.

- Older workers can be more affected by technology adoption than younger ones *(Aubert, Caroli, et al. 2006; Behaghel et al. 2014)*
  - Age-biased effect of ICT and innovative **working practices**;
  - **On-the-job training** can serve as a protective measure for older workers *(Allen and Hart 1998)*.
Training and older workers

- Aghion et al. 2022 measures rents that workers receive when a new invention is introduced (Finland).

- Initial results show dominance of the negative effects of aging. But when temporal distance to the last degree obtained is considered:
  - The age effect is reversed or disappears
  - The negative effect comes from the distance to the human capital frontier

- Important role for governments investment in job training: targeted focus on ICT for older workers.

- Yet, empirical evidence on attempts to train older workers is not encouraging (Armstrong-Stassen and Cattaneo 2010; Martin et al. 2014; Fleischmann et al. 2015; Leppel et al. 2012; Picchio and Van Ours 2013)
Technological change and older workers:
Empirical approach

▶ Biased results if endogenous nature of regressors not accounted.

▶ Estimate (firm level) age-wage and age-productivity profiles using GMM:

$$\Delta \ln y_{i,t} = \sum_{j-1} \gamma^y \Delta \left( \frac{L_j}{L} \right)_{i,t} + \sum_{m-1} \theta^y \Delta \left( \frac{L_m}{L} \right)_{i,t} + \phi^y \Delta X_{i,t} + \Delta \epsilon^y_{i,t}$$

▶ $i$ denotes the firm, $j$ age groups, $m$ labor types (gender and education) and $t$ time;

▶ $y$ is either the the firm’s average hourly wage (age-wage profile model), or the firm’s average value added per labor hour (age-productivity profile model);

▶ $X$ is a set of firm-level controls and $L$ the quantity of labor (hours).

▶ Split the sample between firms that operate in high (IT, chemistry) and low (food, textile) technology intensive sectors
Age-wage and age-productivity profiles: The tipping point

Figure 7: Age-wage and Age-productivity profiles (Portugal, 2004-2018)

Source: Authors' calculations using Quadros de Pessoal
Age-wage and age-productivity profiles: Firms in high vs. low technology intensive sectors

Figure 8: Age-wage and Age-productivity profiles by technology intensity (Portugal, 2004-2018)

Panel A: Firms in low technology intensive sectors
Panel B: Firms in high technology intensive sectors

Source: Authors’ calculations using *Quadros de Pessoal*
Technological change and older workers: Results

- Economy-wide estimates:
  - Inverted-U shaped relationship between age and productivity that peaks at the age 45-49
  - Productivity increases faster in the early stages of the life cycle and slows down with age.

- Differences between high and low technological intensity firms:
  - High technology intensive firms: productivity increases with age;
    Low intensity firms: flatter age-productivity profile.
  - Productivity increases faster in the early stages of the life cycle and slows down with age.
  - Result might support the hypothesis that scarcity of young labor can trigger the adoption of robotics technology (Acemoglu et al. 2022).
Conclusion

Answering 3 broad questions:

▶ Is the workforce ageing in developing countries?
  ▶ Yes, since the 2000s (less of a concern in MENA, SSA and SA)

▶ How will this affect firms’ productivity?
  ▶ Wage-productivity gaps (negative profitability) will arise among older workers

▶ What can be done about it? Can we postpone the tipping point through training and technology?
  ▶ Wage setting norms may imply that wages continue to increase with age, while worker productivity does not.
  ▶ Technology and training can postpone this tipping point, avoiding an early inflection of productivity.
Future work

**Workforce ageing**

- Does workforce ageing also happen in the informal sector? What does it mean for the overall economy? (Census data)

**Ageing and firm productivity**

- How do increases in the worker age affect (better measured) firm-level productivity? (Manufacturing and services censuses)
Future work

Ageing, technology adoption, and training

▶ How do different types of technology adoption affect the wage-productivity gap of older workers? How do technology and training interact?

▶ Can technological progress bust labor demand for older workers, bringing them out of unemployment?

Policy

▶ Given the profitability effects and the existing pension systems, what is the optimal level and type government intervention?

▶ Implementation challenges of training programs for older workers: Difficulty in creating schemes with both large coverage and high efficiency.
Thank you!