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Renata Pęciak
Uniwersytet Ekonomiczny w Katowicach
Poland
e-mail: renata.peciak@ue.katowice.pl
ORCID: 0000-0001-7684-8137

POPULATION AGEING IN MAINLAND CHINA. DOES THE MEASURE MATTER?

Abstract. The study aims to answer the following question: Does using different measures to assess population ageing lead to the same conclusions? The study evaluates the advancement of ageing in mainland China using selected conventional measures based on chronological age and the prospective age measures in which changes in life expectancy are considered. The conventional old-age dependency ratio and the prospective old-age dependency ratio, as well as the conventional median age and the prospective median age were calculated and compared in two versions. Conventional measures reveal a very unfavourable trends in China's population ageing and indicate that a faster increase in life expectancy leads to a faster population ageing. Prospective measures show a more moderate increase resulting from longer life expectancy. The use of both, conventional and prospective measures provide a more accurate understanding of ageing, which is essential for effective policy and social planning.

Keywords: population ageing, measurement of ageing, old-age dependency ratio (OADR), prospective old-age dependency ratio (POADR), demography of China.

Introduction

The process of population ageing in the 21st century is an unprecedented and prevailing demographic phenomenon. Rapid changes in the demographic structure of population especially affect highly developed countries. Demographic changes have a significant impact on the labour market, savings, consumption, economic growth, the health sector, asset values, budgetary spending, and fiscal balance [Chen and Zhang, 2025; Chen, Li, Sun, 2025; Bloom, Luca, 2016]. Population ageing determines the shape of pursued economic policy. In order to understand the socioeconomic implications of population ageing, it is necessary to measure this phenomenon.

The aim of this paper is to assess the advancement of population ageing in mainland China, the country with the largest elderly population [Chen and Zhang, 2025; Zhu and Walker, 2022]. The study uses conventional measures and selected alternative measures of population ageing. The study aims to answer the following question: Does using different measures to assess population ageing lead to the same conclusions?

The rest of the paper is organized as follows. Section 2 introduces the literature review. The review presents two approaches to measuring the population ageing phenomenon: conventional and alternative. Section 3 describes the data and methods used in the paper. In this section, the characteristics and trends of population aging in China are presented based on selected conventional measures and historical data. In section 4, a comparative analysis of demographic changes based on conventional measures is conducted, juxtaposing them with alternative measures. Section 4 presents discussion and conclusion.

2. Literature review

Conventional approaches to measuring the advancement of population ageing

Many various indicators are used to measure the advancement of ageing populations. Some of them are conventional, others are alternative measures. Conventional measures are based on a specific old age threshold determined by chronological (calendar) age. Old age is defined by determining a universal age threshold, often derived from social policy or norms, such as the age at which people stop working. In this approach, the threshold set by an exact (or full) number of years is indicated [Abramowska-Kmon, 2011]. Any person over a certain age threshold (usually 60 or 65 years[1]) is considered to be part of the older population. The percentage of older persons is most commonly used for measuring the ageing process advancement [Gietel-Basten, Scherbov and Sanderson, 2016]. Other measures include age distribution, average life expectancy, life expectancy from birth, median age, or remaining years of life.

Relational measures that reflect changes in relationships between individual groups are also indicated among the conventional measures [Abramowska-Kmon, 2011; Gietel-Basten, Scherbov and Sanderson, 2016]. They include:

- total age dependency ratio (TADR) which is calculated as the ratio of the number of people of non-working age (children under 14[2] and the elderly over 65) per hundred people of working age between 15 and 64 ($P_{0–14} + P_{65+}/P_{15–64}$). The people aged 65+ are considered to be 'old' and 'dependent' upon those aged 15–64 (who might be considered to be a labour force or working population);

- old-age dependency ratio (OADR, elderly dependency ratio) representing the number of people aged 65 or more per 100 people aged 15–64 ($OADR_{15–64} = P_{65+}/P_{15–64}$). Proportion of the elderly population refers to the proportion of the elderly population in a total population. The elderly population is usually defined as people aged over 60 or 65 years old. The old-age dependency ratio is the most common way to assess and compare the burden of population ageing [Skirbekk et al., 2022];
- ageing index – calculated as the proportion of people aged 60+ or 65+ per hundred people aged under 15; this is the number of grandparents per 100 grandchildren ($P_{65+}/P_{0–14}$);
- dependency ratio for young people (youth) is the number of 0–14-year-olds per one hundred 15–64-year-olds ($P_{0–14}/P_{15–64}$);
- double ageing index is the proportion of the oldest people (80+ or 85+) among the elderly (P_{80+}/P_{65+}).

Alternative approaches to measuring the level of population ageing

The common measurement of population ageing based on the rate of the population over the age of 65 is increasingly debated. The main core of the discussion relates to the concept of an 'old' or 'dependent' person. Conventional measures, which consider a person over 65 (sometimes 60) to be old, assume that 'old age' is static and does not change over time or depend on ability or health. Demographic projections based on chronological age refer to a fixed old-age threshold, ignoring that people's living conditions and mortality have changed significantly over the years. The use of such fixed threshold is often justified by the fact that a fixed age corresponds to the age qualifying for certain social programmes, especially the pay-as-you-go pension scheme. The relationship between chronological age and dependency varies across the world [Skirbekk, 2022]. The age at which a person becomes an elderly person varies over time, so calculating the proportion of the elderly based on chronological age may provide incorrect, biased, and partial information.

Longer life expectancy, as well as increased spending and access to public and private medical care, force a change in the approach to the criterion of 'older person'. Today's 60-year-olds are often different from parents or grandparents of the same age. Many people over 65 live independent and active life, including working life. The chronological criterion seems anachronistic and insufficient. Similarly, the use of 65 as fixed age threshold for the term 'old age dependency' seems outdated. The old-age dependency ratio does not provide information on any individual characteristics other than age itself and therefore allows only a limited assessment of the challenges of an ageing population [Skirbekk et al., 2012; Sanderson and Scherbov, 2013].

Alternative measures for assessing the advancement of population ageing introduce new ways of defining various age groups in the population in relation to the cut-off ages of these groups. They also propose to consider changing mortality conditions, time remaining to live [Abramowska-Kmon, 2011; Sanderson et al., 2005; 2007; Skirbekk et al., 2019; UN, 2019], objective measures relating to health status, as well as physical, and functional health [Chang et al., 2019; Skirbekk et al., 2012; Skirbekk et al., 2019].

The disability-adjusted life expectancy (DALE) used widely by the World Health Organization or health-adjusted life expectancy (HALE) measure the equivalent number of years of life expected to be lived in full health (Mathers et al., 2003). Extending healthy life expectancy is one of the important goals of social policy, especially health policy. If DALE or HALE are increasing faster than average life expectancy, it means that people are in good health for an increasing part of their lives.

In studies relating to a physical-health, the measurement of the functional status of older people in terms of health status or disease burden is the key element. *The Global Burden of Diseases, Injuries, and Risk Factors Study* (GBD) examines health trends worldwide and provides an empirical assessment of health around the world [IHME, 2024; Murray, 2024]. The GBD considers both change in mortality, life expectancy, population health status as well as the level of increase in the burden of age-related disease. The study considers the estimation of health burden in relation to a comprehensive and comparable list of diseases over time and in geographic location. Such an assessment of population ageing can facilitate pursuing appropriate social policy by identifying key factors in ageing [Chang et al., 2017].

The health-adjusted dependency ratio (HADR) combines information on the burden of disease at the global and national levels, together with demographic data, to estimate the ratio of burden to population [Skirbekk et al., 2022]. HADR is based on the ageing-related health of the adult population. The aim of the study is to determine the number of adults (aged > 20 years) in each country who have the same or higher burden of diseases associated with ageing as the average 65-year-old worldwide.

The HADR was calculated as the ratio of adults who were less healthy than the average 65-year-old (dependent population) to those in better health (supporting population). Comparison of the OADR and the HADR showed that in some younger populations, diseases related to aging occur earlier, and in many older demographic populations, these diseases occur later. The health may therefore be more important than age for determining dependency ratios [Piriu et al., 2025; Skirbekk et al., 2022].

The major differences in older adults' physical health are also used in demographic studies. They can be increasing between countries and are especially important in middle- and low-income countries (or regions) where large disparities in physical health persist [Kämpfen et al., 2020]. This aspect is particularly important when examining the demographic challenges arising from the population ageing [Kämpfen et al., 2020].

The cognitive functioning based on age variation in cognitive functioning refers to the mental functioning and cognitive abilities (attention, thinking, understanding, learning, remembering, solving problems, and making decisions) across populations [Crimmins, Saito, Kim, 2016; Liverman et al., 2015; Rapp, Ronchetti, Sicsic, 2022; Skirbekk et al., 2012].

Alternative indicators that consider advanced research on, for example, population health are complex and difficult to perform. In addition, they are conducted in various groups, at different times and in different spaces, and can therefore be difficult to compare [Chang et al., 2019; Skirbekk et al., 2019]. Kawada, Nakamura, Okamoto [2025] propose a new ageing indicator centered on the concept of the "thickness" of the working-age population. This indicator emphasizes the density of the labour force.

In the recent studies the new approach to remeasuring age was also proposed by Sanderson and Scherbov [2005; 2007; 2008; 2010; 2015; 2016a; 2016b; 2020]. The new approach includes the changing conditions in longevity, remaining life expectancy and mortality. The increase in life expectancy makes it necessary in demographic analyses to think about age also in terms of years remaining until death or proportionally to the increasing lifespan [Sanderson and Scherbov, 2005]. Population ageing should therefore be analysed in terms of retrospective and prospective age. Retrospective age, or chronological age, refers to the number of years lived (a measure of how many years a person has already lived). Prospective age is relating to the future. It refers to the number of years a person is expected to live. Prospective measures redefine the ageing of the population on the basis of remaining life expectancy, rather than on the number of years lived. These two measures of age are complementary and refer to two different aspects of ageing [Gietel-Basten, Scherbov and Sanderson, 2016;

Sanderson and Scherbov, 2005, 2007, 2008; 2016a; 2016b; 2020]. Prospective age is a coherent measure in terms of time horizon, because all people of the same prospective age have the same expected number of years ahead of them, regardless of the number of years they have already lived so far [Sanderson and Scherbov, 2005; 2007; 2016a; 2016b; 2020]. Based on the concept of prospective age, it can be seen that someone who is 65 today is in some respects equivalent to someone who was 40 in the mid-19th century, as well as someone who was 65 a century ago is equivalent to someone who is over 70 today [Sanderson and Scherbov, 2007].

In prospective age approach, the old age threshold does not refer to chronological age which is determined on the basis of a certain number of years already lived (e.g. 65 years) but on remaining life expectancy (RLE). Various studies have aimed at determining a suitable, fixed remaining life expectancy but there is a general consensus that the RLE should be 10–15 years [Basten, 2013; Basten, Yip and Chui, 2013; Gietel-Basten et al., 2016; Sanderson and Scherbov, 2010]. When UN reports in the 1960s–70s adopted 65 years as the threshold for old age, a 65-year-old person living in low-mortality countries had an average of 15 years ahead to live [Scherbov and Sanderson, 2015]. Therefore, the RLE threshold is often set at 15 years [Sanderson and Scherbov, 2005; 2008; 2010].

One of the measures proposed by Sanderson and Scherbov is the prospective old-age dependency ratio (POADR), which defines old age based on a remaining life expectancy of 15 years [2005; 2007]. Studies show that, in many countries, the old age dependency ratio indicates a slower increase in the dependency burden than traditional measures of old age [Basten, Yip and Chui, 2013; Gietel-Basten, Scherbov and Sanderson, 2016; Sanderson and Scherbov, 2005; 2007; 2010; 2013; 2015; 2015; 2016a; 2016b; 2020]. Sanderson and Scherbov [2005], also proposed new measure of ageing: the median age of the population standardized for expected remaining years of life. The prospective median age defined as the prospective age of a person at that median age [Sanderson and Scherbov, 2007]. The prospective median age is defined as the age in the life table in a standard year when people have the same remaining life expectancy as the person at median age of the population of reference year. The prospective median age in a given year, e.g. 1950, is the age of a person in 1990 whose remaining life expectancy is the same as median age of a person in 1950, both calculated from the life tables of that period.

The POADR and the prospective median age have been used to study the advancement of the Chinese population ageing and to compare it with its conventional counterparts.

3. Data and methods

In this population-based study, the main focus is placed on the Chinese population. The conventional measures of China's population ageing were based on historical data from 1982[3] to 2023 published in the *China Statistical Yearbook 2024*. The following key conventional measures of ageing are presented:

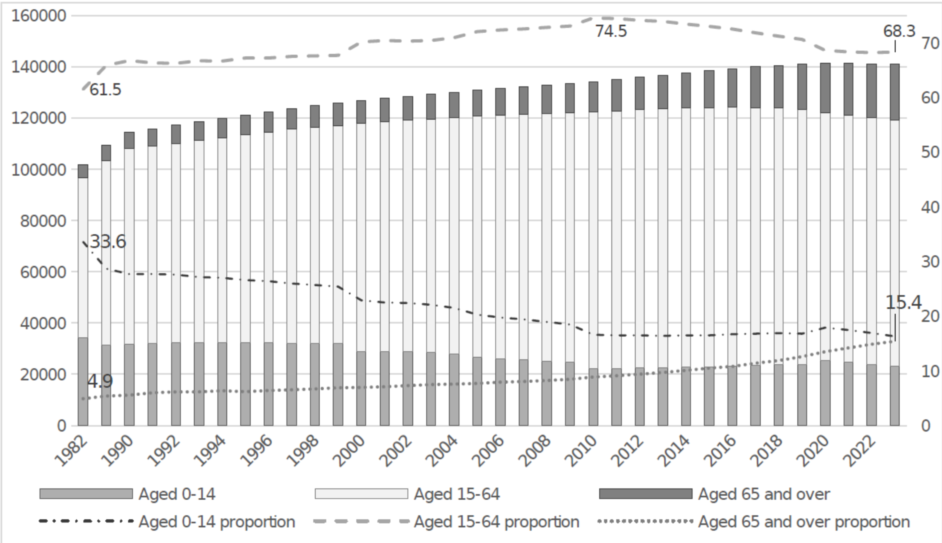
– age composition between 1982 and 2023,
– age structure diagram which is a graphical representation of the distribution of a population by age group and by sex in 1970, 1990 and 2020,
– total age dependency ratio, children dependency ratio and elderly dependency ratio of population between 1982 and 2023.

The analysis of conventional measures of the ageing show China's advanced level of ageing. The age composition in China between 1982 and 2023 as shown in Figure 1 confirms the trends in population ageing. During this period, the share of older people (aged 65+) in the population structure increased by 10.5 percentage points (from 4.9% to 15.4%), while the share of people under 15 years of age fell significantly from 33.6% to 16.3%. For more than a decade, the proportion of young people has remained stable at around 16–17%, but the share of people 65+ in the total population has been growing rapidly. These changes determine the size of the working-age population. While it is true that the share of people between 15 and 64 years of age is higher than in 1982 and currently represents 68.3% of the population, it is significant that this proportion has been gradually decreasing since 2010. The share of working-age population peaked around 2010 (about 74.5%), but given the shrinking of the Chinese population, this share will decline.

The demographic transition and change in the age structure of the population in China is well illustrated by a graphical presentation of the population distribution by age group and by gender (Figure 2). The population pyramid as a tool can be used to visualise the current age structure, types of age structure and future changes.

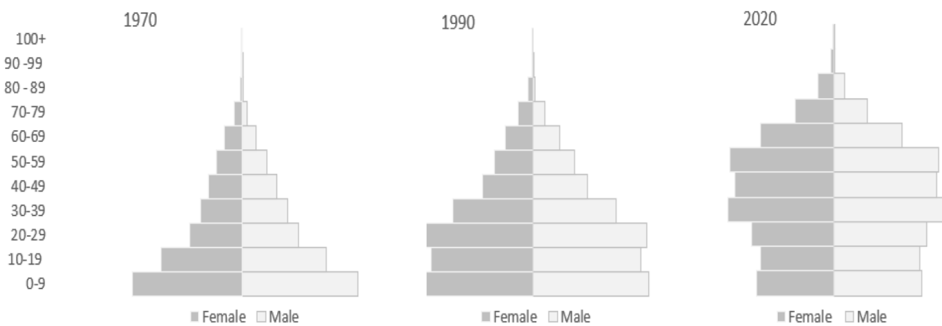
In the 1970s, the shape of Chinese age pyramid was typical of young or progressive societies. In the 1980s the age structure shifted to the mature type, but in the 1990s features of the old type of age structure emerged. In the 2020s, the population age structure can be described as close to regressive. The shape of the pyramid is similar to that of old societies with high ageing rates. It indicates the advanced demographic old age of the Chinese population.

Figure 1. Age composition in China between 1982 and 2023 (in 10 thousand people – right scale and in percent – left scale)



Source: Author' calculations based on *China Statistical Yearbook 2024*. Retrieved from https://www.stats.gov.cn/sj/ndsj/2024/indexeh.htm (10.06.2025).

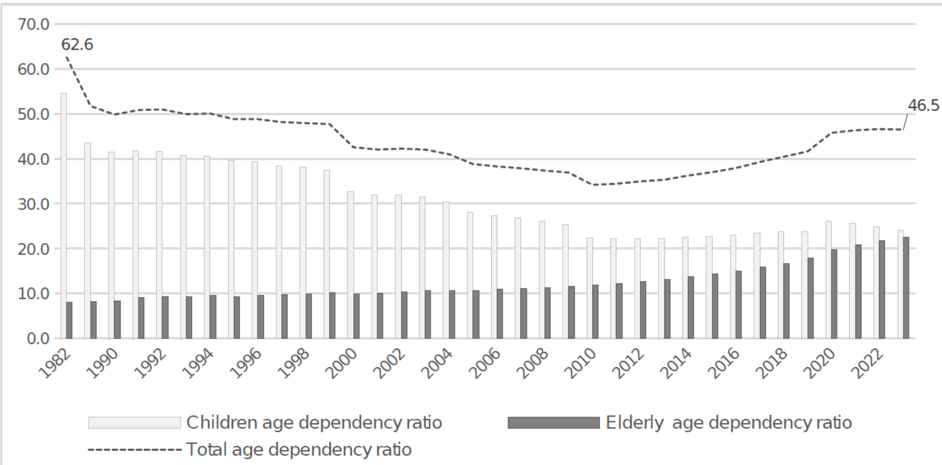
Figure 2. Age structure diagram by age groups and sex in China (thousands) in 1970, 1990 and 2020



Source: Author' calculations based on United Nations, (2022), *World Population Prospect 2022*. Department of Economic and Social Affairs, Population Division. Retrieved from https://population.un.org/wpp/ (14.02.2025).

Total age dependency ratio (TADR $= P_{0-14} + P_{65+}/P_{15-64}$) examines, to some extent, the impact of the age structure of the population on the economy and society. In China, between 1982 and 2010, the TADR rate decreased from ca. 63% to about 34%. However, it has been rising steadily since then, and has increased by more than 10 percentage points over the decade to over 46.5%. The share of children under 14 years of age in relation to the working-age population has decreased significantly, from almost 55% to around 24%. However, there has been a continuous increase in the share of older people in relation to the population of working age, which has risen from around 8% to 22.5%. These changes are shown in Figure 3.

Figure 3. Total age dependency ratio, children dependency ratio and elderly dependency ratio of population in China between 1982 and 2023 (in percent)



Source: Author' calculations based on *China Statistical Yearbook 2024*. Retrieved from https://www.stats.gov.cn/sj/ndsj/2024/indexeh.htm (10.06.2025).

A study of selected conventional measures of population ageing reveals very serious demographic changes in Chinese society. Changes in the age structure measures primarily result from the changes in fertility and mortality rates. If mortality and migration rates remain constant, declining fertility rate causes faster population ageing and an increase in the rate of older people in the entire population [Sanderson, Scherbov and Gerland, 2018].

In order to remeasure ageing of mainland China based on the prospective age model proposed by Sanderson and Scherbov, the demographic data for key analysis were obtained from reliable historical records (1950–2021) and future projections (2022–2100), both published by the UN's *World Population Prospects: 2022* [UN, 2022]. These data include age-specific population counts and life tables for both sexes combined, providing mortality rates and remaining life expectancy (RLE) at different ages. After data preparation, several key demographic measures were calculated, as follows:

- the $OADR_{15–64}$ – the conventional old-age dependency ratio, where the old-age threshold is set at 65 years and the working-age starting at 15 years ($OADR_{15–64} = P_{65+}/P_{15–64}$);

$$\mathrm{OADR}_{15–64} = \frac{\text{number of people aged 65} \vee \text{older}}{\text{number of people between 15} \wedge \text{64 years old}}$$

- the RLE_{15} – is set at the point at which a person is defined as 'old' or 'dependent'. This point then changes as overall life expectancy rises (or falls). The life tables have been used to identify the exact ages at which the remaining years of life for individuals are closest to 15 years;
- the RLE at age 65 – demonstrates how many remaining years of life a person has at the age of 65;
- the POADR – the prospective old-age dependency ratio[4] is calculated as the number of people older than the age of RLE_{15} for each year divided by the number of people of working age. The calculation is a combination of both age-specific population counts and life tables. Projected life tables were used to calculate the POADR up to the year 2100. The old age limit was set at a moving point with a fixed remaining life expectancy of 15 years (RLE_{15});

$$\mathrm{POADR} = \frac{\text{number of people older than the old-age threshold } (\mathrm{RLE}_{15})}{\text{number of people between 15} \wedge \text{the old-age threshold } (\mathrm{RLE}_{15})}$$

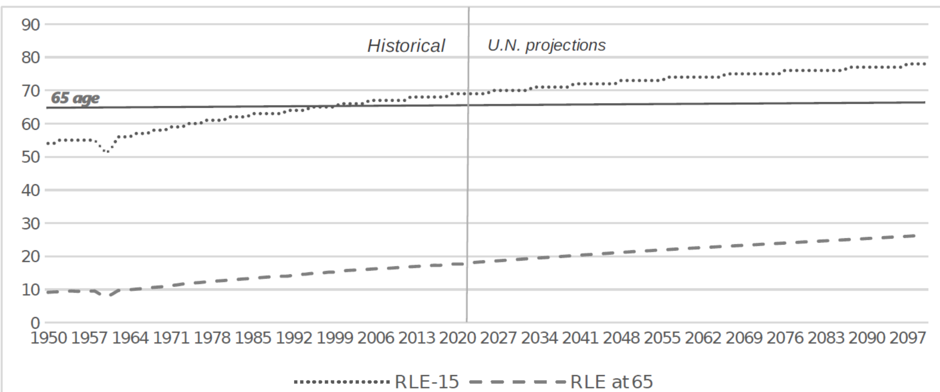
- the life expectancy at birth – is the number of years that a person born in a given year can be expected to live, assuming a constant rate of mortality in that year. This measure describes the life expectancy of the population under study, reflecting the changing conditions of extinction of the population in question [Abramowicz-Kmon, 2011];
- the conventional median age – is the age that divides the population of each year into equal halves in terms of age (calculated as the age of central individual from a vector of sorted ages);
- the prospective median age – is defined as the age in the life table of a standard year at which people have the same remaining life expectancy as they have at the median age of the population in the reference year [Sanderson, Scherbov and Gerland, 2018]. Prospective median age is calculated by first determining the RLE at the median age for a given reference year. For other years, the age at which the RLE most closely approximates this benchmark will be found.

In the study, first the age at which the RLE equals 15 years in China was calculated and identified as an alternative threshold for 'dependency'. Using this new threshold, the prospective old-age dependency ratio (POADR) was calculated for China. Then the POADR based on the RLE_{15} and the conventional $OADR_{15–64}$ was compared. After that then conventional and prospective median ages for China were calculated and compared. The prospective median is presented in two versions based on two different reference years: 2021, which provides the latest empirical data from the UN, and a cross-section of 1995–1999, where the conventional (65 years) and RLE_{15}-based old age thresholds overlap.

4. Results

To identify the exact ages where the remaining years of life for individuals in China are closest to 15 (RLE_{15}) the life tables were used. Figure 4 shows the test results for RLE_{15} between 1950 and 2100.

Figure 4. Remaining life expectancy of 15 years (RLE15) and remaining life expectancy at 65 years in China between 1950 and 2100



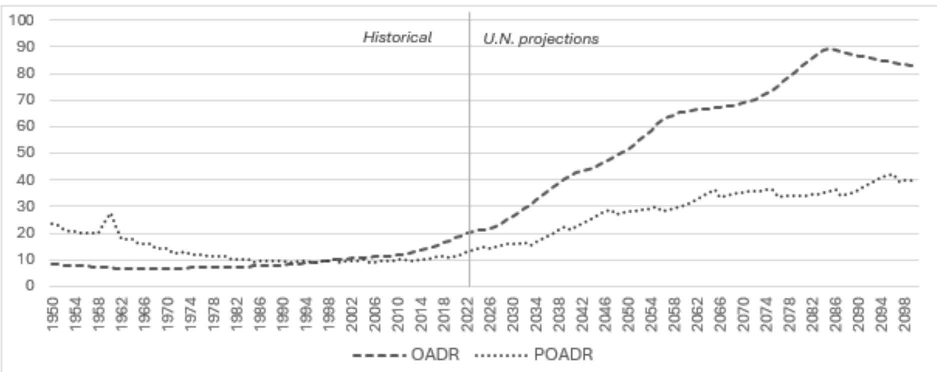
Source: Author' calculations based on United Nation, *World Population Prospect 2022.*

In 1950, a Chinese person with a life expectancy of 15 years was 54 years old. In 2021 a Chinese with life expectancy of 15 years was 69 years old, and in 2050 the person will be around 73 years. The age at which remaining life expectancy is 15 years (RLE_{15}) shows an increasing trend, indicating that people live longer until older age before their remaining life expectancy falls to 15 years. This increase is probably due to improvements in health care and living conditions.

The chart also presents the remaining life expectancy at the age of 65 which demonstrates how many remaining years of life a person has at the age of 65 (for each year between 1950 and 2100). Thus, a Chinese person aged 65 in 1950 expected to live for another 9 years. In 2022, they had 18 years of life ahead, and in 2050, statistically, they will still live for over 21 years. Thus, RLE at age 65 was below 10 years in 1950 and will have increased to approximately 20 years by 2100.

Figure 5 shows a comparison of the conventional $OADR_{15-64}$ with the POADR calculated for China for years 1950–2100. In the case of the POADR, the working age is defined between the age of 15 and the RLE_{15}. For example, in 2021, a Chinese with 15 years life expectancy in life table was 69 years old. Thus, in the year under study, the old age threshold used to calculate the POADR is 69. Therefore, the POADR is percentage of Chinese aged 69 or older divided by the percentage of the population aged 15 to 68 inclusive. The POADR shows how the 'old-age dependency' age changes over the years if the upper limit of working age is defined dynamically based on RLE_{15}. This means that the old-age dependency ratio maintains prospective age at a constant level.

Figure 5. $OADR_{15-64}$ and POADR in China between 1950 and 2100 (in percent)



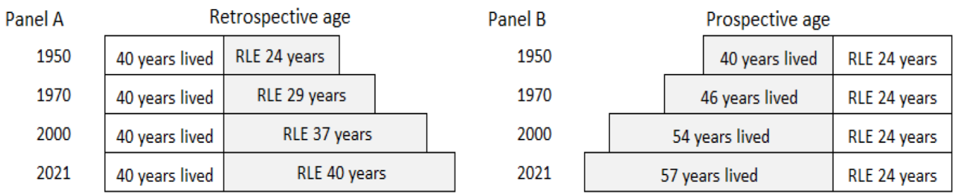
Source: Author' calculations based on United Nation, *World Population Prospect 2022.*

The projections for the growth of the conventional OADR are worrying. The OADR increased from about 10% in 2000 to about 19% in 2021. Projections indicate that it will reach 51% in 2050 and over 65% in 2060. Meanwhile, the POADR increased from about 10% in 2000 to about 13% in 2021 and is projected to increase to 27.9% in 2050 and to about 30.5% in 2060.

The prospective old-age dependency ratio grows at a slower pace than the old-age dependency ratio. The gap between the OADR and the POADR will grow as a result of the rapid increase in the OADR. This results from the fact that the fixed chronological age is set at 65, while the life expectancy of population is increasing. These two pictures of ageing in China are fundamentally different. As life expectancy increases, the prospective old-age dependency ratio remains lower, and the observed increase is also slower than conventional measures.

The prospective ages are chronological ages adjusted for changes in life [Sanderson, Scherbov and Gerland, 2018]. The measure of prospective age allows for comparing the age at which the RLE remains the same. The method for calculating and comparing the retrospective and prospective age is shown in Figure 6.

Figure 6. Remaining life expectancy in China comparing in 1950, 1970, 2000 and 2021



Source: Author' calculation based on [Basten, et al., 2013 and United Nation, 2022].

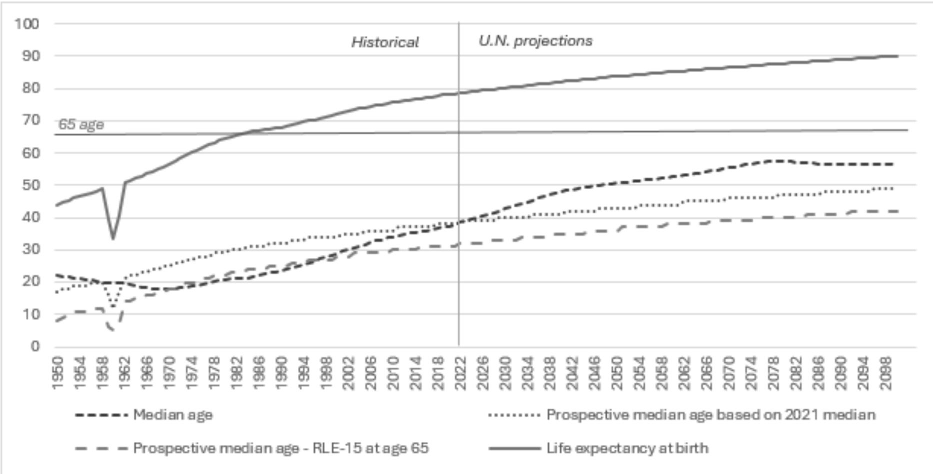
Panel A compares the remaining life expectancy of a 40-years-old alive in 1950, 1970, 2000 and 2021. In 1950 a Chinese could expect to live for about 24 years, while the 40-years old Chinese in 2021 could expect to live for almost 40 years. Panel B shows the prospective age for a Chinese when he had the same remaining life expectancy of a 40-years old person in 1950. A 40-years old person in 1950 has the same remaining life expectancy as a 57-year-old person in 2021.

Figure 7 provides a comprehensive perspective of the trends in the aging process of China's population between 1950 and 2100, using traditional and prospective measures, such as life expectancy at birth, median age, prospective median age based on 2021 median, and prospective median age based on RLE_{15} at the age of 65.

Although life expectancy at birth is not a typical measure of population ageing, it does reveal some demographic trends. China's life expectancy at birth increased from 43.7 years to 78.2 years between 1950 and 2021. Projections show that it will reach 83.8 years in 2050 and over 85 years in 2060.

The advanced process of population ageing is also reflected in median age. The decline in the median age from 24 years in 1950 to 19 years between 1968 and 1970 was due to the effects of the 'Great Leap Forward' policy introduced by Mao Zedong. In 1960, the remaining life expectancy

Figure 7. Median age, prospective median age based on 2021 median, prospective median age based on RLE_{15} at age of 65 and life expectancy at birth in China between 1950 and 2100



Source: Author' calculations based on United Nation, *World Population Prospect 2022.*

at the median age was 33.3 years, the lowest since the establishment of the People's Republic of China. The conventional measure of the median age shows a sharp rise from below 20 years in the late 1970s to about 37.9 years in 2021, and 51 years in 2050.

By contrast, the prospective median age, presented in two versions, shows a more moderate increase. From the 1960s to the 2020s, the prospective median age based on the 2021 reference year (specifically on the median age in 2021) was higher than the conventional median age. Now, the prospective median age remains consistently lower for the coming years but follows a similar upward trend.

The prospective median age in reference to 2021 is consistent with the current trends in life expectancy and provides an appropriate and contemporary measure of ageing. The prospective median age based on cross-section of 1995–1999, where the conventional (65 years) and RLE_{15}-based age thresholds overlap (RLE_{15} at age 65), has been consistently lower than the conventional median age and also than prospective median age based on the 2021 median age, but follows the same general trend over time.

While conventional measures indicate that a faster increase in life expectancy leads to faster population ageing, prospective measures indicate a less dramatic ageing process due to increasing life expectancy. Prospective median ages increase less rapidly. This suggests that as people live longer, the age at which they are considered 'old' tends to move upwards. This highlights the relative nature of ageing in relation to specific life expectancy thresholds.

When the threshold for being considered 'old' is related to a specific remaining life expectancy, the population appears relatively younger compared to the conventional measure. This highlights the importance of using dynamic measures of ageing in demographic analysis to better reflect the changing realities of longevity. The use of current and historical benchmarks for prospective median ages provides a more accurate and nuanced understanding of ageing trends, which is essential for the development of effective policy and social planning.

5. Discussion and conclusions

A study of Chinese ageing using conventional measures reveals a very unfavourable demographic trend in the ageing process from 1970 until now. China has a rapidly ageing population, in terms of size and structure. The country, the largest economy in terms of population until recently, has the largest number of people aged over 65. By 2022, older people accounted for around 15% of the population, or almost 210 million people. The number of people aged 65 and over and their ratio to those of working age (old-age dependency ratio) are also growing rapidly. For more than a decade the share of children has remained stable. However, there has been a gradual decline in the proportion of the working age population. The demographic transition of the population shows the rapid pace of population ageing. In the 1970s, China was a typical young demographic population. In the 1990s, it reached the status of a mature population and now has the characteristics of a regressive society.

The rapid ageing of China's population is also confirmed by other conventional measures such as the total dependency ratio, the children dependency ratio, the elderly dependency ratio, or the median age. Shrinking population, (dramatic) fertility decline, mortality decline, and increasing longevity are crucial for this process [Mao et al., 2020; Sanderson and Scherbov, 2008].

Increased life expectancy leads to a faster ageing of the population according to conventional measures. Adopting an old age threshold at a specific chronological age results in disregarding the population diversity in terms of both economic activity, including labour market participation, and functional capacity. The conventional approach does not distinguish between

65-year-olds in 1970 and 65-year-olds in 2020. Characteristics of people that are not related to chronological age, such as changes in remaining life expectancy, health, morbidity, disability, or cognitive function are also not included. These measures may therefore be of little use in examining the levels of dependency in such dynamically changing populations. Furthermore, not all people of chronological working age are economically active, and some are economically dependent.

Measures based on chronological age also portray a dramatic picture of China's demography landscape in the coming decades. Conventional measures are likely to overestimate the burden of population ageing in many countries that are demographically older, including China. The study of China's population ageing using prospective measures, i.e. the prospective old-age dependency and the prospective median age, gives a less dramatic perspective of China's demography.

The RLE_{15} and the RLE at 65 show that life expectancy has increased enormously. In 1950, a 65-year-old Chinese lived for an average of nine years; today, the average is more than 18 years. In other words, the number of remaining years of life for the 65-year-old (the cut-off age for conventional measures) has doubled. A Chinese with 15 years to live is now statistically about 69, whereas in 1950 they were 54. Prospective measures show that a faster increase in life expectancy leads to a slower ageing of the population. The rate of population ageing in light of alternative methods is lower than the traditional measures. This gives a different picture of China's demography. If we consider increasing age or improving general health, we can still expect China's population to age, but definitely at a slower rate.

Economic policies and measures aimed to reduce unfavourable demographic phenomena should consider the fact that the growth in ageing will be slower when the measures are adjusted to, for example, changes in life expectancy. Many behaviours concerning e.g. saving, investment, education, health care, the pension schemes and retirement planning depend on the number of remaining years of life, so it is important to complement the usual retrospective definition of age with a prospective one. The concept of prospective age can also be useful for determining the statutory retirement age [Sanderson and Scherbov, 2008].

Measuring population ageing influences the perceptions of demographic trends. At the same time, it plays a crucial role in shaping social policy. Conventional measures are useful as a simple measure to describe changes in population structure or as a tool for comparative analysis between countries. However, relying on them alone may overestimate future difficulties and may lead decision-makers to misjudge ageing and result in poorly designed policies.

The study of this phenomenon should therefore be approached with caution, using different measures and techniques. Policy decisions should be based on the actual population ageing. A better understanding of the challenges posed by this apparently irreversible phenomenon can be achieved by assessing population ageing using both a retrospective approach based on chronological age, and a prospective approach, which considers changes in life expectancy over the years.

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NOTES

[1] Most studies of demographic phenomenon use 65 as the conventional threshold for age. This is also the threshold that has been adopted for the study in the paper.

[2] In some studies, the age of 20 is assumed as the lower limit of the productive age [see Sanderson et al., 2018]. For the purposes of this study, all calculations use age 15 as the lower limit of working age.

[3] In the *China Statistical Yearbook* database, the earliest data on population structure is for 1982.

[4] A detailed methodology for calculating the prospective old-age dependency ratio was proposed by Sanderson and Scherbov [2005; 2007; 2008].

REFERENCES

Abramowska-Kmon, A. (2011), O nowych miarach zaawansowania procesu starzenia się ludności, *Studia Demograficzne*, Vol. 1, No. 159, pp. 3–22.

Basten, S. (2013), Redefining 'old age' and 'dependency' in East Asia: Is 'prospective aging' a more helpful concept? *Asian Social Work and Policy Review*, Vol. 7, No. 3, pp. 242–248, doi: 10.1111/ASWP.12015.

Basten, S., Yip, P., Chui, E. (2013), Remeasuring ageing in Hong Kong SAR: or 'keeping the demographic window open'. *Journal of Population Research*, Vol. 30, No. 13, 249–264, doi: 10.1007/S12546-013-9113-1.

Chang, A.Y., Skirbekk, V.F., Tyrovolas, S., Kassebaum, N.J., Dieleman, J.L. (2019), Measuring population ageing: An analysis of the global burden of disease study 2017, *The Lancet Public Health*, Vol. 4, No. 3, e159-e167, doi: 10.1016/S2468-2667(19)30019-2.

Chen, S., Li, Y., Sun, Q. (2025). Population aging and innovation slowdown: Dual mechanisms of firm cost structure and consumption preference, Economic Modelling, Vol. 150, 107120, doi: 10.1016/j.econmod.2025.107120.

Chen, Y., Zhang, K. (2025), Impact of population aging on Chinese residents' consumption: Empirical analysis based on impact of digital inclusive finance, Finance Research Letters, Vol. 82, 107490, doi: 10.1016/j.frl.2025.107490.

China Statistical Yearbook 2023. Retrieved from https://www.stats.gov.cn/sj/ndsj/2023/indexeh.htm.

Crimmins, E.M., Saito, Y., Kim, J.K. (2016), Change in cognitively healthy and cognitively impaired life expectancy in the United States: 2000–2010, *SSM Population Health*, Vol. 2, pp. 793–797, doi: 10.1016/j.ssmph.2016.10.007.

Gietel-Basten, S.A., Scherbov, S., Sanderson, W.C. (2016), Towards a reconceptualising of population ageing in emerging markets, *Vienna Yearbook of Population Research*, Vol. 14, pp. 41–65, doi: 10.1553/populationyearbook2016s041.

Institute for Health Metrics and Evaluation (IHME) (2024), *Global Burden of Disease 2021: Findings from the GBD 2021 Study*, IHME, Seattle; https://www.healthdata.org/research-analysis/library/global-burden-disease-2021-findings-gbd-2021-study (14.05.2024).

Kämpfen, F., Kohler, I.V., Bountogo, M., Mwera, J., Kohler, H.-P., Maurer, J. (2020), Using grip strength to compute physical health-adjusted old age dependency ratios, *SSM-Population Health*, Vol. 17, 100579, doi: 10.1016/j.ssmph.2020.100579.

Kawada, Y., Nakamura, Y., Okamoto, N. (2025). A measurement of population ageing: From the perspective of thickness of the labor force, Mathematical Social Sciences, Vol. 134, pp. 50–57, doi: 10.1016/j.mathsocsci.2025.01.004.

Liverman, C.T., Yaffe, K., Blazer, D.G. (2015), *Cognitive aging: progress in understanding and oppor-tunities for action*, The National Academies Press, Washington.

Mao, G., Fuzhong, Lu, F., Fan, X., Wu, D. (2020), China's ageing population: The present situation and prospects, in: J. Poot, M. Roskruge, (Eds.), *Population change and impacts in Asia and the Pacific*, New Frontiers in Regional Science: Asian Perspectives 43, Springer Nature Singapore Pte Ltd, doi: 10.1007/978-981-10-0230-4_12.

Mathers, C.D., Murray, C.J. Salomon, J.A. (2003), Methods for measuring healthy life expectancy. In: C.J. Murray, D.B. Evans (Eds.), *Health systems performance assessment: debates, methods and empiricism.* Publisher World Health Organization, Geneva.

Murray, Ch.J.L. (2024), Findings from the Global Burden of Disease Study 2021, *The Lancet*, Vol. 403(10440), pp. 2259–2262, doi: 10.1016/S0140-6736(24)00769-4.

Piriu, A.A., Bufali, M.V., Cappellaro, G., Compagni, A., Torbica, A. (2025), Conceptualisation and measurement of healthy ageing: Insights from a systematic literature review, Social Science & Medicine, Vol. 374, 117933, doi: 10.1016/j.socscimed.2025.117933.

Rapp, T., Ronchetti, J., Sicsic, J. (2022), Where Are Populations Aging Better? A Global Comparison of Healthy Aging Across Organization for Economic Cooperation and Development Countries, Value in Health, Vol. 25, Issue 9, pp. 1520–1527, doi: 10.1016/j.jval.2022.05.007.

Sanderson, W.C., Scherbov, S. (2005), Average remaining lifetimes can increase as human populations age, *Nature*, Vol. 435(7043), pp. 811–813, doi: 10.1038/nature03593.

Sanderson, W.C., Scherbov, S. (2007), A new perspective on population aging, *Demographic Research*, Vol. 16, No. 2, pp. 27–58, doi: 10.4054/DemRes.2007.16.2.

Sanderson, W.C., Scherbov, S. (2008), Rethinking age and ageing, *Population Bulletin*, Vol. 63, No. 4, pp. 1–16.

Sanderson, W.C., Scherbov, S. (2010), Remeasuring aging, *Science*, Vol. 329(5997), pp. 1287–1288, doi: 10.1126/science.1193647.

Sanderson, W.C., Scherbov, S. (2013), The characteristics approach to the measurement of population aging, *Population and Development Review*, Vol. 39, No. 4, pp. 673–685, doi: 10.1111/j.1728-4457.2013.00633.x.

Sanderson, W.C., Scherbov, S. (2015), Faster increases in human life expectancy could lead to slower population aging, *PLoS One*, Vol. 10, No. 4, e0121922, doi: 10.1371/journal.pone.0121922.

Sanderson, W.C., Scherbov, S., Gerland, P. (2018), The end of population aging in high-income countries, *Vienna Yearbook of Population Research*, Vol. 16, pp. 163–175, doi: 10.1553/populationyearbook2018s163.

Scherbov, S., Sanderson, W.C. (2016a). Innovation and translation in East Asia that takes life expectancy into account, *Australasian Journal on Ageing*, Vol. 35, No. 2, pp. 139–14, doi: 10.1111/ajag.12267.

Scherbov, S., Sanderson, W.C. (2016b), New approaches to the conceptualization and measurement of age and aging, *Journal of Aging and Health*, Vol. 28, No. 7, pp. 1159–1177, doi: 10.1177/0898264316656517.

Scherbov, S., Sanderson, W.C. (2020), New approaches to the conceptualization and measurement of age and ageing, in: S. Mazzuco, N. Keilman, (Eds.) *Developments in Demographic Forecasting.* The Springer Series on Demographic Methods and Population Analysis, Vol 49. Springer, Cham, doi: 10.1007/978-3-030-42472-5_12.

Skirbekk, V.F., Dieleman, J.L., Stonawski, M., Fejkiel, K., Tyrovolas, S., Chang, A.Y. (2022), The health-adjusted dependency ratio as a new global measure of the burden of ageing: a population-based study, *The Lancet Healthy Longevity*, Vol. 3, No. 5, e332-e338, doi: 10.1016/S2666-7568(22)00075-7.

Skirbekk, V.F., Loichinger, E., Weber, D. (2012), Variation in cognitive functioning as a refined approach to comparing aging across countries, *PNAS Proceedings of the National Academy of Sciences of the United States of America*, Vol. 109, No. 3, pp. 770–774, doi: 10.1073/pnas.1112173109.

Skirbekk, V.F., Staudinger, U.M., Cohen, J.E. (2019), How to measure population aging? The answer is less than obvious: A review, *Gerontology*, Vol. 65, No. 2, pp. 136–144, doi: 10.1159/000494025.

United Nations. (2019), *World Population Ageing 2019. Highlights* (ST/ESA/SER. A/430), Department of Economic and Social Affairs, Population Division. Retrieved from https://population.un.org/wpp/.

United Nations. (2022), *World Population Prospect 2022*. Department of Economic and Social Affairs, Population Division. Retrieved from https://population.un.org/wpp/.