

## **Ageing preparedness in an age of robotization**

Which countries are better prepared to grow old?

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### ***Abstract***

The current indicators assessing preparedness for aging primarily focus on aspects such as demography, health disparities, fiscal sustainability (including old age dependency ratios), the prevalence of chronic diseases, disability rates, and the provision of pension and healthcare services. Unfortunately, they often overlook critical intersections, including the impact of illness, poverty, and limited skills on inequality assessments. Moreover, many of these indicators do not sufficiently consider combined trends in demographics, the economy, health, and skill sets. They also tend to neglect the effects of technological advancements, changing labor requirements, and a lack of insight into how different cohorts transition in terms of health and skills. Our objective is to develop a more comprehensive approach to understanding the diverse experiences of older populations in various countries. This approach takes into account factors like their participation in the workforce, their skill proficiencies, their health status, familial structures, and the educational and work backgrounds of women. We propose the creation of "DemReady," a new demographic indicator designed to assess the extent to which countries are well-prepared for the challenges and opportunities presented by aging populations. This indicator will provide a more holistic view of a nation's readiness to address the multifaceted aspects of aging.

## **1. Introduction**

All nations will in the 21<sup>st</sup> century experience population ageing (1, 2). Attempts to counter this through raising fertility or increasing immigration will in the longer term not counter ageing, as all populations inevitably grow older following decreasing later age mortality. Unless mortality decline should reverse (which would reverse a two-century trend for some of the world's highest life expectancy regions – greater population shares will dominate older age groups). Migration will like fertility only amplify ageing in the longer term. What matters is how well we age and how to minimize dependence and maximize economic and social activity -- and thereby best can adjust to an older population.

Key challenges of ageing include i) supporting a growing number of people who have a disease either by improving cognitive and physical functioning, ii) minimize the rise in taxes, yet keep benefits at a high enough level that provide good living standards for the older population, iii) keep productivity at a decent level, iv) maintaining enough folks to support the old.

A decisive question on how well nations will cope with ageing is whether the 50 plus are skilled and healthy enough to be likely to find work where they can be productive? Many jobs are hard to get for the older unless they are sufficiently healthy, skilled, cognitively fit, with relevant labour market experience and have a high enough productivity potential. Moreover, labour markets must be flexible to allow for employment among seniors – and one seek to minimize age-discrimination. Lastly, working longer is not an alternative to all. Social and economic inequalities, in all dimensions, should be considered when discussion extension of the working life as well as setting the level for old-age support. The economic and social impact of population ageing should be regarded as a life course issue related to health status, educational attainment, labor market trajectories, gender equality and other factors that will impact on the preparedness for an ageing society. Moreover, regions and nations characterized by high unemployment levels, slow economic growth and less job availability will have fewer opportunities to reap economic rewards. More unequal societies will have more challenges as e.g., educational and health inequities can limit countries ability to realize ones demographic potential. Longer working lives, is, henceforth, not likely an option for several nations.

## **2. Background**

### ***2.1 Current statistics on labour force age distributions***

In the US in 2022 the share above age 55 is 24% (3). In Europe, the share above age 55 is 14% in 2008, projected to increase to a level in 2050 between 21% and 27% (4). In Japan the 55+ share is 31% in 2022, which is the highest in the world (5). The Japanese median age is projected to rise from 48 in 2022, gradually peaking at 55 years in 2064 before decreasing the 54 years by the end of century (1). In less developed countries, similar trends are also being observed. In Brazil and Mexico, for instance, population aged 60+ will increase from less than 15% in 2022 to over 25% in 2050.

A common trend for a large share of countries is to promote longer working lives to reduce the impacts on the sustainability of pension programs. Recent research has argue that longer working lives, especially for a more educated workforce , can lead to a silver dividend.

The extension of working life is a key response to changing age structure. Raising economic activity among older individuals would reduce rising dependency burdens and provide a key response to cope with rapid demographic changes. Raising retirement ages can allow countries to realize the “silver dividend” - can mitigate the impacts of population changes, enhancing economic growth and the sustainability of public retirement programs. We are, however, facing a paradox: most countries are

implementing reforms to extend working life, but there is not enough research on the abilities of older adults to remain in their jobs, especially in less developed countries and for less educated workers.

There is evidence that older workers would be negatively affected by the rapid development of information and communication technologies, as well as the expansion of innovative practices and the acceleration of the process in which skills become obsolete. This age-biased tech change would bring a new implication of the development process on employability rates and standards wages of older workers, driven by technological change. Despite the improvement in income levels and the reduction of physical demands in jobs, on the other hand, the demand for skills such as computer use is growing.

However, in many parts of the world, the older population is composed of individuals with less schooling, poorer skills and health, and may lack relevant labour market experience. Many of those who work remain in the labor market more out of necessity – income supplementation, transfers to younger people – than by choice, in less skilled positions and informal sector. These aspects should be taken into consideration when investigating the possible impacts of automation and robotization in different labor markets. In countries that are ageing more recently, and rapidly, there was a rapid change in occupation from agriculture, rural sector, to low-skilled services (urban areas), female labor force participation is still lower and very concentrated on more low-skill activities. In case of low and middle income countries (LMIC), dual labor market and context of high income and social inequality are also important issues to discuss.

In addition to that, promoting working lives and looking only at the relation between workers and retirees (or economic dependent population) is not enough to investigate whether countries are prepared to an ageing population. The impacts of population age structure are broader and should be investigated and analyzed considering a broader range of metrics and ideas.

## ***2.2 Why current metrics are insufficient***

Current ageing metrics tend to be narrowly focused on specific aspects of ageing and fail to take certain concepts into account. Many are either purely demographic, focusing mainly age distributions, others focus on health, disability and functional status, and others on economic factors such as income or fiscal viability of ageing (6).

Here are examples of how aging can be measured:

**Chronological Age:** This is the most straightforward measure, based on the number of years since birth. However, as may have pointed out, this measure does not necessarily reflect functional ability, productivity, or health status.

**Biological or Health Age:** This refers to the physical and mental health status of individuals. Measures can include indicators like morbidity rates, cognitive function, physical ability, and susceptibility to diseases. This also includes assessments based on telomere length, epigenetic ageing, molecular assessments of ageing and organ function.

**Functional Age:** This concerns the ability of an individual to function in society, which can be linked to factors like cognitive ability, physical mobility, and sensory abilities. For instance, the age at which a person is no longer able to live independently or engage in productive work might be considered their functional age.

**Dependency Ratios:** Traditional measures include the old-age dependency ratio, which can for instance be the ratio of the population aged 65 and over to the population aged 15-64. This gives a

sense of the potential burden on the working-age population. However, a more nuanced measure that accounts for changing labor market behavior and health status.

**Economic Dependency Ratios:** This extends the traditional dependency concept by considering not just age but also economic activity. It looks at the ratio of non-workers to workers, regardless of age. This can provide insights into the actual economic burden on the productive segment of the population.

**Subjective Age:** How old individuals feel, which can be different from their chronological age. This subjective measure might be influenced by health, cognitive function, societal roles, and other factors.

**Cohort Measures:** These consider the experiences and characteristics of specific cohorts (groups of people born in a specific time frame). Cohort effects, shaped by historical and societal events, can influence aging processes and perceptions.

**Prospective Aging:** Proposed by some demographers, this approach measures age not by years since birth but by remaining life expectancy. For instance, "old age" might be defined as the age at which a person has a certain number of expected years left to live.

It is important to emphasize the need for a multifaceted approach to understanding aging, given the complexities of demographic transitions, societal changes, and individual experiences.

In the following, a brief description of some ageing indices are given.

One ageing preparedness indicator is the Hartford Aging Index (7) which includes i) work and volunteering ii) well-being and health indicators, iii) economic and educational inequality, iv) generational cohesion including coresidence, trust and quality of social networks v) Sustainability of social security – public debt, support for retirement and physical safety. It is a macro-level aggregate, allowing country rankings (where Norway tops the list, Hungary at the bottom in terms of the 18 countries included in the index).

Many are individual level and fails to assess macro-level dimensions. One model is that of Rowe & Kahn<sup>2</sup> who posit that successful aging is enjoying a low risk of disease and disease-related disability, maintaining high mental and physical functioning, and active levels of social engagement (8)

Baltes and Baltes presents an individually based psychological "human development model" of successful aging whereby age-related decrements are considered a normal aspect of aging. Individuals do the best with the functioning they have and maintain it using various adaptation strategies (9).

The Global Ageing Preparedness Index (GAP-Index): The GAP-Index is a composite index developed by the United Nations Population Fund (UNFPA) in 2015 to measure countries' preparedness for population ageing. The index covers four domains: income security, health status, access to essential services, and enabling environment (10, 11). Ageing Society Index (ASI): The ASI was developed to measure the ageing potential of OECD countries and the challenges they face in adapting to population ageing. The index covers eight dimensions: education, employment, income, health, housing, long-term care, social networks, and social support (12). The Global Liveability Index (GLI) is an annual index developed by The Economist Intelligence Unit (EIU) that assesses the overall liveability of 173 cities around the world. The index covers five factors: stability, healthcare, culture and environment, education, and infrastructure. While the GLI is not specifically designed to measure ageing preparedness, it can be used as a proxy measure for the quality of life and well-being of older adults in a city.

Fried's frailty indices indicate assess vulnerability levels among older populations and how these may change over time(13). Frailty, in geriatric medicine, is described as a state of increased vulnerability to

external stressors. It is characterized by a decline in physiological reserves and a reduced ability to maintain homeostasis. If one has one out of these five traits one is “pre-frail”, including i) unintentional substantial weight loss (in the past year), self-reported exhaustion, weakness (as measured by grip strength), slow walking speed or low physical activity. Those who meet three or more are classified as “frail.”

### **Ageing preparedness**

At a macro level, many studies focus on savings, wealth, income and pension levels of older individuals (14-16). However, higher pensions does not necessarily mean better preparedness – only when social security and health systems are sustainable in the longer term, preparedness is high.

A WHO model of ageing preparedness stresses the intrinsic capacity of the individual and how relevant environmental characteristics influence how well on ages (17). Others again stress how mental health or chronic disease affect ageing (18-20). Many discussions on ageing preparedness emphasize how heart disease, dementia, cancer, and stroke are highly prevalent aging-related diseases that are associated with lifestyle choices – where the age at onset and severity can be modified through smoking cessation, moderating alcohol consumption, staying social, avoiding pollution, eating healthier, and exercising (21).

A challenge is that due to data availability and a focus on contemporary demographically older countries, one often restricts to a set of Western and East Asian countries – ignoring the fact that the absolute highest shares of older individuals are situated in poorer countries already since the 1980s (1).

The Cognitively Adjusted Dependency Ratio looks at the cognitive health of the elderly for most of the world’s population, recognizing that not all individuals over a certain age are “dependent” in the same way. It is the ratio of the number of 50 plus individuals in the “dependent” category (remembering less than half the words in a standardized memory test) relative to those (regardless of age) who can remember at least half of the words (22).

The Health Adjusted Dependency Ratio focuses on all diseases and account for health to understand ageing dependency. It shows that ageing is quite similar across the world’s countries in spite of different age structures (the onset of poor health occurs at a earlier age in demographically younger countries (2).

Verbrugge and Yang (23) studied adults (ages 18+) who reported difficulties performing instrumental and basic activities of daily living (IADL, 6 items and ADL, 6 items) and selected physical activities (8 items—walking, , bending, standing, climbing stairs, lifting, reaching, grasping, and holding). Approximately 11.5 million adults reported difficulty with any of these items. For each item, persons were asked at what age the difficulty began. Selecting the earliest age of onset within each domain, thirty percent of adults of all ages reporting a basic ADL difficulty had an onset at 44 years of age or younger.

Central to whether one copes well with ageing without cutting too drastically back on pensions or loosing productivity shortcoming in terms of work readiness, whether they find jobs, whether they stay productive or whether they will retire early and not have the skills in demand.

### **3. Data and Methods**

## **Demready**

We propose DemReady (Demographic Transition Ready). The indicator aims to account for the extent to which countries are well prepared for aging. It captures older adults engagement in work, skill proficiencies, health status, familial structures, and the educational and work backgrounds of women. That is, we construct our index using 5 general dimensions aiming to cover: Social Support, Health Status, Educational Level and Work Experience.

Social support indicator contains information on, considered more important:

- Social networks/families
- Friends,
- partners,
- children,
- quality/frequency of interactions

Additional dimension of social support, and also considered to be important, includes:

- being married (sharing resources, support, practical issues)
- Mental health
- Low levels of drinking/smoking
- Exercise
- Sufficient income

## **Particular relevance to work capacity**

- Relevant labour market capacity (low RTI work experience)
- Having worked the last 10 years
- Cognition functioning
- Experience in computer use, job histories – having worked in an occupation with low RTI (low routine intensity)
- education
- Fluid/learning memory; Immediate recall
- verbal fluency, other crystallized assessments

In many countries, individuals aged 50-69 are characterized by

- low education -- secondary/tertiary education would be helpful
- low female LFPR - Having recent high level employment could be of use
  - many have retired/are on disability pension/unemployed
  - others in this age group have both relevant education and are still working
- **Having / having had recent low RTI jobs - agricultural/primary industry/factor work could be a risk factors for future employment**

Willingness to adapt (allow more flexible wages) from both employers and employee side is a decisive factor [but can we operationalize this]

## **Approach**

We use a series of surveys, both cross-sectional and longitudinal, from the family of the health and retirement study around the world. We construct an index based on all variables available for all countries following a strategy similar to the construction of the Human Development Index (HDI). HDI aims to capture key achievements of human development in certain key dimensions: income level, healthy life and knowledge. The measure is not free of critics, but it is relatively easy to compute since all variables are readily available for most countries in the world. We follow the same spirit in constructing our measure.

## **Data<sup>1</sup>**

We use data from the following countries. We focus our analysis on older adults, aged 50 to 64, considering that they are closer to retirement and still might have additional years of working life. In the present version, we show results for a few and aggregated measures, but we will show more detail analysis at the EPC meeting in 2024

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<sup>1</sup> Descriptive analysis can be found here:

<https://public.tableau.com/app/profile/gustavo.de.freitas/viz/StoryOutput/StoryOutput>

Table 1 – List of Countries and Surveys

<b>Countries</b>	<b>Years</b>	<b>Survey</b>
United States	2010-2016	HRS
China	2010-2014	<b>CHARLS</b>
England	2010-2016	ELSA
Japan	2010	<b>JSTAR</b>
Costa Rica	2010-2012	Creles
Brazil	2015 – 2019	ELSI
Korea	2012-2016	<b>KLoSA</b>
Mexico	2012	MHAS
Austria	2012 – 2014	SHARE
Belgium	2010 – 2014	SHARE
Czech Republic	2010 – 2014	SHARE
Denmark	2010 – 2014	SHARE
Estonia	2010 – 2014	SHARE
France	2012 – 2014	SHARE
Germany	2010 – 2014	SHARE
Greece	2014	SHARE
Hungary	2010	SHARE
Ireland	2010 – 2012	SHARE
Israel	2012 - 2014	SHARE
Italy	2010 – 2014	SHARE
Luxembourg	2012 - 2014	SHARE
Netherlands	2010 – 2012	SHARE
Poland	2010 – 2014	SHARE
Portugal	2010 – 2014	SHARE
Slovenia	2012 – 2014	SHARE
Spain	2010 - 2014	SHARE
Sweden	2010 – 2014	SHARE
Switzerland	2010 - 2014	SHARE



## Findings

Education and health are related and, therefore, associated with the capacity to extend working life (Coile, 2018). Any public pension reform – such as increasing retirement age – aiming to increase labor force participation of the elderly might be limited by the economic and health capacity of the individuals (Coile, 2018). Better health conditions, increasing educational levels, transformations in the types of activities carried out (from being excessively physical) and changes in private security systems and social security reforms are elements that lead to the expansion of working life and create conditions for the countries to be ready for a new demographic scenario. In addition to that, growing female participation; the influence of the spouse on the decision to work; some reduction of the racial gap in the labor market are also important elements and are all related to changes in the educational and health composition of the population.

Figure 1 shows the distribution of workers, aged 50-54, by educational level. We show the percentage of individuals with less than secondary education and the percentage of those with tertiary education. We use individuals in this age range since they are still in the labor force and have a good number of years before reaching retirement age. The results show a large variation in the workers with the then secondary education across countries. For less developed and still in the process of important changes in population age structure, there is a high percentage of workers with less than complete secondary education.

Figure 1 – Educational Distribution, selected countries, 2012-2018

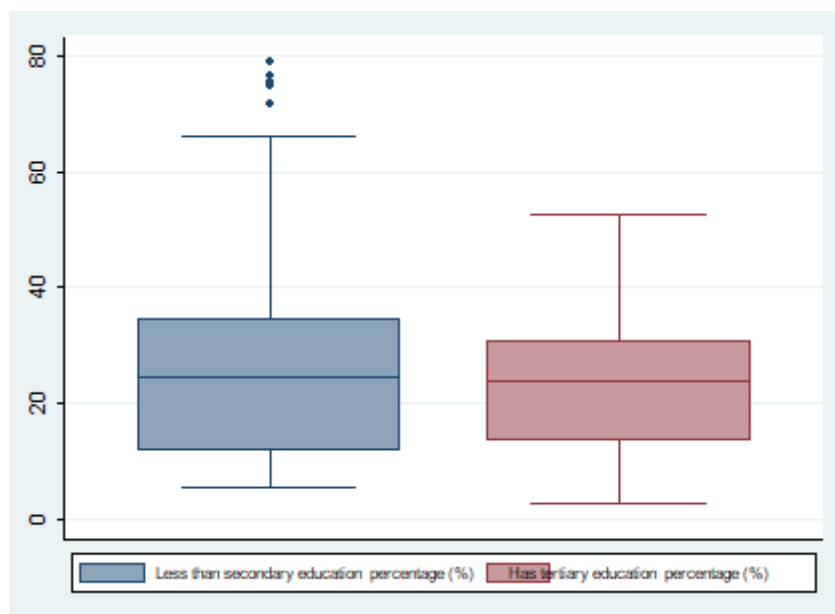


Figure 2 shows the percentage of individuals aged 60-64 and 65-69 reporting difficulties in Instrumental Activities of Daily Living (IADL) for the countries in the sample. IADL provides an informative measure of the capacity of individuals to live independently and to remain active in the labor market and adapt to new demands at work. The results show that for countries that are relatively young (in terms of population age structure), the percentage of individuals below age 70 reporting difficulties are quite high. Thus, a young population age structure (and other economic measures) does not capture the readiness of each country to an ageing society.

Figure 2 – Percentage of Individuals reporting Difficulties in IADL, selected countries, 2012-2018

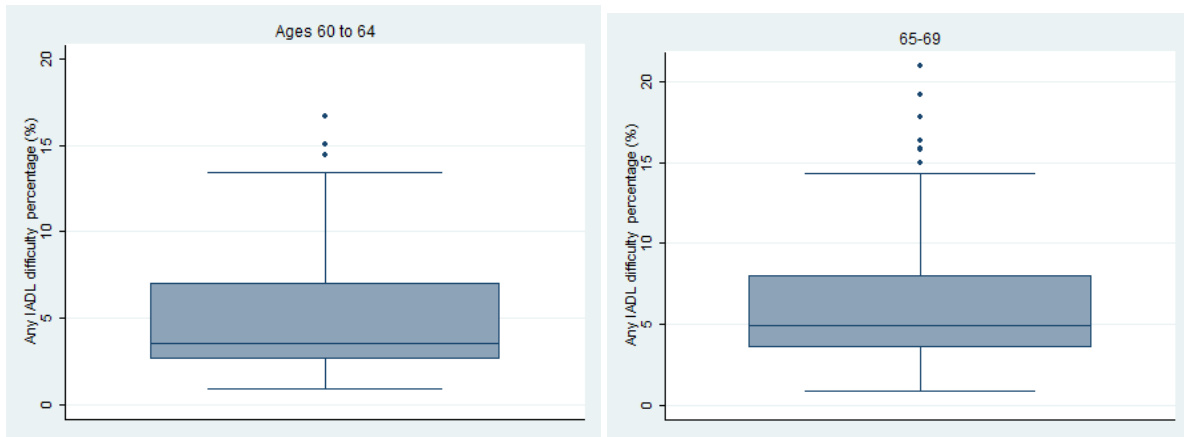
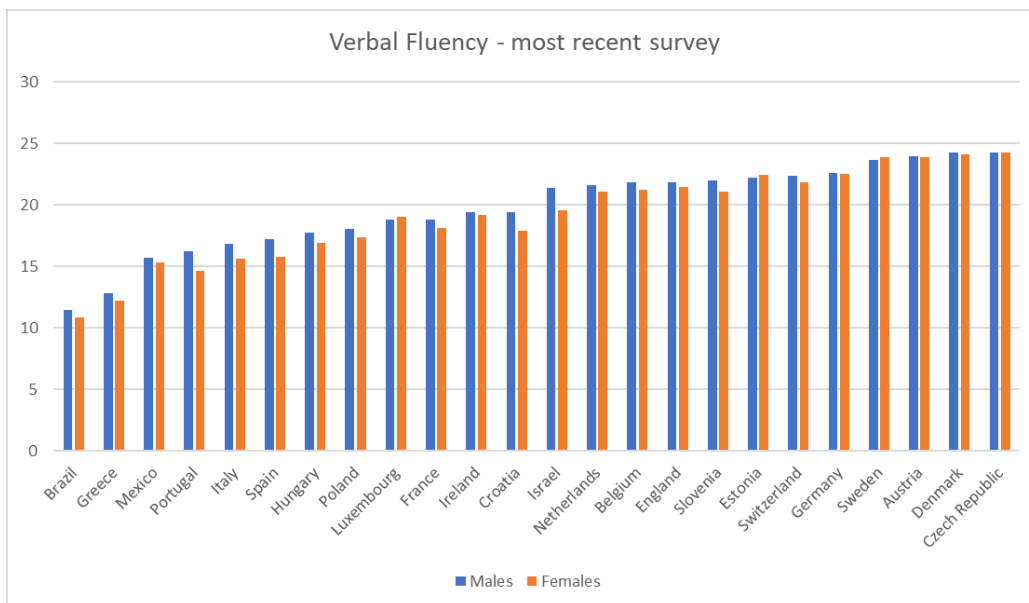


Figure 3 shows the differences in Verbal Fluency, from the most recent survey across countries in our study. In the surveys, Verbal Fluency is measured by the number of animals the responded can enumerate in 60 seconds. The results show that relatively younger countries, such as Brazil and Mexico, have much lower cognitive capacity than older countries. This indicates that these countries might have harder time to adjust to the demands of the labor market in the near future.

Figure 3 – Verbal Fluency by country and sex, selected countries, 2012-2018



## Discussion

Productivity declines with age and this might affect both labor supply and demand for older adults and younger workers. As discussed before, health conditions might also impact the capacity and ability to stay in the labor force in a changing labor market. Recent research, in less developed economies, shows an improvement in health conditions of the elderly that could lead to the capacity to work longer, however large inequality might harm this potential (De Souza, Queiroz and Skirbekk, 2019). Coile, Milligan and Wise (2016) argue that these gains are superior among individuals with higher education, showing that higher socioeconomic levels are related greater capacity to offer additional years of work.

The demand side and the existence of discriminatory aspects related to the participation of the poor, among them the relationship between the remaining productivity and the perception of high salaries. We can also discuss the transformations in our workplaces and the need for technological adaptation as determining factors in decisions to extend working life.

## Discussion and further work

- Finalize the estimates of DemReady index for all countries;
- Compare traditional ageing measures and compared to our proposed index;
- Test the robustness of our approach using different variables
- Next Steps:
  - Developed more the literature review
  - Additional data analysis

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