Impact of Demographic Changes on Labor Market Productivity in Developing Countries:

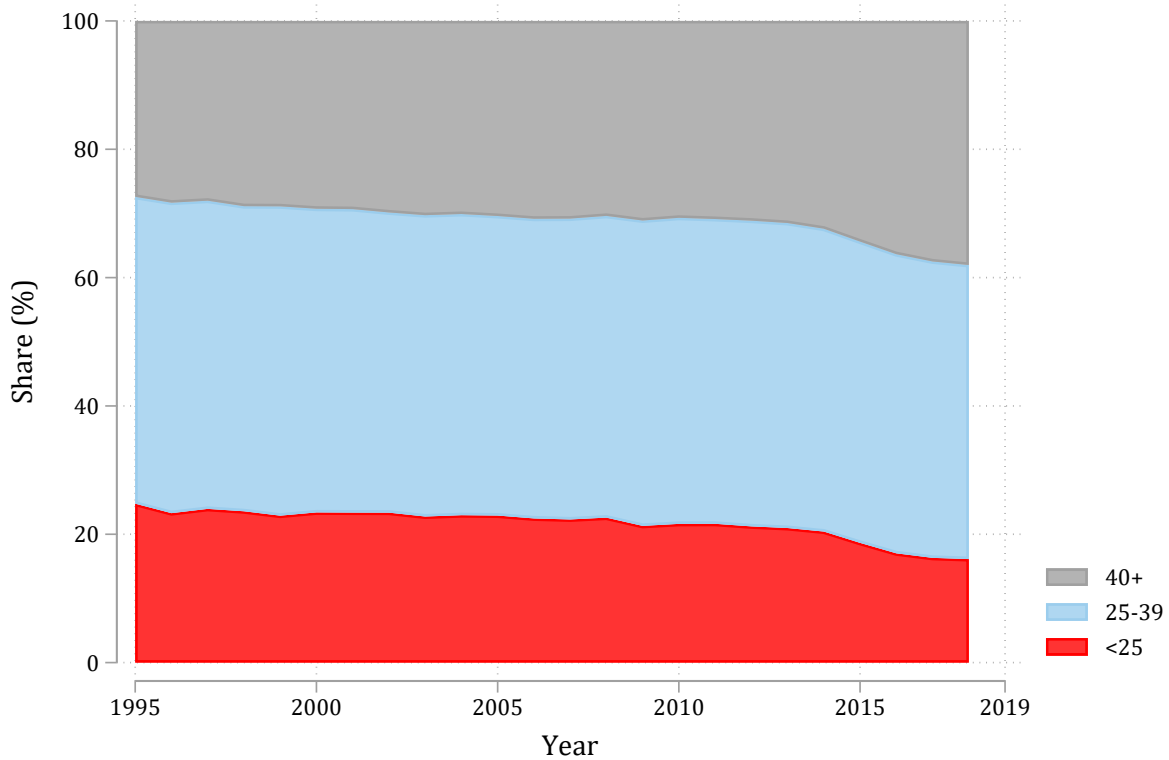
Challenges, Policy Responses, and the Role of Technology

Joana Silva
(World Bank)

June, 2024

The structure of the labor force is changing

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



Source: Authors' calculations using RAIS

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

Outline

Workforce ageing

Effect on productivity: Age and wage-productivity gaps

What can be done about it?

Outline

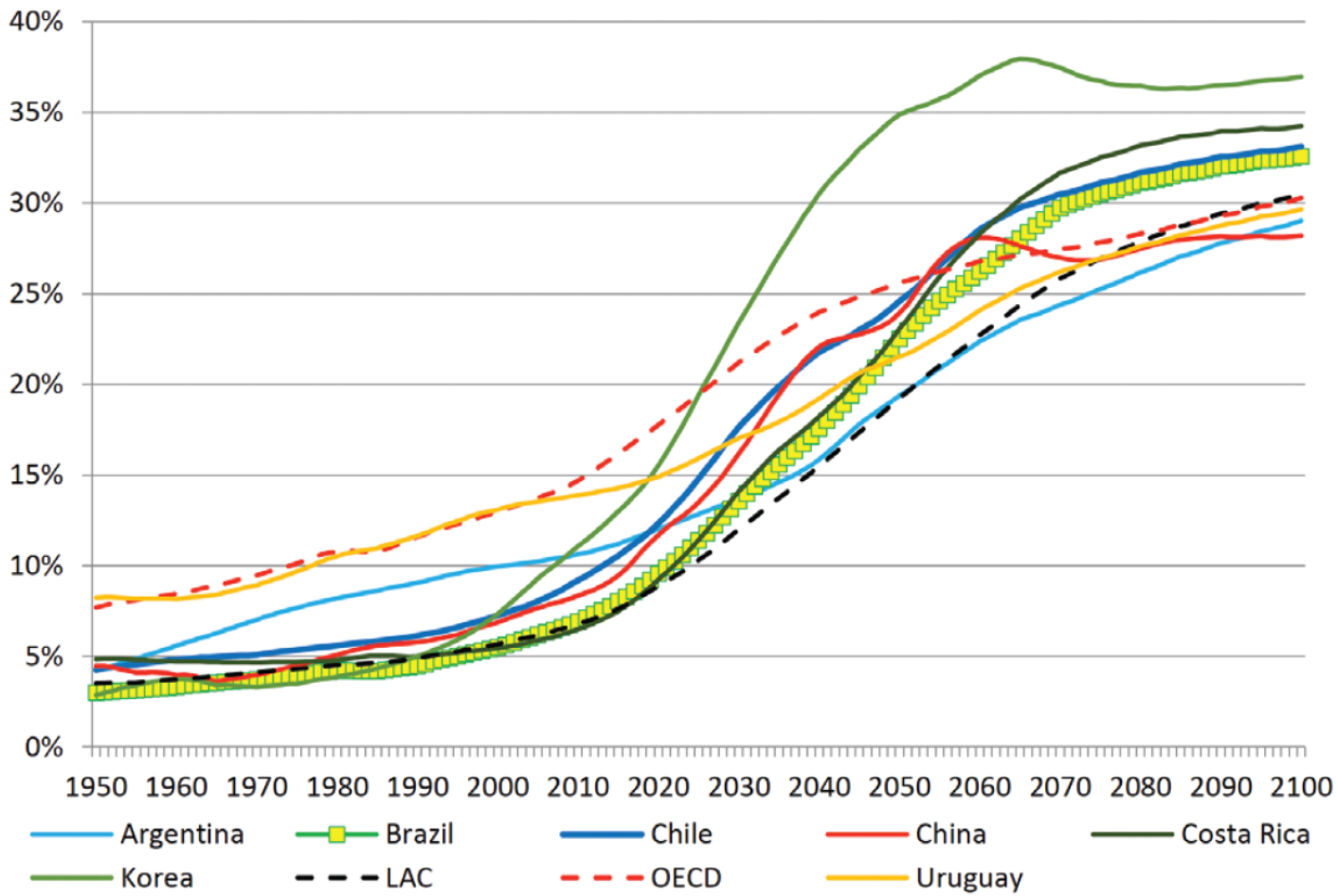
Workforce ageing

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

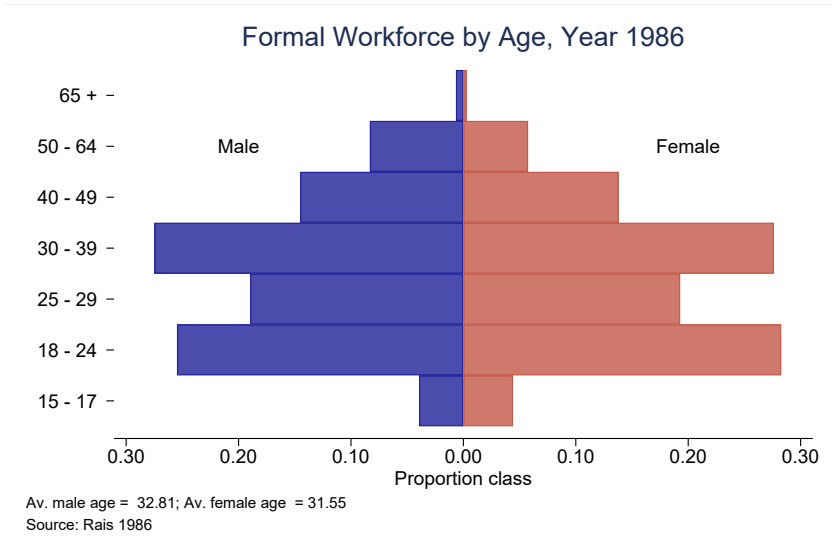
Figure 2: Old-age dependency ratios for a selection of countries (1950-2100)

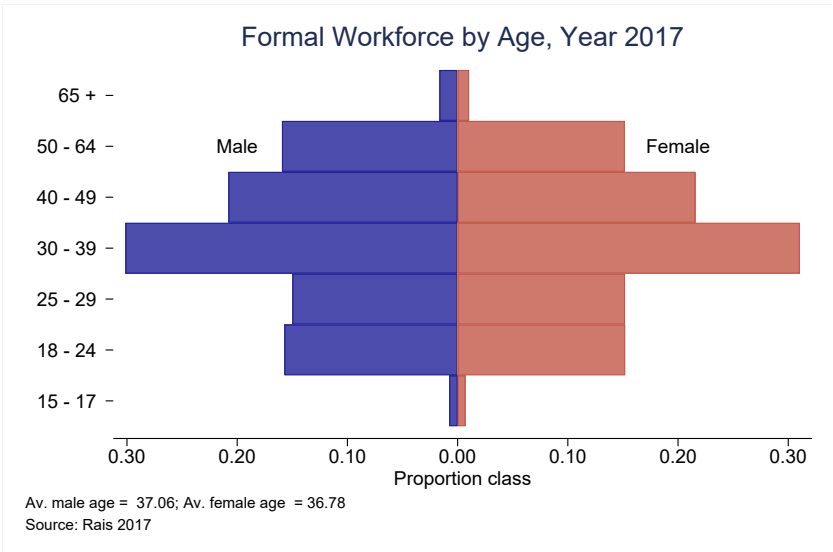


Source: United Nations 2017

But aging has also a large impact on the composition of the workforce

Figure 3: Formal Workforce by Age in shares for Brazil



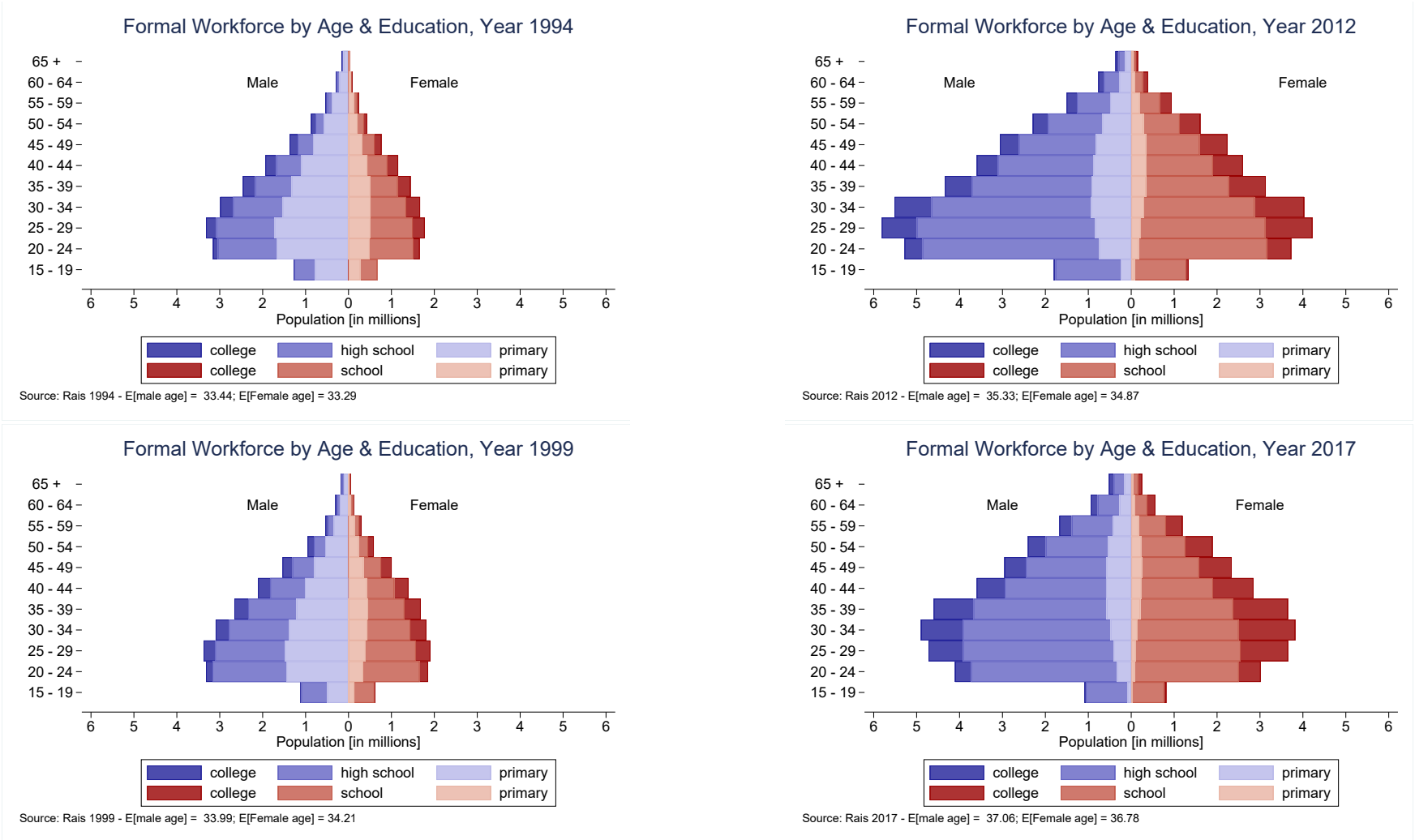


Average Age	1986	2017
Men	32.8	37.1
Women	31.55	36.8

Source: Authors' calculations using RAIS

Education change also occurred, but started in the 1980s (aging in the 2000s)

Figure 4: Formal Workforce by Age and Education for Brazil



Source: Authors' calculations using RAIS

Outline

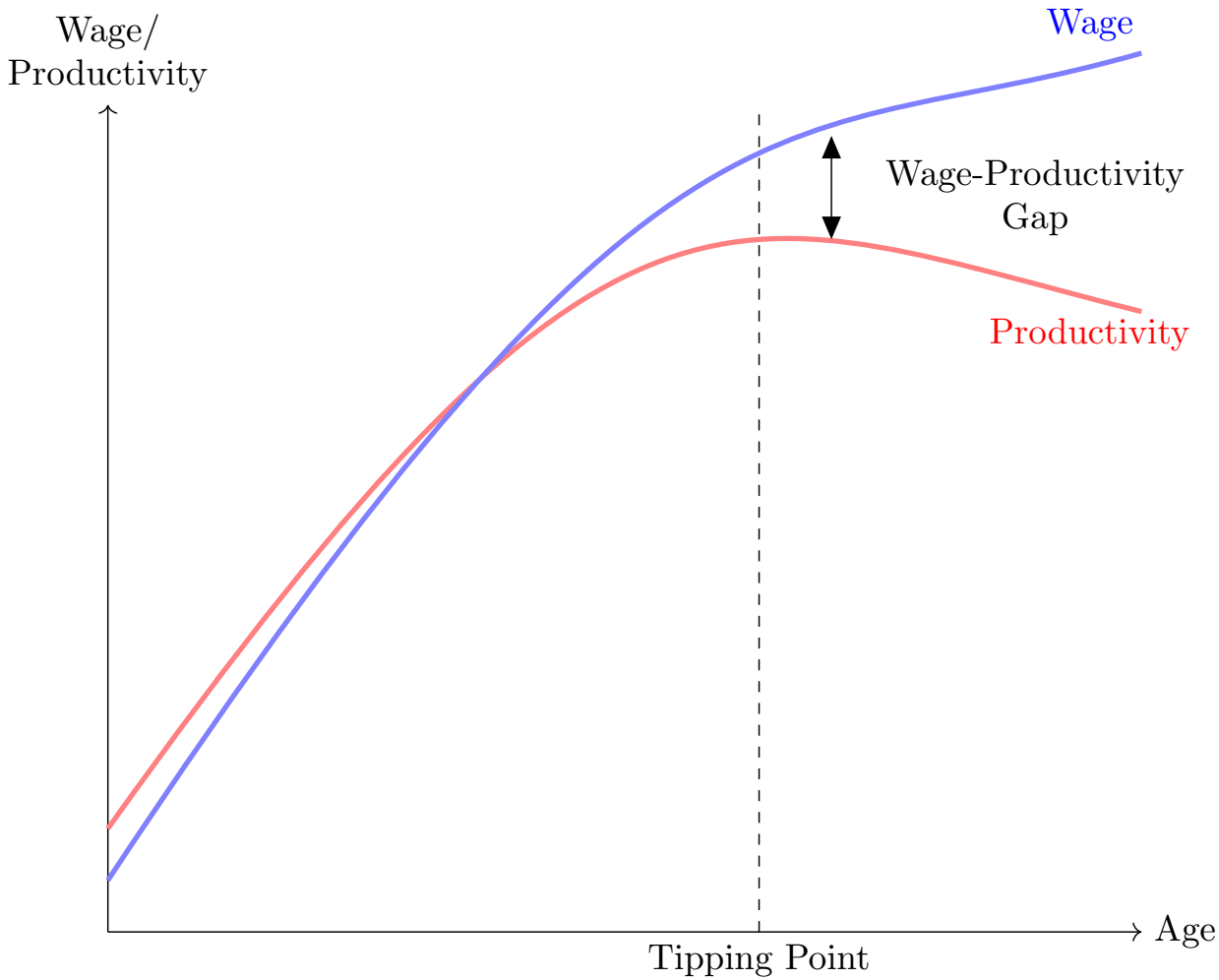
Workforce ageing

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)

Effect on productivity: Age and wage-productivity gaps

Evidence from linked-employer employee datasets

- 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

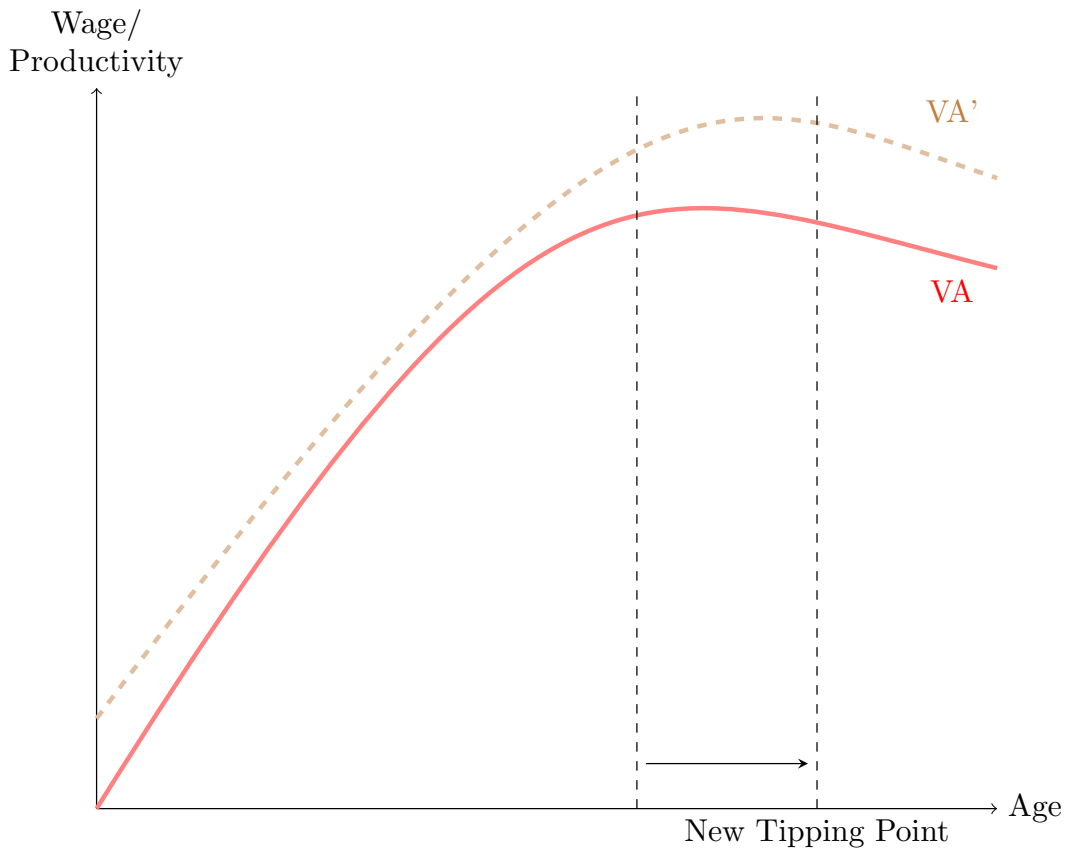
Effect on productivity: Age and wage-productivity gaps

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

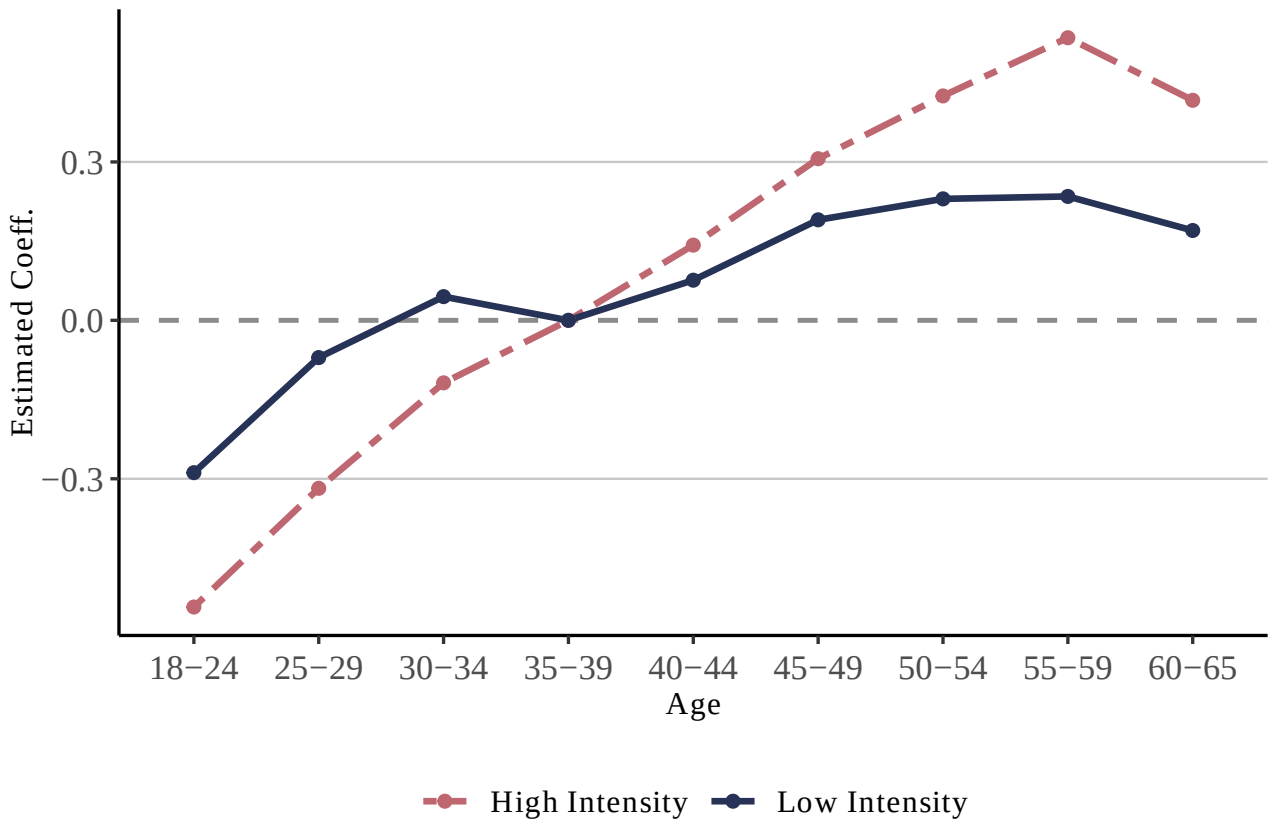
Age-wage and age-productivity profiles: The tipping point

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

Source: Authors' calculations using *Quadros de Pessoal*

Age-productivity profiles: Firms in high vs. low technology intensive sectors

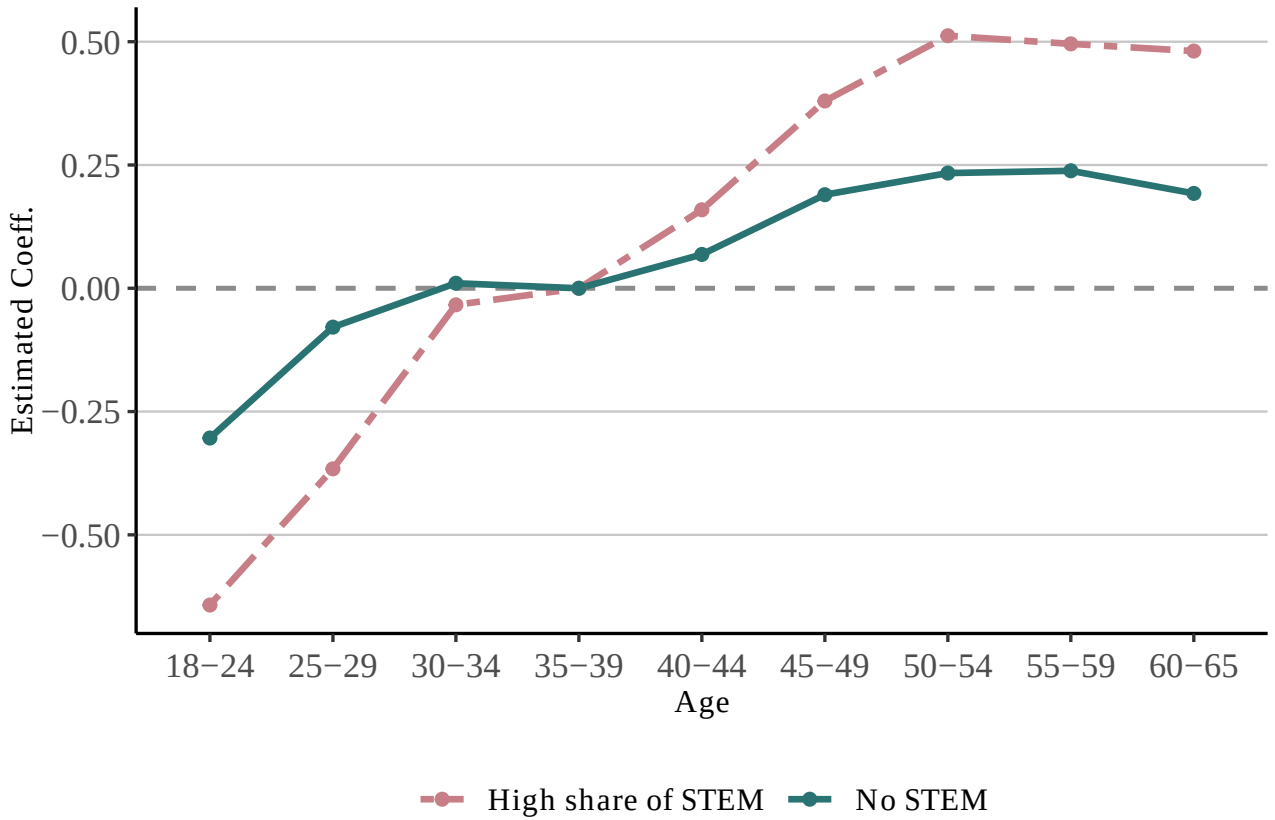
Figure 8: Age-productivity profiles by technology intensity (sector)
(Portugal, 2004-2018)



Source: Authors' calculations using *Quadros de Pessoal*

Age-productivity profiles: High vs. Low technology intensity firms

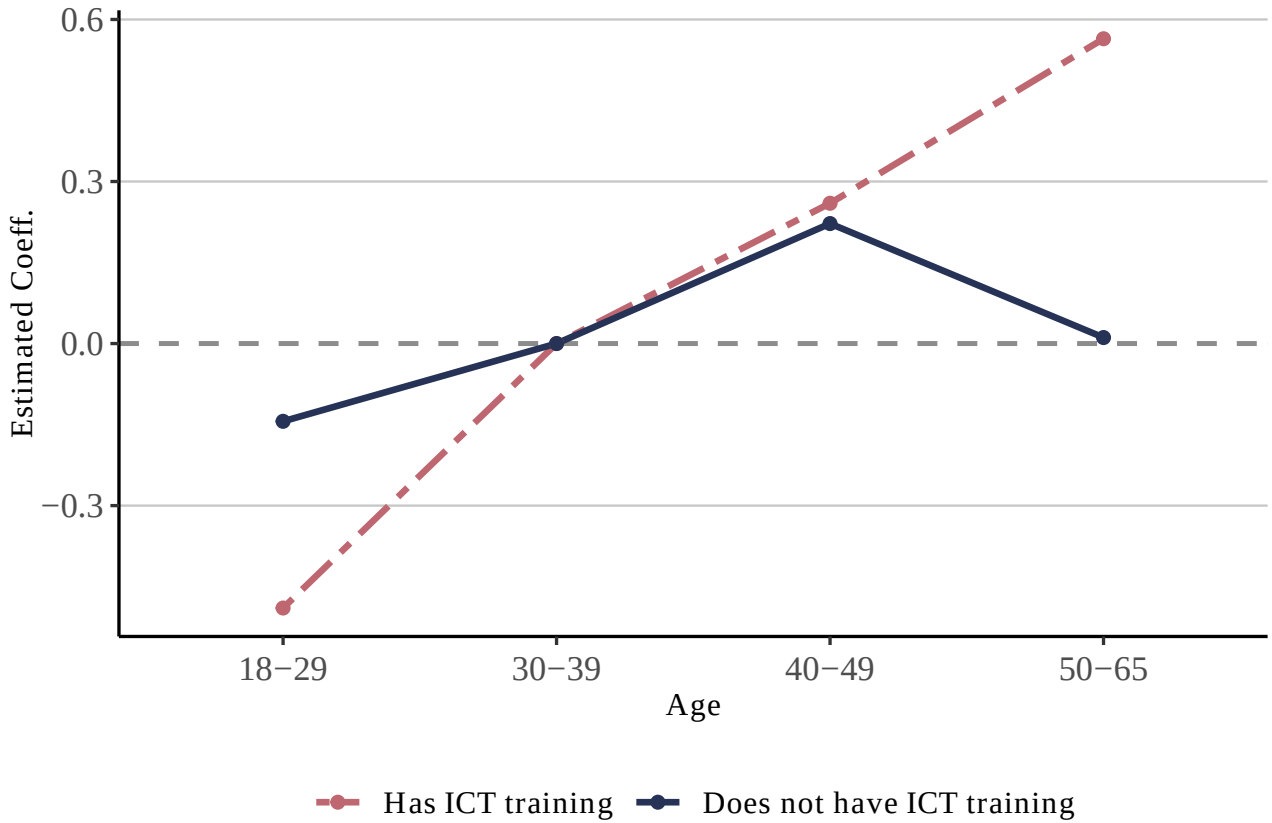
Figure 9: Age-productivity profiles by technology intensity (firm) (Portugal, 2004-2018)



Source: Authors' calculations using *Quadros de Pessoal*

Age-productivity profiles: Firms that use ICT training

Figure 10: Age-productivity profiles and ICT training (Portugal, 2010-2018)



Source: Authors' calculations using *Quadros de Pessoal* and *IUTIC*

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!