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Old workers, young machines: can AI and automation offset population ageing?

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## Old workers, young machines: can AI and automation offset population ageing?

### Key takeaways

- *Artificial intelligence (AI) and robots have the potential to offset the macroeconomic consequences of an ageing workforce, but the ability to automate jobs depends on which industries are ageing.*
- *AI and robots substitute most readily for jobs in industries with younger workforces (eg finance), while older, high-employment industries (eg agriculture, health) have less scope for automation.*
- *A new ageing–automation scorecard for over 130 economies shows that some of the fastest-ageing economies may face more substantial challenges in easing demographic pressures through automation.*

Around the world, populations are ageing rapidly, with broad macroeconomic consequences. A smaller, older workforce weighs on aggregate supply, productivity and growth; shifts spending towards health and long-term care; and strains pension systems and public finances (Bloom et al (2010); Maestas et al (2023)). Automation, in the form of artificial intelligence (AI) and robots, offers the possibility to counteract some of the adverse effects of an ageing workforce. But automation's ability to offset population ageing hinges in large part on whether ageing occurs in industries where labour can be automated.

This Bulletin assesses jurisdictions' capacity to use AI and robots to automate their ageing workforces. We combine industry-level workforce demographics for 135 economies with measures of industries' exposure to AI and robots to build an "ageing-automation overlap" index, which we make available as a data set with the Bulletin. The index measures the extent to which each jurisdiction's workforce ages in industries that lend themselves to automation and how important each industry is in terms of total employment. Economies with a higher overlap are better placed to offset adverse demographic headwinds, as their ageing occurs in industries that are more amenable to automation through AI and robots.

Three findings emerge. First, ageing is highly uneven across industries, as some industries in the same jurisdiction have a much higher share of workers aged 55 and above than other industries. Ageing is also highly uneven for the same industry across jurisdictions. Second, while AI and robots substitute for different tasks, both are geared towards industries that currently have younger age profiles in general. Industries with older workforces are often the least automatable and tend to employ comparatively more workers. Third, the ageing-automation overlap correlates positively with income per capita. Richer economies thus have a more favourable industry mix in terms of their potential to automate an ageing workforce. Yet several advanced and fast-ageing economies fare poorly in terms of automation potential.

The Bulletin concludes with a discussion of policy responses to population ageing. Where alignment is more favourable, priorities could include removing barriers to technology adoption. Where ageing is concentrated in industries with limited automation potential, policy may need to lean more heavily on higher labour force participation or promote labour reallocation and/or immigration to sustain economic growth. However, countries with lower automation potential currently have fewer migrants, and the correlation between the overlap and measures of labour market mobility is close to zero.

## Population and workforce ageing across jurisdictions and industries

The workforce implications of population ageing depend, among other things, on: how quickly the population as a whole is ageing; by how much ageing differs across industries; and how important individual industries are in the total economy.

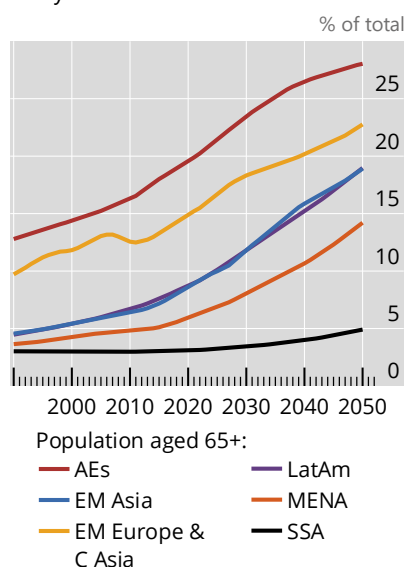
All regions are ageing, but at markedly different rates (Graph 1.A). In advanced economies (AEs), the share of people aged 65 and over has risen by about two thirds since 1990, to over 20% of the population, and is projected to reach 28% by 2050 (red line). Emerging Europe and Central Asia display similar patterns, albeit at a lower level (yellow line). Emerging Asia, Latin America and the Middle East are younger today, but are ageing quickly, whereas sub-Saharan Africa (black line) remains comparatively young.

Workforce ageing proceeds at different speeds across industries. Globally, the employment-weighted share of workers aged 55 and over ("55+ share") rose from 24% in 2010 to 33% in 2024 in agriculture and from 27% to 34% in real estate (Graph 1.B). Health and social work saw an increase from 18% to 25%, while manufacturing, finance and accommodation and food services saw smaller increases. Moreover, the 55+ share in the same industry varies substantially across countries (Graph A.1).

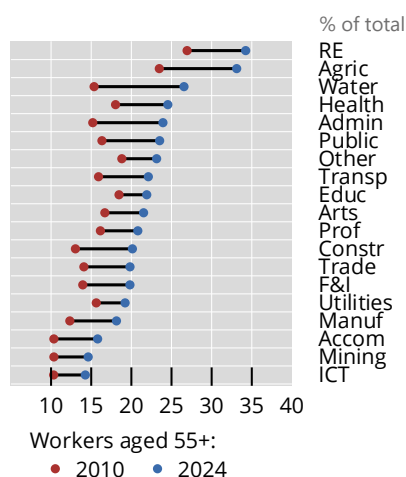
### Ageing is pervasive but uneven across regions and industries

Graph 1

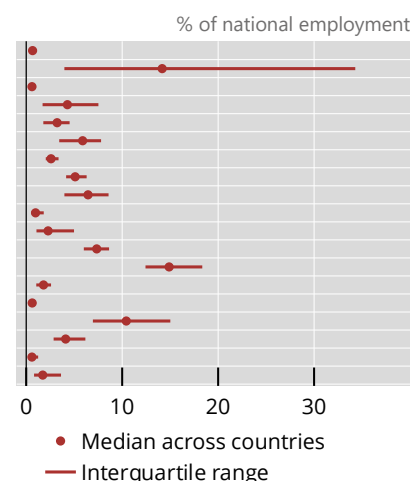
A. Populations are ageing everywhere...<sup>1</sup>



B. ...but some industries are ageing much faster than others<sup>2</sup>



C. Industries differ markedly in size<sup>2</sup>



<sup>1</sup> AEs = advanced economies; EM Asia = emerging Asia; EM Europe and C Asia = emerging Europe and Central Asia; LatAm = Latin America; MENA = Middle East and North Africa; SSA = sub-Saharan Africa. <sup>2</sup> Based on employment-weighted average across jurisdictions. RE = real estate; Agric = agriculture; Water = water and waste; Health = health and social work; Admin = administration and support; Public = public administration; Transp = transportation; Educ = education; Arts = arts and recreation; Prof = professional and technical; Constr = construction; Trade = wholesale and retail trade; F&I = finance and insurance; Manuf = manufacturing; Accom = accommodation and food; ICT = information and communication technology.

Sources: United Nations, *World Population Prospects 2024*; International Labour Organization, ILOSTAT; authors' calculations.

Industries differ markedly in their employment shares. Across our sample, trade has the highest median employment share (14.9%). It is followed by agriculture (14.2%), which has by far the widest dispersion (over 30 percentage points) and is the largest global employer, at over 700 million workers. Manufacturing is also a major source of jobs, with a median employment share of about 10%.

These patterns imply that the impact of ageing on labour supply, and hence GDP growth, will depend on each economy's industry mix and on the age structure within industries. Considering economy-level

ageing in isolation masks where labour shortages are most likely to bind, which calls for a measure that captures the demographics and relative importance of different industries.

## Industry exposure to automation through AI and robots

To assess in which industries automation could substitute retiring workers, we combine two established measures of industry-level exposure to AI and robots into an indicator of “AI-robot exposure”.

AI exposure draws on the AI Industry Exposure index of Felten et al (2021), which measures the match between AI capabilities and the task and ability content of different occupations. The index links a broad set of AI applications to workplace abilities, maps these to occupation-specific task requirements and aggregates to the industry level using employment shares. Industries with higher AI exposure contain a larger share of tasks that current AI technologies can support or automate.

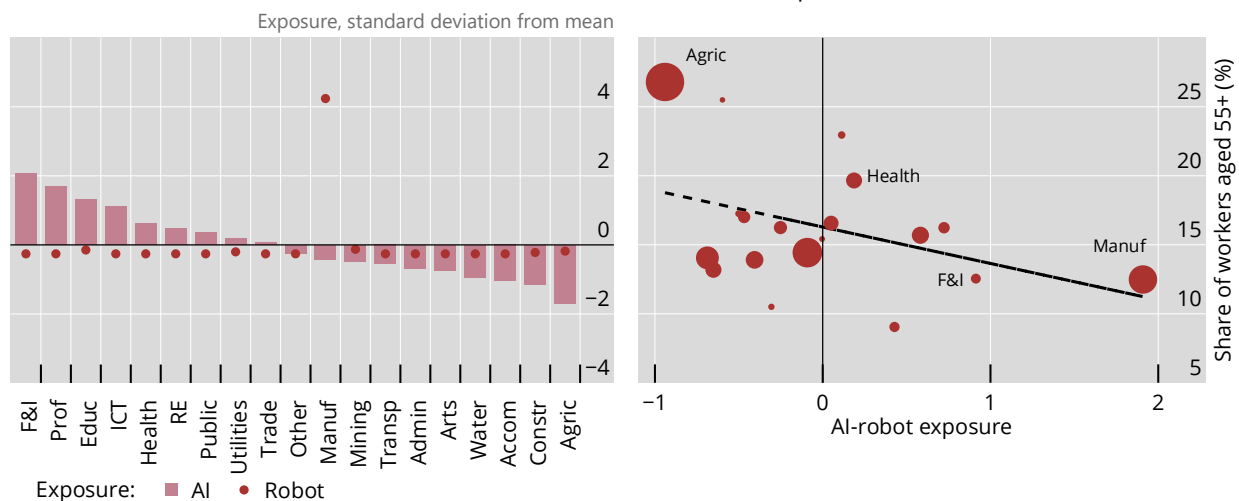
Robot exposure uses data on industry-level robot adoption from Acemoglu and Restrepo (2020). The measure combines the stock of industrial robots with employment to derive each industry’s robot density. Higher values indicate more intensive robot adoption and hence greater scope for automation.

### AI and robots target different, and on average younger, sectors<sup>1</sup>

Graph 2

A. AI targets cognitive work, robots target manufacturing

B. Workforces are older mainly in industries where automation helps the least<sup>2</sup>



See the notes to Graph 1 for definitions of the abbreviations on the x-axis.

<sup>1</sup> See the online annex for details on the exposure measures. <sup>2</sup> Y-axis: Industry share of workers aged 55 and above, employment-weighted average across jurisdictions. Marker size is proportional to total sector employment.

Sources: Acemoglu and Restrepo (2020); Felten et al (2021); International Labour Organization, ILOSTAT; authors’ calculations.

Globally, AI exposure is currently highest in occupations with cognitively demanding tasks, while robot exposure is concentrated in manufacturing. Graph 2.A shows that AI exposure is highest in finance and insurance, professional and technical services, education and information and communication (bars). By contrast, robot exposure is negligible outside the manufacturing sector (dots), reflecting industrial robots’ capacity to substitute for repetitive physical tasks in factories.

We combine these measures into a composite industry-level AI-robot exposure in two steps. First, we standardise the AI and robot exposure measures across industries, expressing each in standard deviations from the global industry average so that the two are comparable. Second, we calculate the composite index as the equally weighted average of the two measures in each industry. Manufacturing, finance and

insurance, and professional and technical services rank highest on this measure, while agriculture, construction, and accommodation and food services rank lowest (see online annex Table A.1).<sup>1</sup>

Industries with a higher 55+ share tend to have lower AI-robot exposure. Agriculture has among the highest 55+ shares (Graph 2.B, vertical axis) but very low AI-robot exposure (horizontal axis). By contrast, industries that rank highest in the AI-robot index, such as manufacturing and finance, have comparatively young workforces. Health and social work is notable: it is large (total industry employment is indicated by the size of the marker) and ageing, but is only weakly exposed to AI and robots. Many care and interpersonal tasks remain hard to automate. At the same time, demand for these services rises as populations age, creating demand precisely where automation has limited potential. These patterns may imply that in many industries the scope for automation to offset ageing currently appears limited.

## Where can automation offset workforce ageing?

To assess jurisdictions' ability to use automation to offset an ageing workforce, we construct an "ageing-automation overlap" index. We construct this by calculating the employment-weighted covariance between the industry-level 55+ share and the AI-robot exposure in each jurisdiction (see online annex for details). Intuitively, the index is higher when older workers are concentrated in industries in which AI and/or robots can relieve shortages, and lower when ageing occurs in industries that are harder to automate.<sup>2</sup>

The ageing-automation overlap varies widely across jurisdictions (Graph 3.A). It is highest, ie most favourable (light red), in North America, parts of northern and western Europe and Australia. Some Gulf economies also record relatively high values. Overlap is low across much of southern and Southeast Asia and in parts of the Balkans and Caucasus (dark red). Most economies in Latin America and sub-Saharan Africa lie in the middle or lower part of the distribution, with a few high-overlap outliers.<sup>3</sup>

Variation in the index across jurisdictions is largely due to manufacturing and agriculture. Agriculture has a low overlap score and employs a fifth of workers on average. It also has a much older workforce than the national average almost everywhere. Manufacturing has high exposure and its workforce is typically younger, so its high automation potential hardly alleviates ageing pressures and its overlap is low. Education, finance and professional services also contribute to variation across jurisdictions, but to a lesser extent: all three are AI-exposed and young, and account for a modest share of employment.

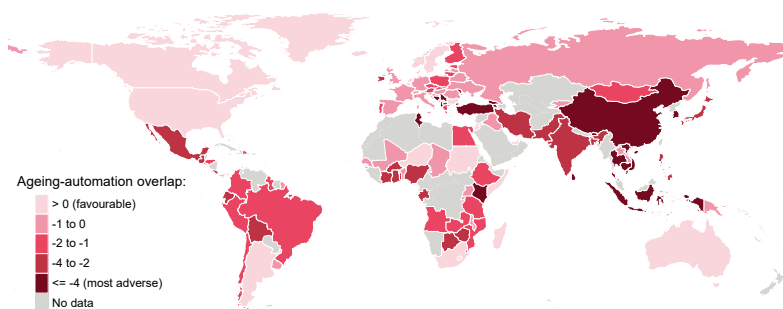
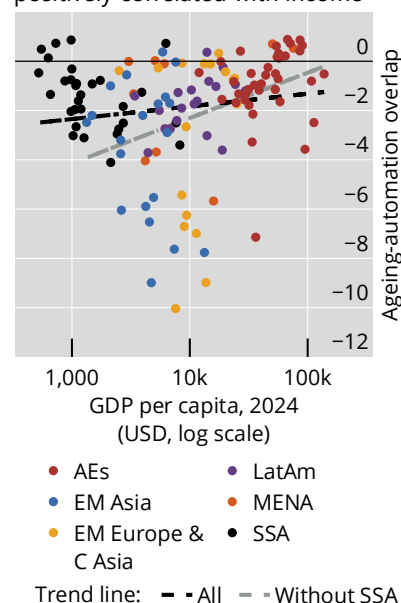
On average, richer economies are somewhat better placed to automate their ageing workforce. The correlation between the ageing-automation overlap and log GDP per capita is 0.14, rising to 0.36 when the comparatively young economies of sub-Saharan Africa (Graph 3.B) are excluded. Higher-income economies therefore tend to age in comparatively automatable sectors. The exceptions include several fast-ageing AEs whose overlaps are among the most adverse, including several Asian economies.

The ageing-automation mismatch has worsened in many jurisdictions. Compared with its average between 2010 and 2013 (the beginning of our sample), the overlap declined in over half of the economies in our sample, with a median change of -0.09. Declines were largest for several economies in emerging and Central Asia, while some smaller European jurisdictions saw substantial improvements.

<sup>1</sup> Note that exposure captures technical feasibility and the potential for AI or robots to perform tasks, not whether they substitute for workers or augment them. Moreover, the static measure does not factor in the possibility that technology might evolve, that workers might upgrade their skills or move across industries, and that policy may itself shape industries' age profiles.

<sup>2</sup> The sign of the overlap warrants care. A concentration of ageing in automatable sectors could, in principle, reflect technology displacing workers in a shrinking sector in the past. We therefore net out the domestic share of workers aged 55 and over.

<sup>3</sup> We also calculate the 55+ share in the quartile of industries with the highest AI-robot exposure ("high-exposure employment share"). It paints a similar picture as the overlap measure (online annex Graph A.2). Annex Table A.2 lists the overlap and high exposure employment share for major economies.

A. The ageing-automation overlap around the world<sup>1</sup>B. The ageing-automation overlap is positively correlated with income<sup>2</sup>

<sup>1</sup> See the Online Annex for the definition of the overlap measure. The use of this map does not constitute, and should not be construed as constituting, an expression of a position regarding the legal status or sovereignty of any territory or its authorities, the delimitation of international frontiers and boundaries, and/or the name and designation of any territory, city or area. <sup>2</sup> Higher values of the overlap indicate more favourable conditions. For regions' full names, see the notes to Graph 1.

Sources: Acemoglu and Restrepo (2020); Felten et al (2021); International Labour Organization, ILOSTAT; World Bank, World Development Indicators; authors' calculations.

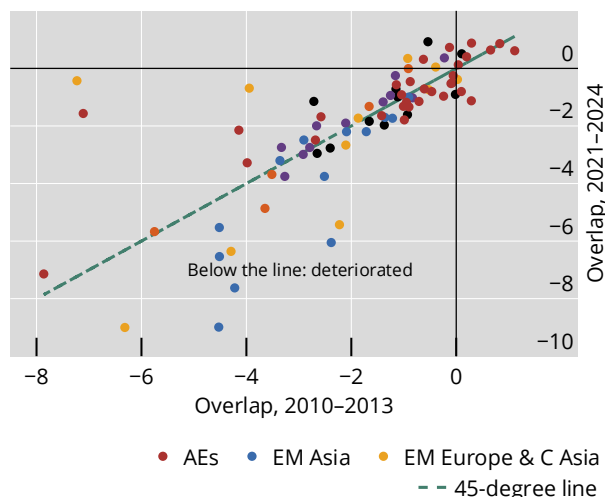
Projected ageing gives a sense of where demographic pressures could be hardest to offset through automation. In East and Southeast Asia, rapid ageing coincides with low overlap (bottom-right quadrant of Graph 4.B), mostly due to a large and young manufacturing sector. Southern Europe and parts of central and eastern Europe lie mainly in the bottom-right corner, reflecting sizeable demographic pressures alongside relatively low overlap. North America and northwestern Europe cluster closer to the top left, combining slower ageing with more favourable overlaps. Many lower- and middle-income economies fall on the far left-hand side, where ageing pressures are projected to rise more gradually.

## Conclusion and policy implications

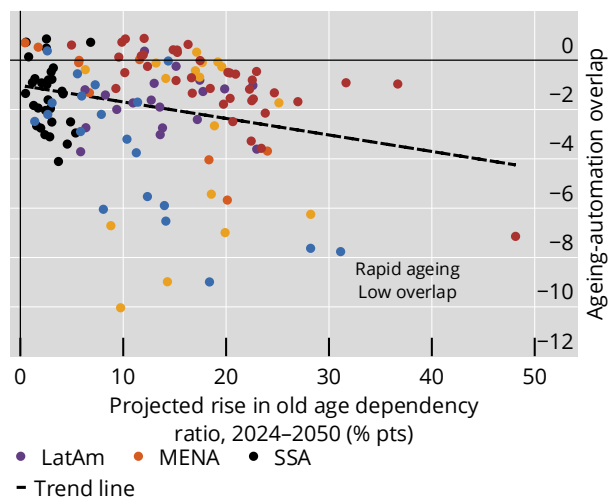
This Bulletin has shown that automation could cushion ageing-related labour shortages, but only where older workers are concentrated in industries with high automation potential. Higher-income economies tend to have more favourable employment-automation overlaps, but there are exceptions: several advanced economies exhibit some of the most adverse overlaps, as their automation capacity is heavily concentrated in manufacturing, where workforces are comparatively young. Their projected demographic developments are likely to amplify macroeconomic pressures. Being a global leader in AI or robot adoption therefore does not necessarily imply that a jurisdiction is well placed to automate an ageing workforce.

A caveat to our results is that they are based on current automation capacity and employment structures, which could evolve as tasks become amenable to automation or workers move across industries. In some economies, industries like agriculture may have scope to mechanise using existing technologies. However, developments in automation capacity are highly uncertain, while job mobility tends to decline with age, potentially hindering reallocation (OECD (2024)). While all jurisdictions may ultimately be able to adapt to ageing, those with a higher overlap are probably *better positioned* to do so.

A. The ageing-automation mismatch is widening in some economies...



B. ...and projected demographics are unlikely to help



<sup>1</sup> See the online annex for the definition of the overlap measure. See the notes to Graph 1 for regions' full names.

Sources: United Nations, *World Population Prospects 2024*; International Labour Organization, ILOSTAT; authors' calculations.

Policy responses should reflect the industry composition of ageing. Where ageing is concentrated in industries with little automation potential, economies may need to lean more heavily on higher labour force participation, labour mobility and/or immigration. Worryingly, however, countries with a worse overlap tend to have a lower migrant stock (Graph A.3.A). Where alignment is more favourable, priorities could include removing barriers to technology adoption. In all cases, improving labour mobility, which is only weakly correlated with the overlap (Graph A.3.B), will be critical to help workers switch occupations. Finally, even in economies where the overlap between ageing and automation potential is low, AI and robot adoption can still raise productivity and output (Aldasoro et al (2024); Gambacorta et al (2026)).

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