Understanding the Productivity Slowdown in Aging Economies

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Motivations

Why do we need to examine the effect of population aging on labor productivity?

Population aging and output growth

- Aging hampers economic performance
  $\downarrow$ GDP per capita in the US (Maestas et al., 2023)
- Aging fosters robust economic growth
  (Acemoglu and Restrepo, 2017, 2022; Cutler et al., 1990; Hicks, 1932; Irmen, 2017)
  $\uparrow$ Labor scarcity
  $\uparrow$ Capital deepening or investment in innovation

Population aging affects growth via shaping labor productivity

- $\uparrow$ Scarcity of active workers in the labor force (Cutler et al., 1990)
- $\uparrow$ Longevity affects saving behaviour and real interest rate, thus influencing capital investments (Carvalho et al., 2016)
- The aging-productivity nexus remains inconclusive

Motivations

Insights from existing studies require different approaches:

- Many advanced economies have experienced pro-longed periods of stagnant productivity and low interest rates since 1990
  Secular stagnation hypothesis (Summers, 2014)

- Previous studies have mainly used aggregate data at the country or sub-national level (Acemoglu and Restrepo, 2022; Maestas et al., 2023)
  A more disaggregated approach accounting for large heterogeneity across industries

Population aging (2000–2030) has a negative influence on the growth in industry-level labor productivity from 2000–2019

Population aging and labor productivity growth

Key mechanisms

- Aging reduces capital deepening in a secular stagnation regime
  - $\uparrow$ Longevity increases incentives to save
  - $\uparrow$ Aggregate savings and $\downarrow$ Real interest rates (Carvalho et al., 2016)
  - Zero lower bound on nominal interest rates (Eggertsson et al., 2019; Jones, 2023)
  - $\downarrow$ Demands for consumption goods
  - Reducing investments and stagnant productivity growth
- Aging hampers long-run technological innovation by reducing the supply of skilled workers
  - $\uparrow$ Incentives to use labor-saving technologies
  - However, firms in younger labor markets are more likely to innovate
  - Innovation requires a complementarity between skills and capital

Industry-level characteristics

- Labor productivity growth: Change in value added per employee
  Log difference in value added per employee between 2000 and 2019
- Data source: The 2023 release of the EU KLEMS database
  It offers harmonized and internationally comparable data at the industry-country year level
- Other outcomes: labour compensation and employment share for each skill group

- Old-age dependency ratio
  - The ratio of people aged 65 and above to people aged from 25 to 64
  - Data source: The United Nations' World Population Prospects for 2024
  - It contains data on population size by age groups from 1950 to 2023 and forecasts up until 2100
- Population aging
  - The difference between the old-age dependency ratio observed in 2000 and its predicted value in 2030
  - Capital investments are considered forward-looking activities

$$\Delta Y_{i,c} = \alpha + \beta Aging_c + \gamma X_{i,c} + \delta H_c + \varepsilon_{i,c}, \tag{1}$$

where $\Delta Y_{i,c}$ is the change in labor productivity between 2000 and 2019 for industry i in country c; $Aging_c$ is a measure of population aging captured by the expected change in the old-age dependency ratio between 2000 and 2030; $X_{i,c}$ is a set of industry-level controls, including the 2000 value of labor productivity, the change in employment and the change in labor costs between 2000 and 2019; H_c is a set of country-level controls, including the 2000 values of gender equality, the quality of human capital, log of GDP per capita, population size, and the old-age dependency ratio; and $\varepsilon_{i,c}$ is an industry-country-specific error term.

- Main threat: Omitted variable bias
  - Population aging is predetermined and exogenous to current economic performance
  - Use historical birth rates as IVs for contemporaneous aging
  - IVs are highly correlated with aging Past birth rates were central to shaping the relative size of different age cohorts in the total population
  - The exclusion restriction
    Historical birth rates are plausibly exogenous to contemporary confounding factors, including immigration, emigration, and labor market institutions
  - Controls for country- and industry-specific characteristics
  - Exploiting within-country, between-period variations

Table: Population aging and labor productivity growth, OLS estimates

	Dependent variable: Change in labor productivity		
	(1)	(2)	(3)
Population aging (2000 – 2030)	-0.022**	-0.026***	-0.028***
	(0.009)	(0.009)	(0.009)
Standardized beta coefficient	-0.185	-0.215	-0.234
Oster's δ for $\beta = 0$	2.57	3.23	3.84
Oster's bias-adjusted coefficient (β^*)	-0.01	-0.02	-0.02
R-squared	0.58	0.60	0.64
Number of clusters (countries)	29	29	29
Observations	1,007	1,007	1,007
Country-level controls	✓	✓	✓
Initial condition		✓	✓
Industry-level controls			✓

Figure: Population aging and labor productivity growth

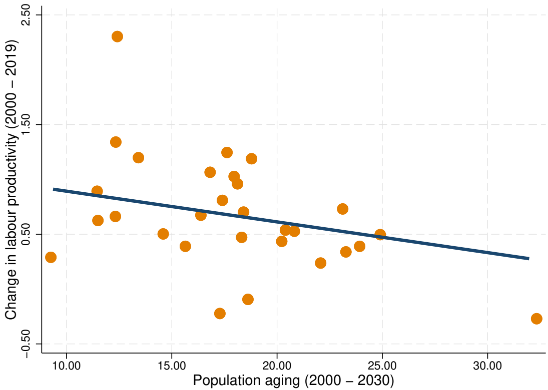

Table: Population aging and labor productivity growth, 2SLS estimates

	Dependent variable: Change in labor productivity		
	(1)	(2)	(3)
Population aging (2000 – 2030)	-0.038**	-0.042***	-0.043***
	(0.015)	(0.016)	(0.015)
Standardized beta coefficient	-0.313	-0.354	-0.355
First-stage F-statistic	15.77	14.00	17.97
Over-id (p-value)	0.32	0.48	0.38
Number of clusters (countries)	29	29	29
Observations	1,007	1,007	1,007
Country-level controls	✓	✓	✓
Initial condition		✓	✓
Industry-level controls			✓

- Our cross-country estimates are robust to:
  - Using alternative methods of measuring population aging
  - Controlling for labor market institutions, and comparative social, economic and institutional development
  - Controlling for industry-specific task characteristics and the offshorability of job tasks
  - Using sub-samples of manufacturing and non-manufacturing industries
  - Excluding or down-weighting outlier observations

$$\Delta Y_{i,c,t} = \alpha + \beta Aging_{c,t} + \gamma X_{i,c,t} + \lambda_c + \varepsilon_{i,c,t}, \qquad (2)$$

where $\Delta Y_{i,c,t}$ is the change in labor productivity for industry i in country c during sub-period t; $Aging_{c,t}$ is the change in the old-age dependency ratio; $X_{i,c,t}$ is a set of industry-specific controls including the change in employment and the change in labor costs; λ_c denotes unobserved time-invariant country-specific factors; and $\varepsilon_{i,c,t}$ is an unobserved error term.

Table: Stacked-differences estimates, OLS results

	Dependent variable: Change in labor productivity			
	(1)	(2)	(3)	(4)
Contemporaneous population aging	-0.027***	-0.027***	-0.028***	-0.033***
	(0.007)	(0.006)	(0.007)	(0.008)
Standardized beta coefficient	-0.233	-0.234	-0.244	-0.285
Oster's δ for $\beta = 0$	8.47	8.73	11.71	4.00
Oster's bias-adjusted coefficient (β^*)	-0.03	-0.03	-0.03	-0.04
R-squared	0.37	0.38	0.43	0.55
Number of clusters (countries)	29	29	29	29
Observations	2,010	2,010	2,010	2,010
Country-level controls	✓	✓	✓	
Initial condition		✓	✓	
Industry-level controls			✓	✓
Country fixed effects				✓

Table: Stacked-differences estimates, 2SLS results

	Dependent variable: Change in labor productivity			
	(1)	(2)	(3)	(4)
Contemporaneous population aging	-0.045***	-0.045***	-0.044***	-0.043***
	(0.011)	(0.011)	(0.010)	(0.010)
Standardized beta coefficient	-0.385	-0.386	-0.374	-0.372
First-stage F-statistic	14.80	14.97	15.33	17.78
Over-id (p-value)	0.60	0.66	0.76	0.52
Number of clusters (countries)	29	29	29	29
Observations	2,010	2,010	2,010	2,010
Country-level controls	✓	✓	✓	
Initial condition		✓	✓	
Industry-level controls			✓	✓
Country fixed effects				✓

- Large heterogeneity in the effect of aging
  - Workers with lower skills and educational attainment tend to have reduced earnings or compensation

Further results

A summary of evidence on potential mechanisms

- Aging negatively influences capital formation
  - Gross fixed capital formation
  - Tangible capital
  - Intangible capital
- Heterogeneity between industries
  - Industries with a higher contribution of assets to productivity growth tend to experience a larger decline in productivity

Summary

Reduced-form relationship: A negative correlation between population aging and industry-level labor productivity growth

Evidence on underlying mechanisms

Population aging reduces capital formation, leading to a slowdown in labor productivity growth