Overview of a Population Question

Foreword

Since 2015, *Population* has published regular chronicles reviewing current knowledge on a particular population issue of global importance. These chronicles aim to provide a wide audience (of scientists, students, journalists, policymakers, and others) with a synopsis of both the data and the key elements of theoretical, methodological, and political debate. They contextualize the issue and provide a historical perspective.

After a critical description of information sources and measurement tools, the authors review the most recent research on the topic and describe overall trends along with any social, spatial, and gender disparities. This is followed by a discussion on the potential political or legal implications of current and future situations, and the challenges for future research.

Previous chronicles have focused on key demographic topics such as the masculinization of births (No. 3, 2015), female genital mutilation (No. 3, 2016), mortality inequalities in low-income countries (No. 2, 2017), and abortion worldwide (No. 2, 2018). This latest chronicle looks at population ageing.

Although demographic ageing is occurring in all countries of the world, situational disparities mean that the issues generated in countries that are still very young, such as the countries of the Global South, are very different from those faced by the populations of European countries, North America, or Japan, for example. In these developed countries, the process of population ageing is already well under way, although the timing and magnitude of the phenomenon may vary. With life expectancy continuing to rise and the large baby boom generations reaching older ages, the population is inexorably ageing, posing many challenges for the whole of society: individuals, families, institutions, and governments. Research in demography, economics, and sociology sheds light on these issues.

Looking at a group of 40 'high-longevity' countries that are relatively homogeneous in terms of health, social, and economic development, the authors describe the current and future situation and provide a wealth of documentation on key questions: How can this ageing be measured? Which indicators are the most relevant for comparing countries and forecasting future trends? What are the demographic dynamics of ageing and its rate of change? Who benefits from increases in life expectancy? What are the health conditions of older people? How are they supported and cared for? What roles should families and institutions play in the provision of this care? How are pension systems adapting to increases in the numbers of older people?

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Population Ageing in High-Longevity Countries: Demographic Dynamics and Socio-economic Challenges

In 1944, Alfred Sauvy described the French population as the oldest in the world. While the ratio of 'elderly' aged over 60 (*vieillards*) to 'children' below 20 (*enfants*) was 15 per 100 in 1790, it stood at 52 per 100 in 1942 (Sauvy, 1944). Drawing on work by Bourgeois-Pichat, he explained in 1954 that the current ageing dynamic, more pronounced in France than elsewhere, was attributable to a fertility decline that was raising the proportion of old people in the population (Sauvy, 1954). This increase of the share of the oldest people is called population ageing (Notestein, 1954; Sauvy, 1954).

Alongside the dynamic Sauvy identified in the early 1950s, the increase in life expectancy observed in France and in other countries of Europe and North America is also a key factor of population ageing and is now its main driver. Mortality in these countries has fallen rapidly and substantially thanks to progress in healthcare, sanitation, disease prevention, and social protection. Today, most people enter the 'third age' (90% survival rate at age 60 in France) and survive to advanced ages.

Now that the large baby boom cohorts have entered their 60s, population ageing is accelerating rapidly. In the first decades of the 21st century, 'entries' into old age in these countries have been more numerous than 'exits'. This growth is sometimes so strong that it can be converted into changes per minute: in France, in 2015, the number of over-65s[(1)] increased by 3 every 5 minutes (eight people joining the over-65s for every five who died). Using Sauvy's terminology, the French population now has more *vieillards* than *enfants*, with a ratio of 110 per 100 in 2020 (17.8 and 16.2 million, respectively).

(1) In this article, the term *over-65s* refers to people who have reached their 65th birthday; likewise for *over-85s*, etc.

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The dynamics of ageing vary from one country to another, and at the global level ageing is still not very pronounced. The young population is still large, and numbers decrease with age due to persistently high mortality in many countries. However, while the speed and scale of ageing vary across world regions in line with each country's demographic history, the number of over-65s is nonetheless projected to surge from 700 million in 2020 to 1.5 billion in 2050, increasing from 9.3% to 15.9% of the world population (United Nations, 2019b).

The challenges of population ageing are immense. Decreasing mortality and rising longevity have been accompanied by profound and lasting changes in demographic behaviours, especially regarding fertility and partnerships. These transformations describe what is called the demographic transition (Lesthaeghe, 2014). The first transition corresponds to the decrease in completed fertility. The second corresponds to a change in the behaviours and timing of men's and women's life cycles: the timing of education, leaving the parental home, singlehood and childlessness, family life (as a couple, with cohabiting or non-cohabiting parents, grandparents), working life, and finally retirement and old age. This transition is also marked by changes in intergenerational relations, at both the individual level and across society. Societies are looking for ways to manage this ageing boom and its multiple implications, often seen as a destabilizing trend that threatens the equilibrium of social systems, and particularly social protection.

The demographic, social, and economic challenges and implications of population ageing take different forms, depending on the specific contexts of each country and the maturity of their welfare systems. This overview covers a set of high-longevity industrialized countries similar in health, social, and economic development. Their life expectancy is longer than the world average and their older adult populations have been increasing rapidly for several decades, including those of centenarians. Populations are also ageing in the rest of the world, sometimes rapidly, but with significantly different implications that deserve to be analysed separately.(2) By focusing on industrialized countries, we can exploit the abundant human and social science literature—still largely centred around the Western world—to investigate the specific challenges that they face.

Focusing on a group of 40 high-longevity developed countries, this article describes how the growing numbers of older adults living to ever greater ages are straining existing systems. These countries are defined in two ways. They are either members of the European Union and/or among the 30 countries with the highest scores on the Human Development Index (Box 1). The sample includes all OECD countries except Chile, Colombia, Mexico, and Turkey. In

(2) In high-mortality countries (notably in Africa), the situation is very different, in terms not only of demographic and epidemiological transitions, but also of health, social, and economic development. In these countries, the dynamics of ageing are affected by large-scale national and international migration that gives rise to specific life trajectories, demographic behaviours, and family situations (aspects mentioned at the end of this article).

Box 1. List of the 40 developed countries in the sample[a]

European Union (27 countries): Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France,[b] Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.
Europe outside the European Union (4 countries): Iceland, Norway, Switerzland, and the United Kingdom.
North America (2 countries): Canada and the United States.
Oceania (2 countries): Australia and New Zealand.
East and Southeast Asia (4 countries): Hong Kong (special administrative region of China), Japan, the Republic of Korea, and Singapore.
West Asia (1 country): Israel.

(a) Selection criteria: member of the European Union and/or among the top 30 countries on the Human Development Index.

(b) Whole of France (including Guadeloupe, French Guiana, Martinique, Mayotte, and Réunion).

2020, it covered a population of 1.1 billion people, representing 14.5% of the world population of all ages, but 30.5% of the over-65 population and 48.3% of that aged 85 and over (United Nations, 2019b). In this group of countries, 1 person in 5, on average, has reached age 65. Over the period 2015–2020, the lowest life expectancy at birth (LEB) was 70 years for males (in Lithuania and Latvia) and 78.5 for females (Bulgaria), and the highest was 81.8 in Hong Kong for males, and 87.5 in Hong Kong and Japan for females (Appendix Table A.2). Combining a statistical assessment of population ageing in this sample of countries (Section I) with an overview of research on their health, family, and socio-economic situations (Section II), this article elucidates the demographic challenges that lie ahead.

Section I presents ongoing research into the ageing dynamics of these countries and some of the debates it has kindled before looking at the various indicators of demographic ageing, the situation in the 40 selected countries, and the projections for coming decades. The analysis uses data from the 2019 revision of the *World Population Prospects* published by the United Nations and its projections up to 2050 (medium scenario), alongside data from the Human Mortality Database that provides more historical depth and more detailed information for certain countries (numbers of deaths by age and year of birth). The study focuses more specifically on the ageing dynamics linked to longevity, about which many unknowns remain. For example, how and why do life expectancy trends differ by country, sex, or social status? What are the determinants of record longevity and of recent fluctuations in life expectancy?

Section II begins by examining the implications of population ageing in these countries. In countries of the sample for which data are available, we aim to explore the implications of life expectancy gains at advanced ages regarding health and individual functional independence, the family changes occurring alongside this ageing process, and the economic challenges that social protection systems will need to address.

I. The demographic dynamics of population ageing

For Uhlenberg, citing a United Nations report, the dynamic of ageing is remarkable because it is unprecedented, pervasive, and enduring, and has profound consequences (Uhlenberg, 2009). It affects numerous dimensions of peoples' living conditions and lifestyles, raising questions for the human and social sciences that extend well beyond the realm of demography alone. These questions provide scope to develop new, largely unexplored avenues of research. They are briefly outlined here before refocusing attention on measures of demographic ageing and the future evolution of human longevity.

1. The context of research on population ageing

Growing interest in a long-standing concern

Population ageing is not a new topic in demography or in the social sciences in general (Sauvy, 1944). In France and other countries where the demographic transition was most advanced, it was temporarily masked in many cases by the post-war baby boom and the subsequent arrival of these large birth cohorts on the labour market. But the impact of ageing has amplified in the early 21st century, as the baby boom generations reach retirement age and life expectancies extend well beyond those of previous generations. Given the large numbers concerned, there is an increasingly visible need to consider the diverse situations and needs—both present and future—of the baby boom generations whose characteristics, expectations, and life prospects differ from those of their forebears (career, health, family, etc.) (Bonvalet and Ogg, 2011). The impact of ageing is also perceptible in the scramble to adjust public policies and adapt social protection systems to meet emerging needs (OECD, 2015).

In the 1990s, this growing awareness of the major transformations that population ageing would entail prompted fierce debates on how the phenomenon should be qualified. Different schools of thought emerged, with opposing views about future implications (Parant, 1992; Bourdelais, 1993; Loriaux, 1995). For its 50th anniversary issue in 1995, *Population* published a dialogue between Jacques Henripin and Michel Loriaux, presenting two conceptions of population ageing and its consequences (Henripin, 1995; Loriaux, 1995). While Henripin describes the financial consequences—those most often mentioned today, notably the rising cost of healthcare and pensions and the need to finance them—Loriaux points up the dangers of an exclusively negative and catastrophist vision. He deplores the absence of perspective on the contexts that gave rise to this dynamic over the long term, such as the choices and measures that led to lower fertility and longer life expectancy. He also criticizes the analogy between individual ageing, a synonym of senescence, and collective ageing. Finally, he condemns the mode of reasoning based on 'unchanging social organization' and argues for an approach based on a 'process of social transformation' achieved through new

modes of social organization adapted to changing population structure. He also highlights the need to rethink the notion of age and the role of the oldest and most vulnerable members of society.

These debates are echoed in the demographic indicators that have been developed to measure ageing, based on both fixed age thresholds (at what age does one become 'old'?) and mobile thresholds (this age may not remain the same over time).

An ongoing need for new knowledge

Despite these visible trends and the major challenges they entail, many aspects of population ageing and its implications remain poorly understood. A large share of population statistics, produced using complex and costly methods (such as surveys by statistical offices on large representative samples of the general population), do not provide an accurate representation of the older population (this aspect will be discussed at the end of this article). Older adults form a growing age group whose needs and living conditions are largely unknown. In this respect, ageing remains a challenge for societies and public policymakers, but also for research (Uhlenberg, 2009).

Forty years after the *Handbook of Aging and the Social Sciences* was first published in 1976, the introduction to the eighth edition, edited by Linda George and Kenneth Ferraro, describes some of the research resources developed over the decades. These include new sources of longitudinal data, notably the Health and Retirement Study launched in the United States by the National Institute on Aging and the Social Security Administration, and the so-called sister studies conducted almost identically in many countries (including in Europe).(3) Multisite surveys are also conducted simultaneously in several regions for more localized analysis of older populations, while cohort data enable researchers to follow individuals and observe their trajectories and health outcomes (George and Ferraro, 2016). The *Handbook* also describes recurring problems linked to economic and climate crises, socio-economic inequalities, changing inter- and intragenerational relationships, and the challenge of adapting societies to the needs of an ageing population (innovation, public policy, health, and social protection). The progress achieved is promising but still insufficient, notably due to the lack of exhaustive data on the oldest populations. The importance of addressing multiple questions on population ageing today goes hand in hand with a crucial need to develop new data sources and indicators as the limits of existing tools become ever more evident.

(3) In Europe, the Survey of Health, Ageing, and Retirement in Europe (SHARE) was launched in the early 2000s. It is conducted every 2 years on a sample of respondents aged 50 and over, with a fraction of the sample being followed over time to permit longitudinal analysis. A consortium coordinates the surveys across Europe and ensures data comparability across countries. The data collected covers health, disability, and living conditions. A retrospective module provides data to analyse the determinants of ageing conditions from a life course perspective (http://www.share-project.org/home0.html).

While it is necessary to distinguish between population ageing and individual ageing, defined here as the set of processes associated with increasing age, starting at birth, the two phenomena are closely related. To understand population ageing, we must first master the biological processes that underlie changes in physiological resources and reserves, disease onset and the capacity to recover, functional decline, and individual length of life. We must also have information on the occupational, social, family, and residential trajectories that are partly determined by living conditions in childhood and that shape the stages of older adult life. These processes and trajectories are closely interlinked, both with each other and with the demographic transitions. They may also lead to severe vulnerability in old age when individuals' resources and reserves have been exhausted by past living conditions (Grundy, 2006).

At the country and world levels, the leading question concerns the future size of the older adult population, as this will have major implications for the organization of society. Population projections are key to planning for the needs of older people but become less accurate as time horizons become more distant: future trends will depend on the demographic behaviours of the younger generations and those yet to be born—it is hardly straightforward to predict patterns of fertility or migration. Some of the uncertainty about the future also has to do with changes in life expectancy. What are the limits of human longevity?

Another question concerns the future living conditions of the older generations, from retirement up to the most advanced ages. Their future health status is the most frequently mentioned issue of concern, prompting a tendency towards medicalization and 'geriatrization' of the ageing question. The onset of dependence (daily need of assistance), related to disabling diseases of old age, is also a high-profile research topic, be it to analyse prevention strategies or the organization of care.

Health is not the only issue at stake. It is also important to ask questions about the family situations that will accompany these changes. Will we live longer alone or with others? New trends in life partnerships and fertility are modifying family trajectories, and hence the situations of older adults. The composition of older households is evolving as a result. On the one hand, the rise in male life expectancy (more rapid than that of women in recent years) is increasing the probability for women of reaching age 65 with a partner and of ageing as a couple; on the other, the greater frequency of union dissolution is increasing the likelihood of living alone, especially for women, who repartner less frequently than men. These changes have also affected intergenerational bonds, leading to new dynamics in personal relationships, mutual support, and even mutual dependence. Intergenerational financial transfers, at the scale of the family or of society, are also strongly affected by demographic change, and children inherit from their parents at ever later ages.

A final question concerns the impact of ageing on working careers, material and economic circumstances, and retirement. Longer life expectancy, more time spent in education and training, and a declining ratio of the older population over the working population are raising questions about retirement age, the ageing of the working population, and the capacity of older workers to remain in employment, especially those with physically demanding jobs. How should our systems of social protection be adapted to offer a sustainable response to these changes in work, health, family, and unions?

This need for knowledge is rendered even more imperative by the growing heterogeneity of the older adult population. The situations of people reaching old age are becoming more varied as the paths into this lengthening phase of the life cycle grow increasingly diverse. This older adult population is made up of several generations, each with different individual and collective histories, and each shaped by practices and norms (in health or dietary behaviour, for example) that have changed substantially and whose impact on needs and resources may vary from one cohort to the next.

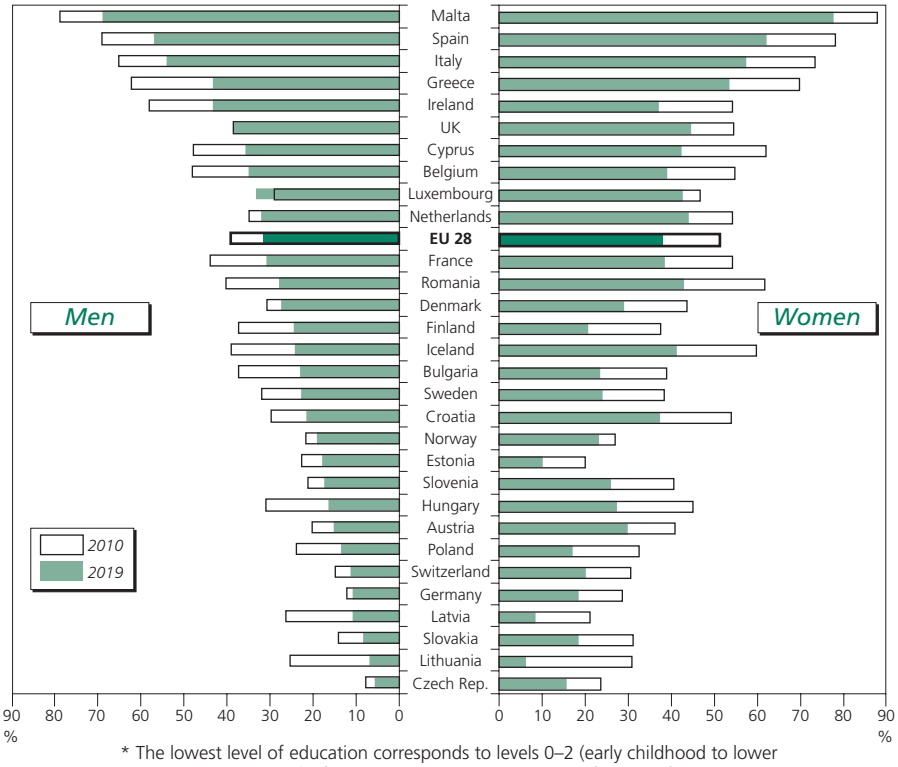
The expansion of education is a striking example of the social evolution of the older adult population. Their mean level of education has increased in all EU countries and, consequently, the share of low-educated people has fallen everywhere, although levels vary considerably by sex and country (Figure 1). At the scale of the 28 EU member countries, among people aged 55–74, it fell from 39% in 2010 to 32% in 2019 for men, and from 51% to 38% for women. This progress has occurred alongside an overall increase in the mean level of education, leading to improved living standards and better health.

Against this backdrop, researchers in the human and social sciences are seeking to shed light on the multiple facets of population ageing and its implications.

2. Measures of population ageing in high-longevity countries

A population is considered ageing when its age composition is modified over time by an increase in the proportion of older adults (Calot and Sardon, 2000). To measure this process, we must first define what is meant by an 'older adult'. Traditionally, an individual is considered old when his/her chronological age reaches a fixed age chosen by convention and which varies according to the type of study or analysis. Age 60 or 65 is generally taken as a threshold value, or sometimes 80 or 85 when focusing on the oldest-old; but other approaches allow this threshold age to evolve so that the major changes in living conditions over the decades can be taken into account. We will begin by illustrating the dynamics of this increase in the older adult population using the conventional threshold of 65 years, before moving on to describe the different measures of ageing.

Figure 1. Percentage of the population with the lowest educational level* among people aged 55–74 in 2010 and 2019 in 30 European countries (ranked in increasing order of percentage for men in 2019)



* The lowest level of education corresponds to levels 0–2 (early childhood to lower secondary education) of the International Standard Classification of Education.

Source: Eurostat, based on European Labour Force Survey data.

A rapidly increasing older adult population

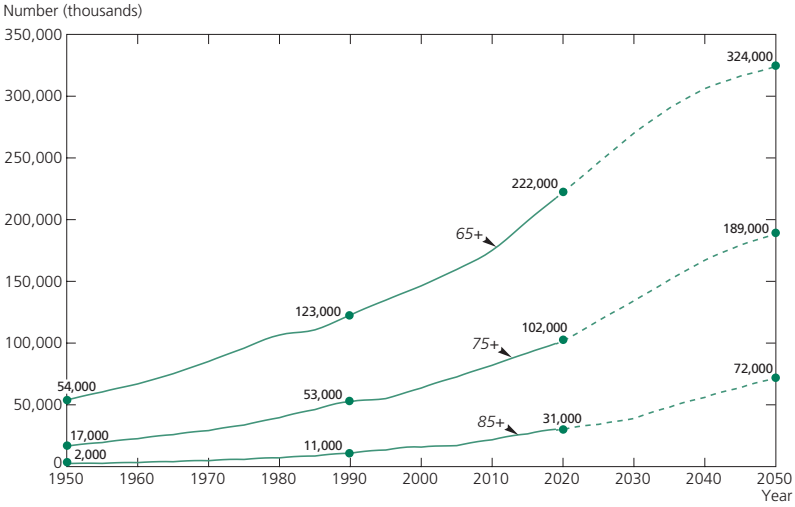
In developed countries, 4 times more over-65s in 2020 than in 1950

Across the 40 countries in our sample, there were almost 4 times more people aged 65 or older in 2020 than in 1950. Their number increased from 54 million to 222 million over the period (Figure 2). The over-85s were 15 times more numerous, increasing from 2 million to nearly 31 million. This growth, sometimes referred to as gerontogrowth, will continue to accelerate until 2050. Under the United Nations medium projection (United Nations, 2019b), the 40 countries of the sample will have almost 324 million over-65s and nearly 72 million over-85s in 2050 (Figure 2).

Components of the numerical increase in older adults

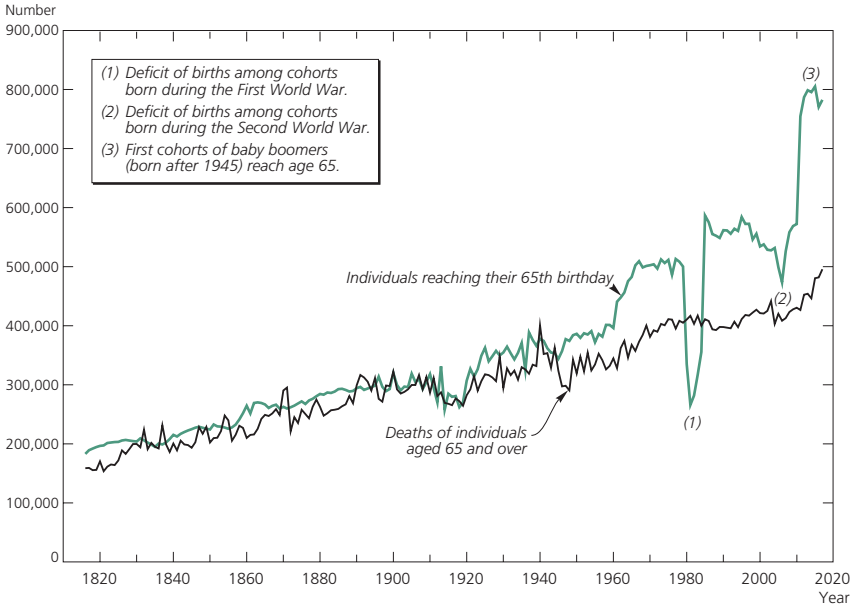
Given that dynamics of population ageing are governed partly by the size of the birth cohorts reaching old age, it is important to distinguish inflows and outflows, as is the case when calculating net population change. Figure 3 shows

Figure 2. Increase in numbers of over-65s, over-75s, and over-85s from 1950 to 2050 in 40 high-longevity countries



Note: Beginning in 2020, projections are based on the United Nations medium scenario (dotted lines).
Source: Authors' calculations based on United Nations (2019b).

Figure 3. Components of annual increase in the population aged 65 and over (excluding migration) in France, 1816–2017



Source: Authors' calculations based on data for France in the Human Mortality Database (2019).

the numbers of individuals reaching their 65th birthday and the numbers dying after age 65 in France from 1816 to 2017. Not counting migration flows, the difference between the two curves corresponds to the annual increase in the older adult population. Until the mid-20th century, inflows and outflows followed a parallel pattern, and for 150 years (between 1816 and 1966) the number of older adults increased steadily by around 25,000 per year. If we ignore the birth deficits due to the two world wars, the 1960s marked the beginning of a period of more sustained increase in inflows among the oldest adults, reflecting a marked decrease in mortality before age 65 in the cohorts born from the late 19th century onwards (Meslé and Vallin, 1989).(4)

Between 1967 and 1979, when the depleted cohorts born in the decades around the First World War reached age 65, the older adult population grew at a rate of close to 110,000 per year. This growth continued between 1985 and 2010 at an annual rate of nearly 140,000. After 2011, the effects of lower mortality among the cohorts born 65 years earlier, combined with the 65th birthdays of the first cohorts of baby boomers (born after 1945), led to a population explosion of older adults in France; excluding migration, their number increased by 324,500 in 2015 alone. In that same year, their number grew by 1.5 million in the United States and by 830,000 in Japan (Table 1). This growth is an important factor to consider for the planning of needs and infrastructure, as more people are entering the older adult population than are leaving it.

Traditional approaches

A growing proportion of over-65s but very different national dynamics

An ageing population is not defined simply by an increase in the absolute number of older adults. It is the increase in older adults relative to the whole population that determines the rate of ageing.

The most widely used international statistics generally use the threshold of 65 years to compare countries and monitor national trends. In the 40 countries of our sample, the share of over-65s, which stood at just 8.0% in 1950, was estimated at 19.7% in 2020 and, according to United Nations projections (2019b), is set to reach 27.9% by 2050, i.e. more than 1 person in 4. However, while this share will increase in all developed countries over the period 1950–2050, the pattern of change varies from one country to another. In the Asian countries of the sample (Republic of Korea, Hong Kong, Japan, and Singapore), ageing is very rapid over the period; they were the youngest countries in the sample in 1950, alongside those of Southern Europe, but will be

(4) Migration inflows and outflows beyond age 65 cannot be determined precisely as no statistics are available on migration by age. Net migration can nonetheless be estimated as the difference between (a) the annual increase in the population aged 65 and over and (b) a 'pseudo natural increase' after age 65 (number of individuals reaching their 65th birthday minus the number of individuals who died beyond this age). Estimated in this way, migration flows have contributed only marginally to the increase in the older adult population in recent years: an estimated 0.3% in 2015 in France, for example, based on data from the Human Mortality Database (2019).

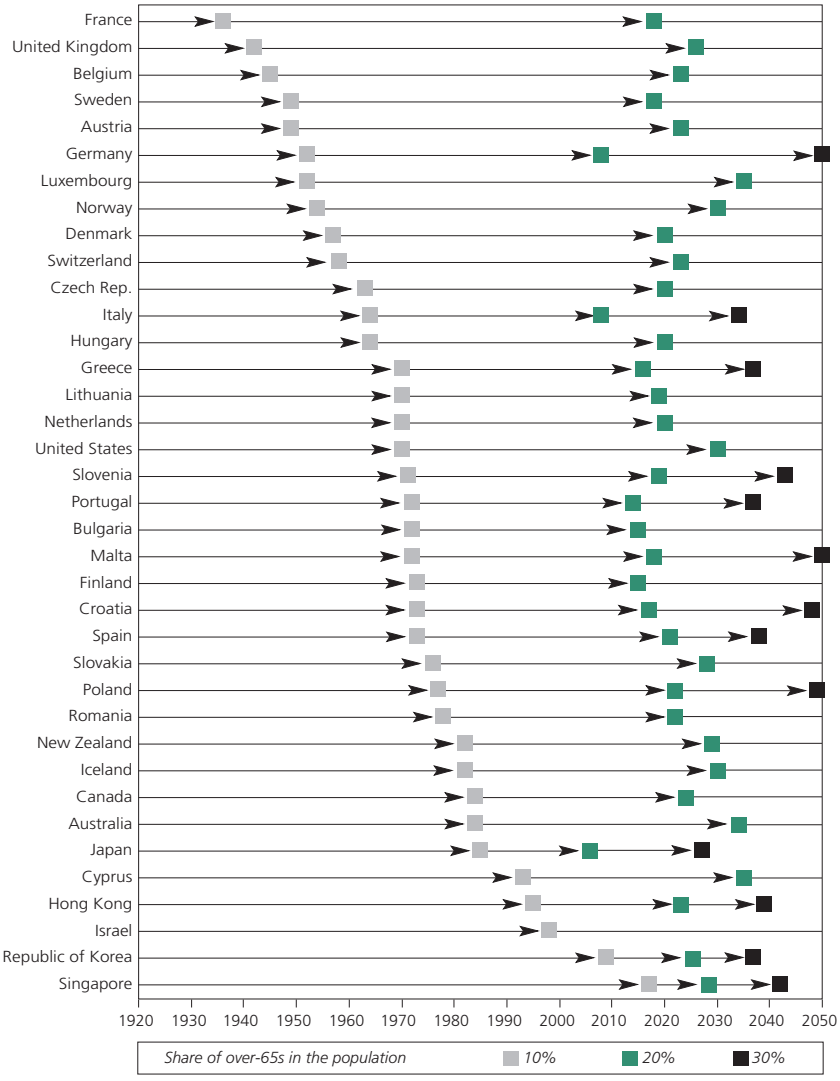
Table 1. Components of the annual increase in the population aged 65 and over in 2015 in 28 developed countries

	Number of people who turned 65 in 2015	Number of over-65s who died in 2015	Net increase in over-65s in 2015 (excluding migration)	Growth rate (%) of over-65s in 2015
Hong Kong	88,000	36,900	+51,100	4.5
Israel	71,800	36,200	+35,600	4.2
Republic of Korea	449,700	205,600	+244,100	3.8
Canada	409,900	210,300	+199,600	3.5
Slovakia	65,500	39,200	+26,300	3.5
Poland	492,500	290,200	+202,300	3.4
Iceland	3,300	1,900	+1,400	3.4
Australia	244,500	128,200	+116,300	3.2
United States	3,488,400	1,992,400	+1,496,000	3.2
Slovenia	27,200	16,100	+11,100	2.9
Finland	75,600	43,900	+31,700	2.9
France	805,000	480,500	+324,500	2.7
Netherlands	202,700	124,100	+78,600	2.6
Japan	1,980,700	1,147,900	+832,800	2.5
Denmark	66,800	43,900	+22,900	2.2
Switzerland	90,200	58,200	+32,000	2.0
Hungary	130,800	100,000	+30,800	1.8
Sweden	114,000	80,000	+34,000	1.8
Portugal	126,500	92,000	+34,500	1.7
Estonia	15,400	11,900	+3,500	1.6
United Kingdom	694,100	509,400	+184,700	1.6
Belgium	126,300	92,500	+33,800	1.6
Austria	91,600	70,300	+21,300	1.3
Spain	468,300	361,900	+106,400	1.2
Germany	999,300	784,400	+214,900	1.2
Croatia	55,100	44,350	+10,750	1.2
Latvia	23,100	21,500	+1,600	0.4
Lithuania	33,000	31,200	+1,800	0.3

Notes: The estimated numbers have been rounded to the nearest hundred. Countries are ranked by the over-65s growth rate. This rate corresponds to the ratio between the net increase in over-65s (excluding migration) and the mid-year population aged 65 and over.
Source: Authors' calculations based on country data in the Human Mortality Database (2019).

the oldest in 2050. The dynamics of different countries can be compared by measuring the time taken by the share of over-65s to rise from one level to the next (Pison, 2009). Figure 4 illustrates this approach for a selection of 37 countries, showing the time taken for the share to increase from 10% to 20% and from 20% to 30%. Some countries, such as France, the United Kingdom, Belgium, and Sweden, already had a share above 10% by the late 1940s and will probably not reach 30% until more than a century later. Conversely, population ageing began much later in other countries, but is advancing much

Figure 4. Speed of population ageing from 1930 to 2050 in 37 developed countries (population projections beyond 2019)



Note: Data from the Human Mortality Database do not go far back enough in time to determine the year when the share reached 10%. Countries are ranked in increasing order by year in which the share of over-65s reaches 10%, 20%, and 30% of the total population.

Sources: Authors' calculations, based on United Nations (2019b) and Human Mortality Database (2019).

more quickly. According to the latest United Nations projections, in the Republic of Korea and Singapore where the share of over-65s was below 10% in 2010, it is set to reach 30% by around 2040 within just 30 years.[5]

(5) For each of the 40 countries, Appendix Table A.1 gives the change in the share of over-65s and over-85s between 1950 and 2050.

Changes in age structure: population pyramid and age-specific rate of numerical increase

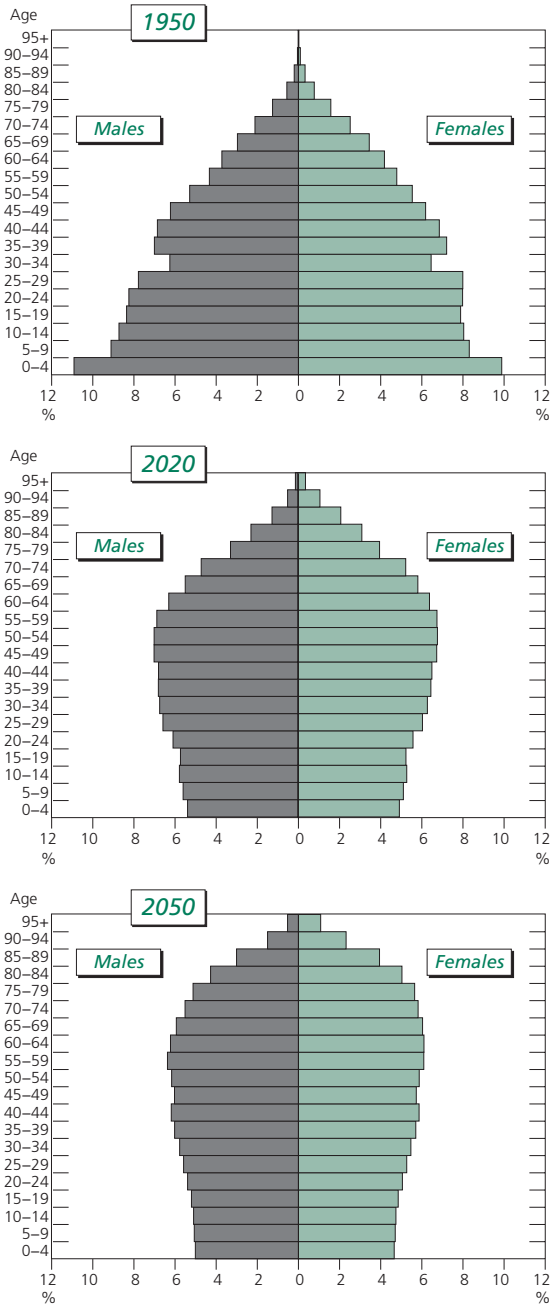
Population pyramids are becoming increasingly top-heavy over time, and they reveal the singular patterns of baby booms and baby busts across birth cohorts in each country. For all 40 countries, from 1950 to 2020 and then from 2020 to 2050, the pyramid grows narrower at its base (ageing from the bottom) and wider at the top (ageing from the top), shifting gradually from a triangle into a chimney shape (Figure 5).

Figure 6 illustrates the striking contrast between France, the oldest country in 1950 (11.4% of over-65s), and the Republic of Korea where, alongside Hong Kong and Singapore, the proportion of over-65s was below 3% at that time. According to the United Nations, ageing in the Republic of Korea will accelerate over the coming years, such that in 2050, its population will be the oldest by far (38.1%). France should occupy an intermediate position in that year (27.8%; Appendix Table A.1).

As mentioned earlier, the substantial growth—although heterogeneous from one country to another—in the absolute and relative numbers of older adults is linked to country-specific patterns of births, deaths, and (often to a lesser extent) migration flows (Parant, 1992; Calot and Sardon, 1999) (Box 2). The effects of demographic dynamics are difficult to tease apart because these three factors interact in ways that change over time. A peak in births will rejuvenate the population initially, before ageing it when the large birth cohorts reach old age. Likewise, when a large cohort reaches age 65, it first rejuvenates the population of older adults, before having the reverse effect, known as 'ageing within ageing'. It is vital to anticipate these waves of peaks and troughs (absolute and relative) in numbers of (very) old people in order to plan for future needs and maintain equilibrium in labour markets, pension systems, health, and long-term care.

Changes in age structure can also be illustrated by the age-specific rate of numerical increase (Figure 7). From 1950 to 2020, the population of the 40 countries in the sample increased at a mean annual rate of 0.73%, but this figure varies substantially by age group, from just 0.06% for the under-25s to 0.87% for the 25–64 age group, 1.89% for the 65–84 age group, and 3.55% for the over-85s. Under the United Nations medium scenario, these differences will be even more pronounced by 2050, with a population decline among the under-65s (–0.27% per year on average between 2020 and 2050) and an increase among the over-65s (+1.19%). The baby boom cohorts are now reaching old age, and as they die, they will progressively be replaced by the smaller cohorts that follow them. In the countries studied here, this means that the growth rate of the older adult population will slow down over coming decades. These rates will apply to ever larger populations, however, so the numbers of older adults will continue to increase at a rapid pace.

Figure 5. Population pyramids (%) of the 40 high-longevity countries in 1950, 2020, and 2050



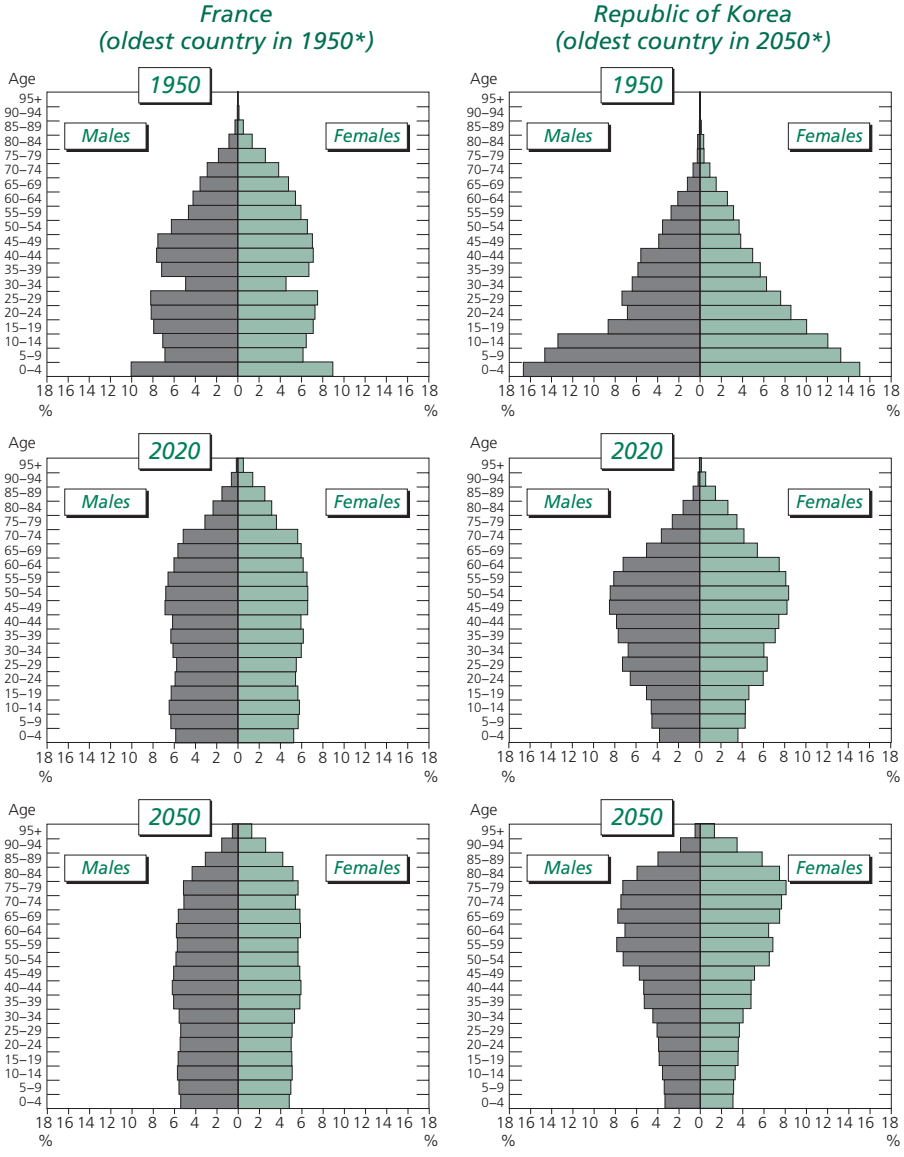
Age group (years)	Males (%)	Females (%)
0–14	28.8	26.2
15–64	64.1	65.0
65+	7.2	8.7
85+	0.3	0.4

Age group (years)	Males (%)	Females (%)
0–14	16.7	15.4
15–64	65.7	62.9
65+	17.6	21.7
85+	1.9	3.5

Age group (years)	Males (%)	Females (%)
0–14	15.2	14.1
15–64	58.9	56.0
65+	25.9	29.9
85+	5.0	7.3

Note: The projections for 2020 and 2050 are based on the United Nations medium scenario.
Source: Authors' calculations based on United Nations (2019b).

Figure 6. Population pyramids (%) of France and the Republic of Korea in 1950 and 2020 and projections for 2050



Age group (years)	1950		2020		2050	
	M (%)	F (%)	M (%)	F (%)	M (%)	F (%)
0–14	24.0	21.5	18.6	16.7	16.7	14.9
15–64	66.6	65.2	62.8	60.4	57.9	55.1
65+	9.4	13.2	18.5	22.8	25.4	30.1
85+	0.3	0.7	2.3	4.4	5.2	8.1

Age group (years)	1950		2020		2050	
	M (%)	F (%)	M (%)	F (%)	M (%)	F (%)
0–14	44.7	40.3	12.9	12.2	10.3	9.5
15–64	52.9	56.3	73.5	69.8	54.9	49.3
65+	2.4	3.3	13.6	18.0	34.8	41.3
85+	0.1	0.2	0.8	2.2	6.3	10.6

*Based the criterion of the share of people aged 65 and over in the population.

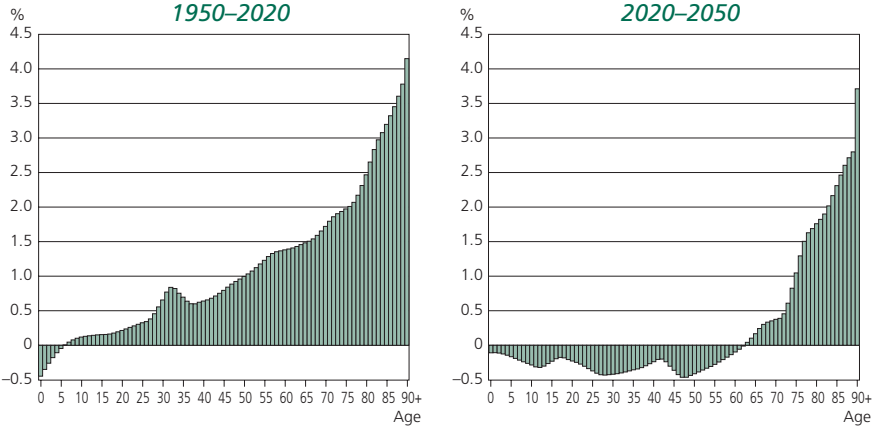
Note: The projections for 2020 and 2050 are based on the United Nations medium scenario.

Source: Authors' calculations based on United Nations (2019b).

Box 2. Contribution of fertility, mortality, and migration to population ageing: the example of France

Calot and Sardon (1999) examined the roles of fertility, mortality, and migration in population ageing in France in the second half of the 20th century. High fertility during the post-war economic boom led to a rejuvenation of the population between 1946 and 1974. Fertility then started to decline, with a total fertility rate of 1.8 children per woman on average between 1975 and 1995, versus 2.7 between 1946 and 1974. This led to a trend reversal which, according to Eurostat projections at that time, would result in population ageing from 2006 as the baby boom cohorts progressively entered their 60s. The effects of mortality reduction differ across age groups. The mortality gains before age 60 since the 1950s have contributed to population rejuvenation, and those after 60 to ageing. With the growing contribution of reduced mortality beyond age 60 to gains in LEB (from 11% for females between 1946 and 1955 to 74% between 1986 and 1995, for example), mortality reduction became the main driver of population ageing during the second half of the 20th century. Migration has helped to rejuvenate the French population since the 1950s, but its impact remains modest.

Figure 7. Mean annual rate (%) of numerical population increase by age group in the 40 high-longevity countries between 1950 and 2020 and projection for 2020–2050



Source: Authors' calculations based on United Nations (2019b).

Summary indicators of population ageing

These trends can be summarized by several measures of central tendency (Table 2). One such measure is the mean population age. Over a century, it will increase in the 40 countries by 14.7 years, rising from 31.2 years in 1950 to 45.9 in 2050. Quantiles are used to identify changes in the age structure, and they show that the increase in mean age over the period is due mainly to growing numbers of older adults.(6) The first quartile is forecast to increase by slightly more than 10 years over the period 1950–2050, and the third quartile by 20 years.

(6) Quantiles are values that divide a data series into intervals with identical numbers of items. Quartiles divide a population into four groups, each containing 25% of individuals. Deciles follow the same logic, dividing the whole into 10 groups of identical size.

Table 2. Summary indicators of population ageing in the 40 high-longevity countries, 1950–2050

	1950	1990	2020	2050
Measure of central tendency (years)				
Mean age	31.2	35.7	41.8	45.9
1st decile	4.8	7.5	9.5	10.3
1st quartile	13.5	18.2	23.1	24.1
Median	28.9	34.1	42.4	45.9
3rd quartile	47.4	52.7	60.8	67.4
9th decile	62.3	67.9	73.9	80.9
Relative share of older adults in the population (%)				
Percentage aged 65+	8.0	12.6	19.7	27.9
Percentage aged 85+	0.4	1.1	2.7	6.2
Old-age dependency ratio [(a)]	12.4	18.8	30.6	48.7
Ageing index [(b)]	22.5	45.3	91.6	141.6

(a) Number of people aged 65+ per 100 adults aged 15–64.
(b) Number of over-60s per 100 under-20s.
Interpretation: In 2020, the mean age of the population of the 40 developed countries was 41.8 years; 10% of individuals were under age 9.5, a quarter under 23.1, half were under 42.4, a quarter over 60.8, and 10% over 73.9.
Source: Authors' calculations based on United Nations (2019b).

The most common method uses indicators that measure the relative share of older adults in all or part of the population, such as the share of over-65s, the share of over-85s, etc. But other proportional indicators exist, such as the ageing index (the ratio of older adults to young people; for example, the ratio of over-60s to under-20s, as used by Sauvy [1944]) or the old-age dependency ratio (the ratio of older adults to the working-age population), a measure frequently used to study the impact of ageing on pension systems.[(7)] Whether expressed as a percentage of the under-20s, the 15–64 age group, or the population at large, the proportion of over-65s has increased sharply since 1950 in all 40 countries. The old-age dependency ratio, for example, which stood at 12.4 over-65s per 100 people aged 15–64 in 1950, had risen to 30.6 in 2020 and is projected by the United Nations to reach 48.7 in 2050. Appendix Table A.4 gives the old-age dependency ratio and median age for each of the 40 countries between 1950 and 2050.

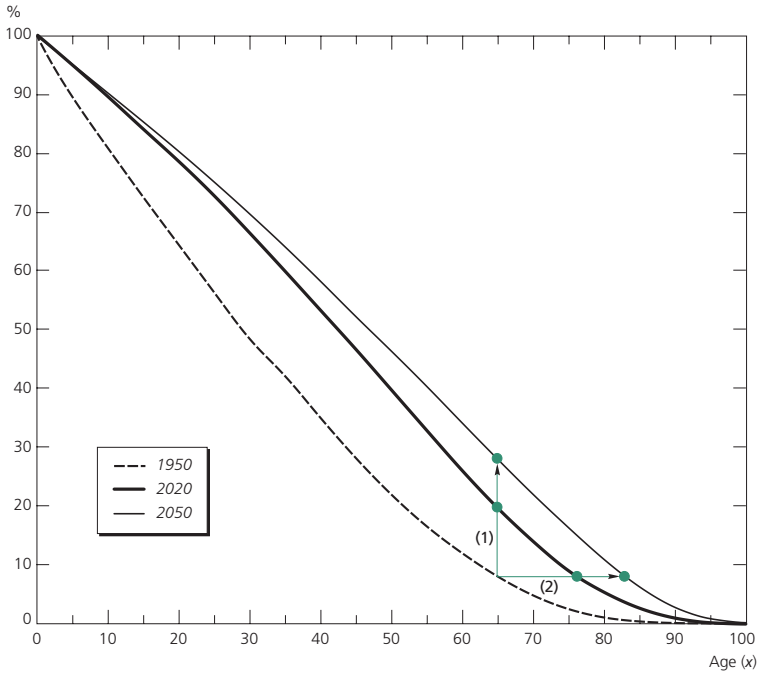
All these indicators provide confirmation of population ageing. This is illustrated in Figure 8, which shows for each age (*x*-axis) the proportion of individuals older than this age (*y*-axis) in 1950, 2020, and 2050. We can see, for example, that the share of over-65s increases from 8.0% in 1950 to 19.7% in 2020 and to 27.9% in 2050. But the growing proportion of older adults is visible whatever the starting age: the curve for 1950 is always below that of 2020, which is below that of 2050. The choice of an age threshold (60, 65, 70, 75 years), sometimes criticized for its arbitrariness, would have no impact on

(7) There are a number of conventions for the age groups used to calculate the old-age dependency ratio. Here, we use the most commonly used ratio of the population aged 65 and over to the population aged 15–64.

the observed trend. Whatever the indicator used, ageing is a reality and will be relatively rapid in all 40 countries up to 2050.

More importantly, the use of a fixed age to determine the onset of old age ignores the impact of improvements in health and life expectancy. Alternative measures of population ageing have been developed to consider these factors.

Figure 8. Proportion of individuals aged *x* and over in the 40 high-longevity countries in 1950, 2020, and projection for 2050



Interpretation: (1) The share of over-65s rose from 8% in 1950 to 20% in 2020 and is forecast to reach 28% in 2050. (2) In 1950, 8% of the population was over 65 years old; in 2020, this proportion corresponds to the population aged 76.3 and over, and in 2050 to the population aged 83 and over (homologous age).
Source: Authors' calculations based on United Nations (2019).

Alternative approaches

The choice of the reference age above which a person enters the statistical category of older adults partly shapes our perception of the increase in the older adult population and our attitude to the economic and social challenges that this entails. This is especially true in a context where ageing is socially devalued at both individual and population levels (Rincaz, 1998). In this respect, as mentioned above, some authors point out that the most traditional measure of ageing, with a threshold at 60 or 65 years, is contributing to an overly negative perception of demographic changes (Sanderson and Scherbov, 2008). New approaches to population ageing have been developed, in some cases offering a more nuanced vision. They all challenge the idea of a fixed age of onset of old age, unchanging across time and space.

Homologous age

Alternative measures of ageing adopt a relative approach, rather than a definition linked to a fixed age. Individuals enter the older adult category when, for example, their age places them among the oldest 20% of the population. Under this definition, as pointed out by Ponthière (2017), 'being old' means 'being older than'. A first approach proposed by Calot and Sardon (1999) looked at population ageing using what they call homologous age. They defined a proportion of older adults that remains fixed over time and examined changes in the age at which this proportion is reached in a given population. For example, in 1950, 8% of the people in our sample of countries were aged 65 or over (Figure 8). By 2020, this proportion is reached at age 76.3 and in 2050 at 83.0. Thus, homologous age increases from 65 years in 1950 to 83 in 2050 (Figure 8). Appendix Table A.5 provides homologous ages for each of the 40 high-longevity countries. The increase in this age illustrates population ageing 'in the vicinity of age 65' (Calot and Sardon, 1999). Ageing is thus measured as a number of years and corresponds to the horizontal distance between the points of each curve with the same *y* value (8%, for example, if we are interested in ageing 'in the vicinity of age 65'). By symmetry, population ageing analysed through changes in the share of older adults in the population is measured by the vertical distance between the points of each curve having the same *x* value (65 years, for example). This measure via homologous age has the advantage of quantifying population ageing in numbers of years. However, a specific time-invariant quantile of the age distribution must be chosen (8% in our example), along with a specific and time-invariant age (generally 65 years), to use this indicator of the share of older adults in the population (Figure 8).

Threshold age of a variable age category

A relative conception of age is used by d'Albis and Collard (2013) to measure population ageing. Under their approach, the age of onset of old age is determined endogenously according to the age distribution of the population as a whole and may vary over time as this age distribution evolves.[8] They apply this approach to the United States for the period 1933–2005. As one might expect, given the age structure of the US population, the age of entry into the last age category increased over the period, from 48.7 years in 1933 to 56.6 in 2005. A 55-year-old would therefore be classified as old in 1933 but not in 2005. Applied to a panel of industrialized countries over the period 1955–2005, this approach views population ageing from a new perspective. It suggests that while the share of older adults is trending upward in Australia, Canada, Iceland, and Italy, no significant ageing is occurring in Denmark, France, Norway, Sweden, the United Kingdom, and the United States. In Austria and Switzerland, the population is

(8) Their method is based on the optimal grouping method whereby individuals in a population are divided into *n* age groups. The cutoff ages for each group are estimated to minimize information loss resulting from the simplification of a detailed age distribution into just *n* groups. See d'Albis and Collard (2013) for further details.

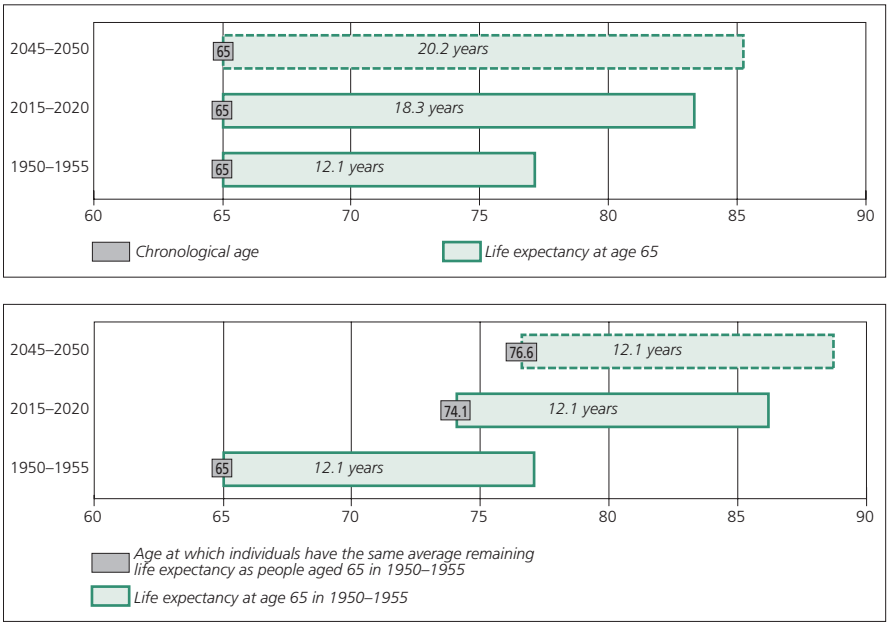
even getting younger. Ageing measured via the age structure of these two countries has been more than offset by the increase in age at onset of old age.

Prospective age, or remaining life expectancy

Ryder (1975) proposed a relative measure of age at onset of old age that depends not on the number of years lived since birth but on years left until death: the 'old' age category comprises individuals who have *x* years of remaining life expectancy on average. This approach to population ageing is based on the idea that individuals aged 65 in 1975 are, in a manner of speaking, younger than those aged 65 in 1950, given that the former can expect to live longer than the latter thanks to improvements in longevity. To use the analogy coined by the economist Victor Fuchs (1984), considering a 65-year-old in 1950 as identical to someone of the same age in 1975 or 2020 would be as meaningless as comparing mean wages in these years without correcting for inflation. Population ageing must not, therefore, be viewed in terms of individuals' nominal age, but rather their real age adjusted for changes in mortality rates.

The most important and widely disseminated contributions to this approach are those of Sanderson and Scherbov (2005). They introduced the concept of prospective age with the aim of capturing a more physiological dimension of individual age that is liable to vary across countries and over time. Figure 9,

Figure 9. Remaining life expectancy of females across the world, chronological age, and prospective age, in 1950–1955, 2015–2020, and 2045–2050



Interpretation: The prospective age of 65 is reached at age 74.1 for females over the period 2015–2020 and at age 76.6 in the period 2045–2050 (based on the reference period 1950–1955).

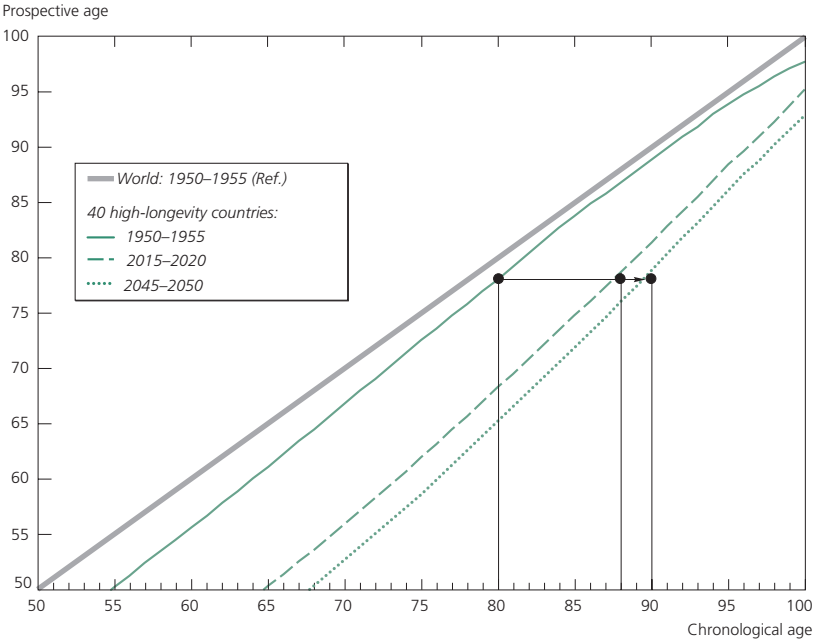
Source: Authors' calculations based on United Nations (2019b).

similar to the one in Sanderson and Scherbov (2008), shows how prospective age differs from chronological age at the global level.

Over the period 1950–1955, female life expectancy at age 65 was 12.1 years worldwide. The top of Figure 9 shows that it has increased considerably since then. This increase represents a rejuvenation of women aged 65, which Sanderson and Scherbov express as a prospective age. The bottom of Figure 9 shows that the age at which women have 12.1 years of remaining life expectancy is 65 years in 1950–1955, 74.1 in 2015–2020, and an estimated 76.6 in 2045–2050. Or stated differently, women aged 74.1 in 2015–2020 and 76.6 in 2045–2050 have a prospective age of 65 (based on the reference period 1950–1955). By analogy with Sanderson and Scherbov's '40 is the new 30', septuagenarians will be the new sexagenarians (Sanderson and Scherbov, 2008).

Figure 10 shows the change in the relation between female chronological age and prospective age from 1950–1955 to 2045–2050 in the 40 developed countries of our sample.(9) Prospective ages are calculated by reference to

Figure 10. Change in the correspondence between female prospective and chronological age in the 40 high-longevity countries, from 1950–1955 to 2045–2050

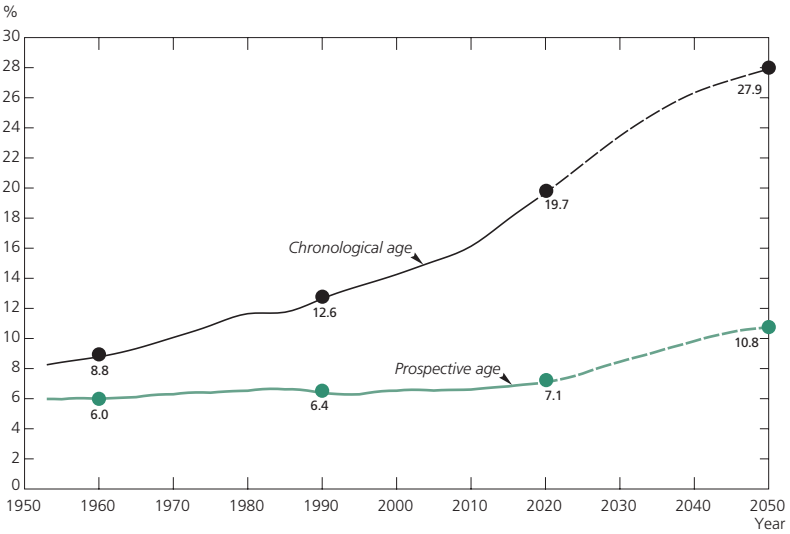


Note: Prospective ages are calculated by reference to global life expectancies in the period 1950–1955.
Interpretation: A woman aged 80 in 1950–1955 could expect to live for the same number of years as a woman aged 88 in 2015–2020 and, according to United Nations projections, as a woman aged 90 in 2045–2050.
Source: Authors' calculations based on United Nations (2019b).

(9) The trends observed in the figure are practically identical for the male population. Appendix Table A.5 shows trends in prospective ages for each of the 40 high-longevity countries.

United Nations estimates of life expectancies in the period 1950–1955 at the global level.[10] Whatever the chronological age, the prospective age in our sample of developed countries is always lower than the global prospective age, reflecting higher life expectancy in these countries than in the rest of the world. The figure also shows a rejuvenation with respect to chronological age between 1950 and 2050. For instance, a woman aged 80 in 1950–1955 could expect to live for the same number of years as a woman aged 88 in 2015–2020 and, according to United Nations projections, as a woman aged 90 in 2045–2050. The prospective age approach gives a much more nuanced picture of ageing than standard measures, as shown in Figure 11 which compares the share of over-65s in the population of 40 countries by prospective and chronological age.

Figure 11. Change in the share (%) of people considered old, by chronological age (65 years) and prospective age in 40 high-longevity countries, 1950–2050



Note: Prospective ages are calculated by reference to global life expectancies in the period 1950–1955. The curve of chronological age represents the change in the proportion of over-65s. The curve of prospective age represents the change in the proportion of people whose remaining life expectancy is below that of a 65-year-old in 1950–1955 at the global level (12.1 years).

Source: Authors' calculations based on United Nations (2019b).

Once life expectancy gains are taken into account in the choice of age at onset of old age, population ageing only becomes perceptible from the 2020s, and its progression is much slower. Before this threshold, the share of people with a prospective age of more than 65 years remains practically stable across the 40 countries. This tendency is the result of two opposing effects created by the increase in life expectancy. The first is an ageing effect, resulting from the numerical increase in older adults (based on year of birth). The second is a

(10) At the global level, over the period 1950–1955, the calculated prospective age is, by construction, equal to chronological age (bisector on Figure 10).

rejuvenating effect via the increase at each age in the average number of years left to live. In the standard approach by chronological age, only the first effect is considered, which explains the trend difference between the two measures.

The prospective age approach could be extended by setting the age at onset of old age on the basis not of years left to live, but rather of the share of LEB left to live.[11] These refinements of the way the threshold age is determined are largely dependent on life expectancy gains. In this respect, the increase in life expectancy is a key component of population ageing in the early 21st century, a topic the next subsection will address.

3. Increasing life expectancy

This subsection describes the increase in life expectancy, the disparities between and within countries, and the trends in causes of death that reflect progress in health, medicine, and social protection. The regular and substantial life expectancy gains in the countries of our sample indicate that a growing proportion of people now live to advanced and even very advanced ages. Over the last 3 decades, increasing numbers of old people have lived to 100 years or more, ages considered unreachable 50 years earlier. While still exceptional, these centenarians and supercentenarians (who have reached their 110th birthday) are becoming less anecdotal and reflect a potential for greater overall longevity. Can longevity be increased even further? By how many years? How many centenarians and supercentenarians will there be in the future?

Life expectancy trends and disparities

Life expectancy at birth

Life expectancy summarizes the mortality conditions observed on a given date. It corresponds to the mean number of years that would be lived by members of a population who, at each age of their life, were exposed to the same average risks of dying as people of the same age observed in year x (estimated from the population size and deaths recorded in that year). It does not provide prospective information on the age at which the members of a population can expect to die; rather, it reflects the mean age at which deaths occurred in a given year. In 2019, global life expectancy was 75 years;[12] it exceeded 80 years in around 20 countries, reaching as much as 88 years for females in Japan and Hong Kong (Pison, 2019). Past life expectancy gains were attributable mainly to a decline in infant and child mortality, while progress in the last 40 years

(11) For example, the threshold of 15 years left to live represents 18% of female life expectancy at birth in France in 2005 and is reached at age 73–74. In 1950, these 15 remaining years represented 22% of female life expectancy, and the threshold was reached at age 64–65. In 1950, 18% of life expectancy corresponded to 12.4 years, and women could expect to live for this number of years when they reached age 68–69. Different approaches can thus be chosen to analyse ageing dynamics, defining old age as either the period beyond a fixed threshold or as a proportion of the total lifespan.

(12) Appendix Tables A.2 and A.3 show trends in life expectancy at birth and at age 65 from 1950 to 2050 in the 40 high-longevity countries.

has been due above all to improved survival at advanced ages.[13] In low-mortality countries, more than 1 in 10 deaths occur after age 90, compared with 1 in 33 in the 1950s.

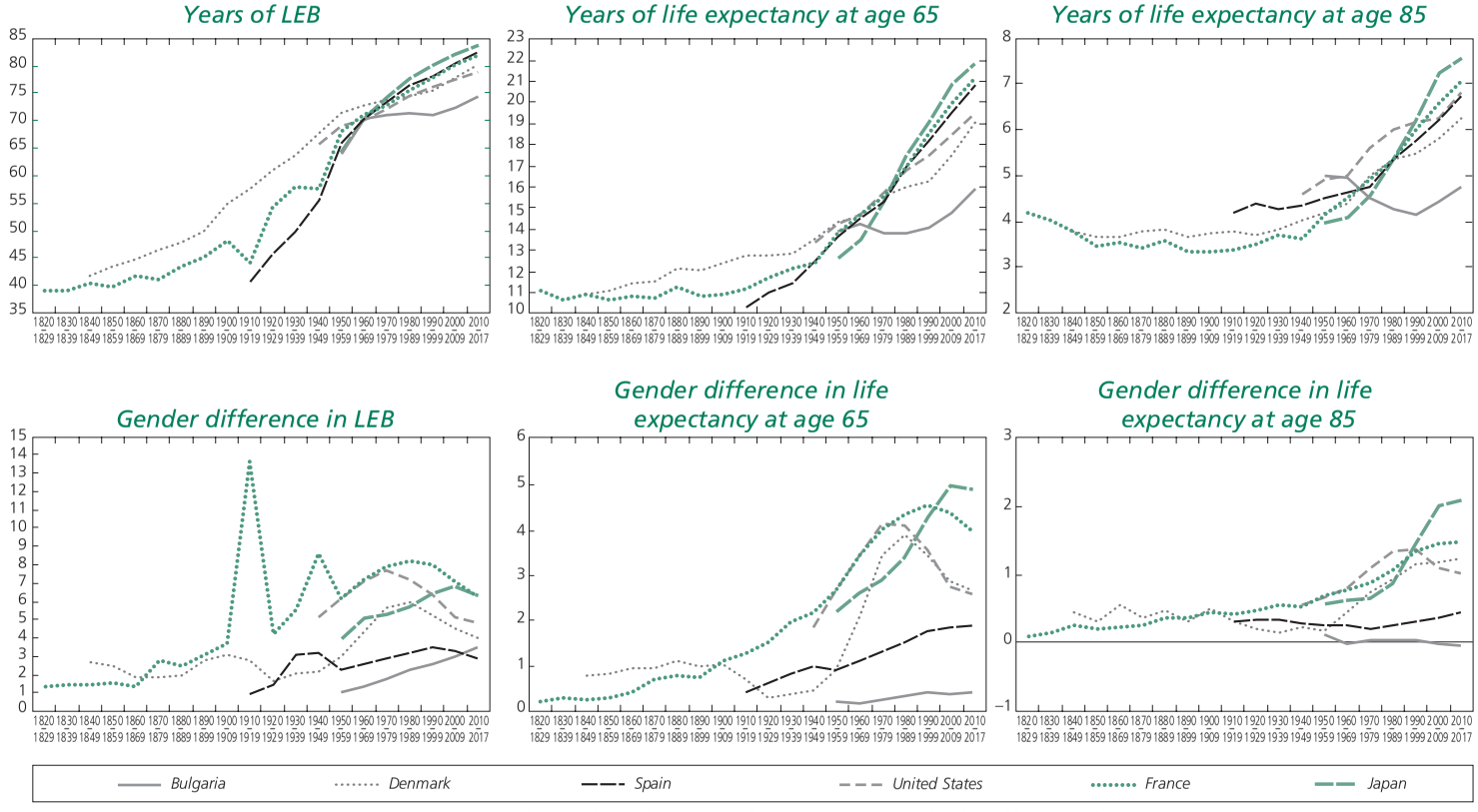
Figure 12 illustrates the diverse range of trends in the 40 countries of our sample. It shows LEB and at ages 65 and 85 in Bulgaria, Denmark, Spain, the United States, France, and Japan, chosen because of their distinctive situations. Excepting the fluctuations related to the two world wars, especially visible in France, LEB has increased steadily across decades in Japan, France, and Spain and has exhibited the highest values since the 1970s. In France, LEB has doubled since the late 19th century, rising from around 40 years for both sexes to 85 for females and 80 for males in the late 2010s. Life expectancies at age 65 in France stagnated throughout the 19th century (at around 11 years), then rose rapidly, reaching 14 years in 1950 and 21 years in 2015. Progress at age 85 began later, rising from 4 years in 1950 to 7 years in the first decades of the 21st century. Japanese life expectancy at age 65 has increased at a remarkable pace. It has ranked highest in the world since the 1980s, reaching 22 years in the period 2010–2017, despite tailing off slightly in recent years. Starting from relatively low LEB in the 1910s, Spain has caught up with the leaders and now ranks close to Japan and France. The pattern in the United States is different. While very similar to France and Spain in the 1950s, gains in LEB and at age 65 have been smaller since the 1980s. In Denmark likewise, where life expectancy was higher than that of many other countries from the mid-19th to the mid-20th century, progress also began slowing from the 1950s. Consequently, Denmark ranks behind the United States in the early 21st century, despite a narrowing of the gap in recent years. In Bulgaria, LEB stood at 74.5 years in the 2010s, a relatively low level with respect to other European countries. It stagnated between the 1960s and 1990s, a period of high mortality at working ages and among older adults. Life expectancy at age 85 fell by almost a year during these decades, although progress resumed between 2000 and 2010. Variations among the countries in our sample reflect differences across space and time in living and working conditions and in healthcare and social protection. Large mortality differences are still observed today between these record longevity 'pioneer' countries and many countries of Eastern Europe (McMichael et al., 2004).

Survival disparities beyond age 65 by sex…

Females have longer life expectancy than males in the countries of our sample, with a few rare exceptions (such as life expectancy at age 85 in Bulgaria). However, the gender gap has been narrowing everywhere in recent years. The gender difference in LEB is very large in France, despite a recent improvement.

(13) While mortality below age 65 is low in many countries, further reduction of these premature deaths can still be expected. Partly avoidable mortality related to risk behaviours or inadequate healthcare should decrease in coming years.

Figure 12. Life expectancy at birth, at age 65 and age 85 (both sexes) and gender gap in 6 countries, 19th–21st centuries



Source: Human Mortality Database, data extracted in August 2020, graphs plotted by the authors.

As shown in Figure 12, it fell from around 8 years in the 1980s to 6 years, as in Japan, in the 2010s. At advanced ages, the gender gap increased sharply in the 20th century, from the 1950s especially. The gender gap at age 65 started narrowing in the 1980s in Denmark and the United States, in the 1990s in France, and in the early 2000s in Japan. It is very small in Spain (2 years at age 65), where life expectancies for both sexes are among the highest in Europe, and narrower still in Bulgaria, where they are among the lowest.

The female advantage is explained partly by distinct physiological traits that protect and expose males and females differently. But it also reflects pronounced differences in practices that increase or reduce exposure to health risks. The decrease among men in risk practices, such as smoking and drinking, and their adoption of healthier practices (prevention, diet, etc.), as women had already done before them, has helped to narrow the gender gap in life expectancy. At the same time, female exposure to certain health risks has increased. This is notably the case for smoking, which, while remaining below the high levels once observed among men, is an issue of concern today.

… and social status

While most research on differential mortality by social status concerns the working-age population for reasons of data availability, some studies focusing on older adults have revealed substantial life expectancy differences at advanced ages.[14] A study in Great Britain, for example, showed that in the years 2007–2011, life expectancy at age 65 was 4 years higher for males (3 years for females) among the former most qualified workers than among the former least qualified workers and that these differences did not narrow over the period (White, 2015).

Social inequalities of life expectancy at age 65 partly reflect individual histories of exposure to health risks and differences in healthcare. They may be due, for example, to a lack of resources (poverty), environmental exposure (pollution, poor sanitation), detrimental working conditions, deprivation and insecurity (financial, occupational, etc.), health risk practices, and lack of access to appropriate care. All these factors are prejudicial to health and are linked to social status (income, occupation, education, social background) (Marmot et al., 2008).

Life expectancy differences across social groups become narrower at advanced ages, in absolute values. This was sometimes interpreted as a selection effect of the most robust individuals with age that weakens the impact of social status on mortality risk among those who have survived to old age. But the mortality differences, both persistent and large in relative values, also suggest that if such selection exists, it does not entirely efface all inequalities, which

(14) While data sources improve over time, it remains difficult to measure these inequalities and make cross-country comparisons, particularly at advanced ages, due to the difficulty of stably measuring social status based on the available variables (level of education, occupation, etc.) and because the mortality data sources of many countries do not mention any social status variables (Mackenbach et al., 2015; Menvielle et al., 2015).

remain difficult to explain due to a lack of data for these ages (Jylhä and Luukkaala, 2006). These studies also reveal that social inequalities in life expectancy are greater for males. It is likely, however, that occupation or educational level (the most widely used criteria) are less revealing of critical social situations for females than for males. Occupation and educational level provide a more accurate representation of household living conditions for men than for women, at advanced ages especially. When social criteria more directly representative of women's living conditions (such as household income) can be used, much larger mortality inequalities are found in the female population.

Is there a limit to human longevity?

Life expectancy gains at advanced ages increase the number of very old people in the population. According to the United Nations, the world population of centenarians rose from 45,000 in 1980 to 573,000 in 2020, of whom 312,000 in the 40 countries of our sample. To anticipate future changes in the population and its needs, it is crucial to explore human longevity and potential life expectancy gains. In demography, longevity can be studied by observing maximum life expectancies and the numbers of people who reach exceptional ages, and by analysing survival probabilities beyond age 100.

Change in maximum life expectancy

One way of determining whether further life expectancy gains are still possible for a given population is to observe the records of life expectancy and human longevity, which provide an indication of future survival 'reserves'. Progress in LEB is tracked via the annual records achieved by females: the countries who hold these records are considered 'pioneers'. According to statistical records, eight countries were record holders between 1840 and the 2000s, starting with Sweden, followed by Norway, then Australia, and Norway once again. From the 1960s, Iceland, the Netherlands, and Switzerland joined this vanguard group. From the 1980s, these countries were overtaken by Japan—still the world reference 40 years later with a female LEB of 87.5 years in 2019 (Oeppen and Vaupel, 2002).

The curve of maximum life expectancies shows clear sequences characterized by the pace of gains in years of life (Vallin and Meslé, 2009). A first period of increase (1790–1885) corresponds to the development of the first vaccines and to the decrease in deaths from famine and infectious diseases (trends in causes of death will be detailed later). This period was followed by an acceleration of gains thanks to medical discoveries and notable improvements in health and social protection from the late 19th century (urban sanitation, primary healthcare, disease prevention). Lastly, the gains achieved since the 1960s reflect the impact of the cardiovascular revolution. Whatever the countries considered (depending on the nature and quality of available data), all studies point to a reserve of life expectancy gains.

The maximum values reached indicate the scope for future progress in countries with still a long way to go (Jasilionis et al., 2014); they highlight the lack of progress in some countries and, in others, the potential for a convergence of mean and maximum life expectancies. Analyses have also focused on 'second-best' countries in life expectancy, such as Switzerland in the 1980s, France up to 1995, and Spain since then (Meslé and Vallin, 2019), to identify challengers with the potential to overtake Japan in the coming decade. These countries include the Republic of Korea, which will probably soon join the ranks of the pioneer countries thank to its rapidly increasing life expectancy.

Over-90s, centenarians, and supercentenarians

According to the United Nations (2019), the number of centenarians in the world, which stood at 150,000 in 2000, reached 573,000 in 2020 (78% women, 22% men), of whom 46% are in Asia, 22% in Europe, and 18% in the United States (312,000 in the 40 countries under study). While these figures sound spectacular, they reflect a minute part of overall population ageing from the top of the pyramid. From 8 million worldwide in the early 2000s, the number of over-90s topped 21 million in 2020, of whom 69% were women, and is set to reach more than 76 million by 2050, according to United Nations projections. Across the 40 countries in our sample, this represents an increase in the share of over-90s from 1% of the population in 2020 to 2.7% in 2050. This proportion is forecast to double or triple between 2020 and 2050 in each of the 40 countries, except the Republic of Korea and Singapore, where the share of over-90s will be multiplied by 5 and 9, respectively. In Japan, the proportion of over-90s will be the highest (1.8% in 2020 and 4.7% in 2050). It is difficult to accurately predict future numbers of very old people, however (Robine and Cubaynes, 2017); the margins of uncertainty are linked, among other things, to the difficulty of measuring mortality at these advanced ages. The International Longevity Database, which includes a large volume of data on people who have reached age 105, will make it possible to analyse this oldest-old mortality and to identify the mortality law (Box 3).

What is the law of oldest-old mortality?

The size of the oldest-old population and its evolution depends on the size of the cohorts reaching advanced ages and on survival probabilities. Until recently, data on mortality beyond age 80 were not considered robust, making it difficult to estimate survival probabilities at these ages. In the 1990s, when older populations started to grow, the models of oldest-old mortality had to be revised to improve the fit between estimates and observations (Kannisto et al., 1994). Specifically, researchers began to question the application of the Gompertz law of mortality (1825) to the oldest-old and its assumption that probabilities of dying increase exponentially with age. While it is agreed that the law works well between entry into adulthood and age 85 or so (in low-mortality populations), opinions diverge about its accuracy beyond this threshold

Box 3. Validating supercentenarian mortality data

While the oldest-old population is increasing, numbers are still not large enough to draw robust conclusions at the national level about the shape of the mortality at older ages. To address this knowledge gap, an international consortium was established to create an international database on oldest-old mortality (International Database on Longevity). It was run by the Max Planck Institute for Demographic Research until 2020 and after that by the INED DataLab. The aim is to record all cases of exceptional longevity in a single database after validating each case using a specific protocol (Maier et al., 2010). This database provides a global reference on mortality of individuals who survive beyond their 110th birthday, known as supercentenarians. In 2019, the database was expanded to include individuals having reached age 105, known as semi-supercentenarians. These observations will be used to analyse the age-specific probabilities of dying so that an accurate model can be developed to estimate and project oldest-old population size and mortality. The data cover 13 European and North American countries.

Collection method and validation protocol: the example of France

In France, each year since 2014, the National Institute of Statistics and Economic Studies (INSEE) has provided INED with nominative data extracts from the national directory of physical persons (Répertoire national d'identification des personnes physiques [RNIPP]) concerning individuals born in France and who died at age 105 or over in the two preceding calendar years. Individuals are enumerated based on the RNIPP extracts and two other non-exhaustive sources: the register of deaths and a nominative list based on newspaper reports of birthdays celebrated by exceptionally old people. These three sources of individually cross-matched data provide a practically exhaustive list of presumed supercentenarians in France. Each listed case is validated by examining the birth records held by the municipality of birth.

An exceptional example of longevity: the world's oldest living person

So far, 213 supercentenarians have been identified across the world, and their ages confirmed (Maier et al., 2010, 2020). Among these extraordinary survivors, the individual record for human longevity is still held by Jeanne Calment, who died in 1997 in Arles, France, soon after her 122nd birthday (Robine and Allard, 1999). This exceptional age has never been reached again, nor even approached. While a recent article raised doubts about this record and rekindled debate on the question (Zak, 2018), the evidence produced to challenge Calment's age has not been adequately documented or has been disproved by the available facts (Robine et al., 2019). Researchers are exploring the mechanisms of survival to extreme old age (Wilmoth et al., 2000). Calment's record has remained unbroken for more than 23 years. Does this suggest that maximum lifespan is tending towards a limit imposed by human biology (Finch et al., 2014)? Or is her survival explained by the purely random occurrence of exceptional lifespans?

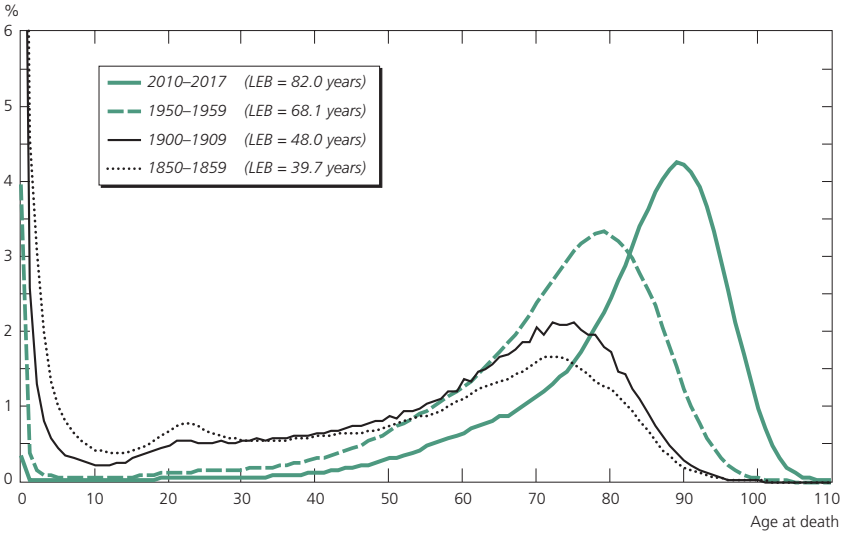
(Robine et al., 2020). Some studies have found that death rates increase more slowly or even level off at very advanced ages. A range of hypotheses have been put forward to account for this deceleration: selection of the most robust individuals less sensitive to health risk factors that occur up to advanced ages; a slowing of the process of senescence at these ages; (over-)protective lifestyles or environments that mitigate the risks of disease or injury. But others point up the limits of existing data and modelling methods. To estimate mortality by age, individuals are often grouped by age at death, whatever their birth cohort, to maximize sample size. This produces heterogeneity in the experience of mortality (that varies across cohorts), which may partly explain the existence of an artificial plateau effect that does not necessarily represent actual mortality

in a given period. Lastly, analysis at country level is difficult due to the small numbers of people concerned. In an initial study of semi-supercentenarians in Italy based on data from the International Database on Longevity, the authors concluded that mortality risks level off after age 105 (Barbi et al., 2018). Their article prompted numerous responses (presented as comments) questioning the robustness of the chosen assumptions and models due to the inadequate sample size. It was pointed out that modelling constraints and margins of uncertainty are still too large to determine whether the probability of dying by age does or does not level off after age 105.

Indicators of changes in human longevity

Life expectancy does not capture the full dynamics of oldest-old mortality. While it provides the mean age of death in a given year, it says nothing about the distribution of ages at death. As shown in Figure 13, based on French life-table data for different periods, the proportion of deaths before age 1 has decreased sharply, from 17% of all deaths under the mortality conditions of 1850–1859 to just 0.4% under those of 2010–2017; and from 31% before age 10 in the first period to 0.5% in the second. The curves show a shift in deaths towards advanced ages. In 1850–1859, 31% of deaths occurred after age 65 versus 88% in 2010–2017. They also show that deaths are concentrated within an increasingly narrow age range and that the modal age (the age at which deaths are most frequent) has shifted from 72 years for the two most distant periods to 79 and then 89 for the

Figure 13. Distribution of deaths (%) by age at death, based on life tables for France (averages of the periods 1850–1859 to 2010–2017, both sexes combined)



Note: Two points are not represented (17% of deaths occur before age 1 in the decade 1850–1859; 14% of deaths occur before age 1 in the decade 1900–1909).

Source: Human Mortality Database, graph plotted by the authors.

two most recent. This modal age and the concentration of deaths around it complement the information provided by life expectancy, making it possible to compare countries or population groups. This corresponds to the concept of rectangularization of the survival curve (Fries, 1980), described in Box 4.

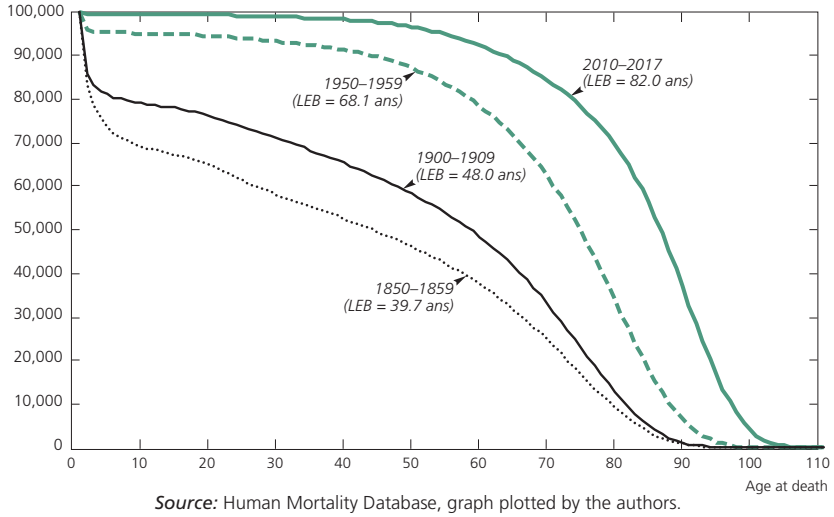
Life expectancy fluctuations in the early 21st century

The record life expectancies observed in pioneer countries suggest that further progress is still possible. That said, life expectancy has fluctuated recently in many of the most advanced countries in our sample for reasons that remain unclear. Examples include the United States, where mortality is tending

Box 4. Rectangularization of the survival curve

The age distribution of deaths can also be plotted on a survival curve, based on the age-specific probabilities of survival given in the life table. These probabilities are calculated by dividing the number of deaths in a given year between ages x and $x + 1$ by the number of individuals of age x who were alive at the beginning of the year. These probabilities at each age are then applied to a fictitious cohort of, say, 100,000 newborns to determine the numbers who reach each age. The curve represents the decreasing numbers of these 100,000 newborns as they advance in age and all eventually die. With the progressive decrease in mortality before the modal age in recent decades, the curve now remains relatively flat until this age. It then dips downwards, forming an increasingly rectangular shape as deaths become more concentrated around the modal age. Fries (1980) argued that this dynamic should lead to a compression of deaths into the average upper limit of life, set at 85 years in 1980. While a trend towards rectangularization and compression of deaths around a modal age was indeed observed at that time, there is still no sign of an upper age limit in the first decade of the 21st century.

Survival curve based on life tables for France
(average of periods 1850–1959 to 2010–2017, both sexes)



Source: Human Mortality Database, graph plotted by the authors.

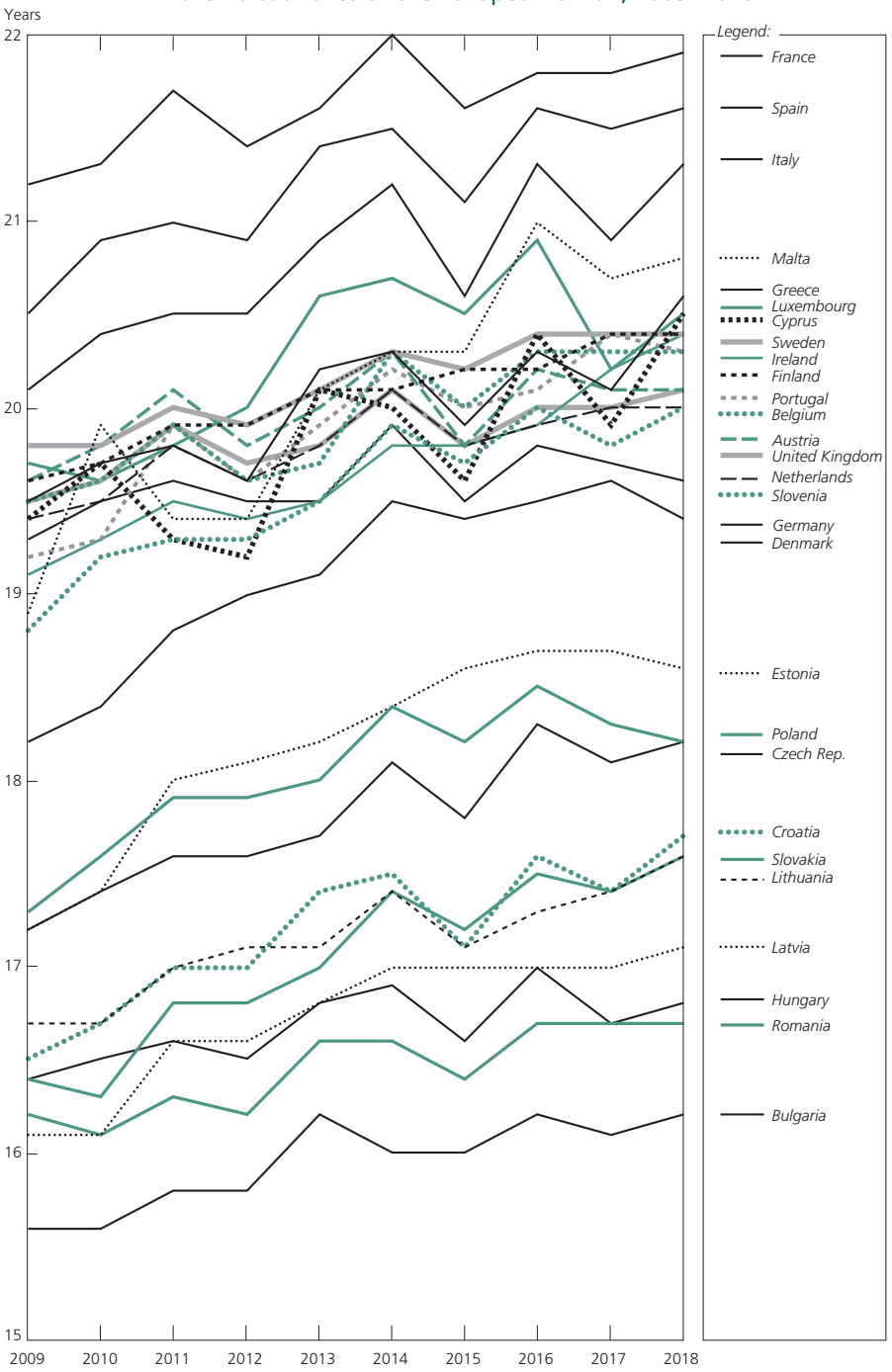
to increase among certain population groups (Case and Deaton, 2015; Barbieri, 2019), and some European countries where unexpected jumps in life expectancy at age 65 are observed in certain years, as illustrated in Figure 14 (in France in 2011 and 2014, for example). In 2015, on the other hand, Europe saw a marked dip from 2014 (slightly more than 7 months in Italy).

These dips may be linked to flu or gastroenteritis epidemics or to heatwaves that are particularly dangerous for the most fragile and oldest populations. These episodes increase respiratory and circulatory mortality, especially among women and the most disadvantaged populations (Khieu et al., 2017). The European heatwave of August 2003 was especially deadly for older adults, with 15,000 excess deaths recorded in France between 1 and 20 August (Toulemon and Barbieri, 2008). Seasonal flu epidemics produce similar mortality peaks. According to Santé publique France, the French public health agency, around 13,000 flu deaths in France occurred in the winters of 2014–2015 and 2016–2017 and around 11,000 in 2017–2018, of which 85% were among people aged over 75. The first (provisional) estimates of the effects of the COVID-19 pandemic on overall mortality in Europe reveal high levels of excess mortality, at advanced ages especially (Dahoo and Gaudy, 2020). During the first wave (March–April 2020), deaths increased by 70% from previous years in Spain, by 47% in Italy, 43% in Belgium and the United Kingdom, and 28% in France, but just 4% in Germany, which fared better than elsewhere. The second wave saw further excess mortality in Europe, with effects that differed across countries. According to INSEE estimates, the excess mortality in France reduced LEB by 5 to 6 months (Papon and Beaumel, 2021). By contrast, no major seasonal flu epidemic occurred in 2020, so flu deaths were much lower than in previous years. Lockdowns and other measures to contain the pandemic also reduced deaths from other causes, such as accidents and injuries. It is still difficult to assess the longer-term consequences of the pandemic, however, as its potential impact on the health of people who contracted the disease or were affected indirectly by the disruption of healthcare and of social and economic life is still unknown.

Do these life expectancy fluctuations at advanced ages mean that gains are levelling off? To answer this question, trends must be observed over the long term to identify any lasting slowdowns. The strong decrease in cardiovascular mortality has made a substantial contribution to the gains observed in recent years. Scope for progress is now more limited, although further advances are probably still possible through targeted prevention, screening, and healthcare for high-risk subpopulations. Additional gains can also be achieved if we succeed in slowing the progression of old-age mortality linked to mental, neurodegenerative, respiratory, and circulatory diseases.

Recent studies of the prevalence of dementia in several European countries and in the United States have found overall evidence of a downtrend (for example, Jagger et al., 2016) due perhaps to improvements in health (notably cardiac health, a risk factor) and living conditions over the life cycle. The rise

Figure 14. Life expectancy at age 65
in the 28 countries of the European Union, 2009–2018



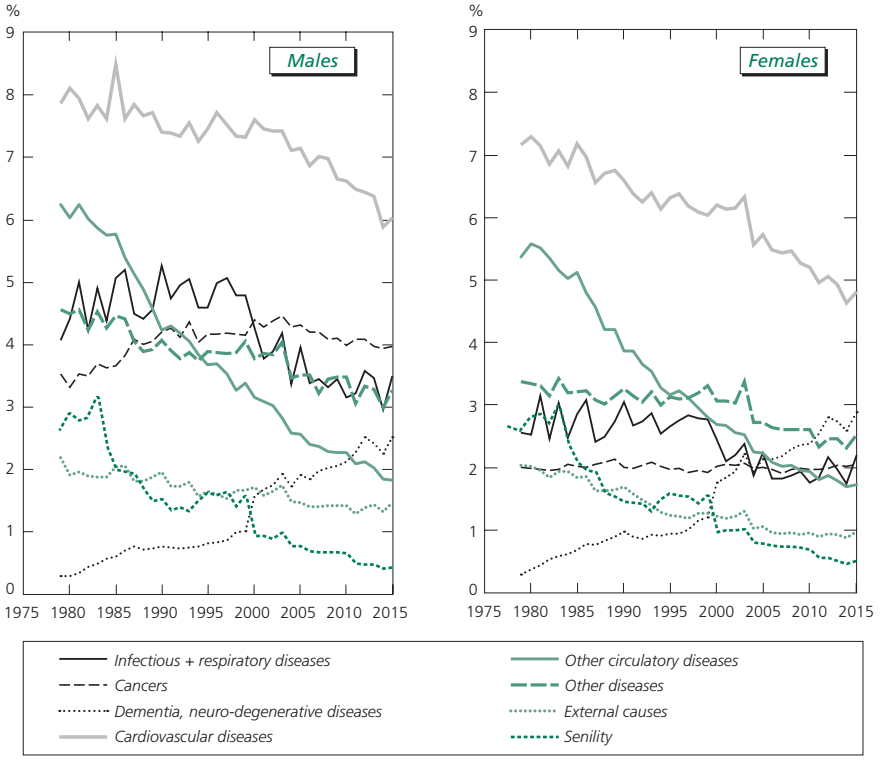
Source: Eurostat, graph plotted by the authors.

in average educational levels across cohorts is contributing directly to these improvements; duration and level of education are associated with later onset of disabling symptoms of dementia.

Causes of death at advanced ages and multimorbidity

Even though the presence of multiple health problems makes it difficult to identify cause of death at advanced ages, the causes recorded on death certificates can be analysed to understand trends and differences in oldest-old mortality (Meslé, 2006). Figure 15 presents the standardized mortality rates at ages 90 and over between 1979 and 2015 in France (Meslé and Vallin, 2020). It shows the decrease in deaths from circulatory and cardiovascular diseases from the 1980s, among women at least. The decline in mortality from infectious and respiratory diseases is more recent, starting in the 2000s, and less spectacular.

Figure 15. Standardized mortality rates by cause of death at ages 90 and over, France, 1979–2015



Source: Meslé and Vallin (2020) based on data from CépiDc (INSERM) and the Human Mortality Database.

Deaths from external causes (accidents [including falls], suicides, etc.) have been decreasing quite steadily since 1980, and slightly faster for women. At the same time, mortality from neurodegenerative diseases and dementia

has increased sharply; many deaths previously attributed to senility (a cause in sharp decline) are now diagnosed more accurately and reclassified, often as dementia. But the rise in dementia mortality also reflects the increase in survival to ages where diseases of this kind are more frequent. Cancer mortality among the oldest women has remained stable for around 3 decades. Among men, it increased in the 1980s and 1990s before dipping again to its 1985 level. To study trends in cancer mortality, deaths must be broken down by cancer site. Risk exposure (which differs for males and females) and specific progress in treatment and prevention affect the pace and timing of mortality reduction. And some curves are uneven, notably those of infectious and respiratory diseases, while others have peaks related to the health crises described above (heatwaves such as that of 2003, seasonal epidemics) that may compromise health and expose people to greater risk of illness or complications.

Multiple causes of death and end-of-life medical conditions

The figures given above concern the underlying cause of death recorded by the certifying physician who generally also mentions other contributing causes. People who die at advanced ages are often in situations of multimorbidity. Analysis of all causes mentioned on death certificates shows that infectious diseases, Alzheimer's disease, and Parkinson's disease are often reported as contributing but not underlying causes of death. So these diseases contribute much more to the death trajectories of older adults than is suggested by analysis of the underlying cause alone (Désesquelles et al., 2014).

Surveys of end-of-life circumstances, conducted notably in Belgium and in France, help to understand these processes. They are not exclusive to older adults, but most people concerned are in this age group. The French survey in 2009 recorded hospital stays in the months preceding death, revealing patterns that vary by sex and by health status (Pennec et al., 2013).[15] The survey data show that 69% of male deaths and 58% of female deaths occur in hospital, and 11% and 25% in a care home. The last medical treatment administered before death often requires hospital care (particularly for infectious, cardiovascular, respiratory, or digestive diseases). The end-of-life trajectories between home, care home, and hospital depend on individuals' care needs and the availability of the necessary care home, in-home, or hospital services, which varies across the country. This factor may explain the findings of a study conducted in 14 European and non-European countries, which showed that while the largest proportion of dementia deaths occurs outside hospitals, this proportion varies between countries (Reyniers et al., 2015).

End-of-life circumstances, causes of death, and their patterns of change are thus important factors in the analysis of longevity and life expectancy gains, particularly at advanced ages. Mortality trends reflect complex demographic dynamics. Improved survival to advanced ages thanks to improved

(15) This survey focused on non-sudden deaths of people aged 18 and over.

treatment of certain pathologies may result in better overall population health, but also in longer survival with chronic diseases that increase other health risks. Analysis of causes of death provides important insight into ongoing trends. However, it is always difficult to make comparisons over time or across countries because of methodological limitations, such as variations in the survey populations (general population or specific subpopulations), or because of disparities in the definitions and tests used to identify diseases (Helmer et al., 2016; Larson and Langa, 2017). Improving the health status of individuals in an ageing population is a key challenge that must be addressed while taking account of the role of social, family, and economic circumstances.

II. Issues and challenges of population ageing

The ageing of the population lies at the heart of many individual, societal, and demographic issues (quality of life and health, social and political debates, population dynamics), which have not, so far, prompted sufficient restructuring by governments to meet the needs of older people and their care. Ageing puts pressure on systems built upon different demographic balances, particularly social protection systems. They need to be revamped and reorganized to adapt to new balances. This section starts by looking at the implications of population ageing regarding health and needs associated with loss of functional independence, before addressing family factors and economic issues, especially those associated with pension systems and intergenerational transfers.

1. Life years gained: in what state of health?

The health of ageing populations and (healthy) life expectancy

Does a longer life expectancy imply more or fewer years of poor health?

It is crucial to know whether years of life expectancy gained are spent in good or poor health. During the 1980s, some predicted a pandemic of mental disorders and associated disabilities, frequent among older people and likely to affect an increasingly large population (Kramer, 1980). Others put forward a scenario involving a compression of years of late-life poor health, with premature death virtually non-existent and life expectancy eventually reaching an average maximum life span; for example, 85 years (Fries, 1980). Still others expected a 'dynamic equilibrium', produced by a probable increase in poor health associated with increasing age and the development of chronic diseases, while the severity and consequences of these diseases are reduced (Manton, 1982).

This is a key issue because whether years gained are spent in good or poor health determines people's quality of life and level of social participation. It determines the needs of a population regarding health care and support for loss of functional independence (Manton et al., 2006). It affects the equilibrium

of social protection systems in their current configurations when it comes to health care and support costs and pension funding. Lastly, it provides an indication of older adults' ability to remain in employment, a vital piece of information in the debate on extending the retirement age. Demographers have therefore developed health expectancy indicators that combine the traditional measure of life expectancy with data measuring certain aspects of health.

What measures of population health are needed to understand the consequences of ageing?

In the context of an ageing population, one of the major public health concerns is chronic disease (often involving long-term or even life-long treatment), which can be disabling. With large numbers of people now living to advanced ages, we have witnessed the significant emergence of such diseases, rare before the age of 80, and particularly of neurodegenerative diseases with serious consequences leading to disabilities, such as Alzheimer's and Parkinson's (Box 5). These disabilities can be categorized as involving either functional limitations or activity restrictions. The former relate to functional impairments that cause difficulties in moving about, seeing, hearing, remembering, reasoning, etc. They can often be reduced through the use of equipment, such as mobility aids, glasses, hearing aids, etc., or through the adaptation of the environment, particularly to facilitate mobility. Where they cannot be (adequately) mitigated, functional limitations may lead to activity restrictions. These are situations in which individuals have difficulty carrying out basic activities of daily living: seeing their family and friends, doing the shopping, doing housework, or, in the most critical cases, performing basic self-care activities such as washing and feeding themselves. When people can no longer perform these activities, they lose some of their functional independence and require support. When diseases affect cognitive functions, there is a risk of a loss of 'decisional' autonomy. Alzheimer's disease and related disorders have been a public health priority since the turn of the 21st century, as the functional limitations they cause are difficult to manage or compensate for (confusion, disorientation in time and space, etc.) This leads to significant care requirements, particularly because even if the person can carry out many of their activities, frequent loss of bearings means they require constant supervision and assistance, even to the point that decisions are made for them.

In addition to severely disabling diseases, moderately disabling conditions are common in adults and especially older adults. Of these, chronic musculoskeletal disorders and anxiety or depression are particularly significant. Because these diseases lead to the restriction of certain social, family, domestic, or personal care activities, they are responsible for substantial deterioration of the individual's quality of life and social participation, and ultimately contribute to the frailty of the population. For example, a study based on French data from 2008 indicates that, among the 50+ age group, 32% of all situations of

health-related activity limitation in women were associated with musculoskeletal disorders and 23% in men, 11% and 19% were associated with cardiovascular disease, and 4% and 6% with chronic non-specific lung disease. The contribution of neurodegenerative diseases (Alzheimer's and Parkinson's) is around 3%, less than that of accidents (in men) and cancers (Nusselder et al., 2019). Far more situations generate functional deterioration than we might initially think. They could be viewed as an area for significant preventive action. In addition to medical and prevention issues, it is important to consider the various situations of loss of functional independence and the associated needs. In the context of ageing, using a disability-based approach provides a comprehensive view of these risks. Looking at this functional dimension of health also captures the dimensions of quality of life, social participation, and loss of functional independence. Health expectancy indicators have been developed using these measures of disability.

Describing and monitoring the health status of the population

In the 1970s, the concept of health expectancy was proposed to add a 'quality' dimension (years lived in good or poor health) (Sullivan, 1971) to the estimate of 'quantity' of years lived (life expectancy). Although developed and often used with measures of disability (disability-free life expectancy, active life expectancy), there are, in fact, as many indicators of health expectancy as there are measurable dimensions of health. From a technical perspective, measuring health expectancy involves incorporating the probability of having a health problem (chronic illness, disability, dependency, etc.) into the calculation of life expectancy; the years of life expectancy are then divided into years with or without this problem. Repeated over time or calculated for different populations, these estimates enable us to answer questions such as: Are the life years gained years with or without disability? Do population groups that live shorter lives also spend fewer years in poor health?

Life expectancy with and without disability in low-mortality countries

Disability-free life expectancy has been calculated in many countries since the 1980s. In 2004, the European Commission included the indicator in its list of structural indicators for each country under the label 'Healthy Life Year' estimated by Eurostat[16] using data from the Study on Income and Living Conditions, or EU-SILC (Jagger et al., 2008). The International Research Network on Health Expectancies (REVES) has produced two international summaries on trends, disparities, and determinants of healthy and unhealthy life years, with and without disability (Robine et al., 2003; Jagger et al., 2020).[17]

(16) Estimates are produced annually and available in the Eurostat database: https://ec.europa.eu/eurostat/statistics-explained/index.php/Healthy_life_years_statistics

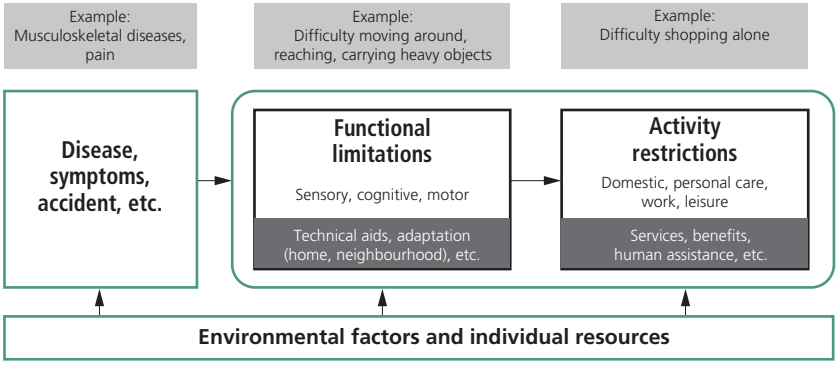
(17) This network, *Réseau Espérances de Vie En Santé,* was created in 1989 by the French National Institute of Health and Medical Research (INSERM, Montpellier, France), the Social Affairs Council (Quebec City, Canada), and the Center for Demographic Studies (Duke University, Durham, USA).

Box 5. Measuring health: disease, disability, and loss of functional independence

Since the 1980s, the literature has proposed models explaining how illnesses can lead to disability, which in turn can lead to dependence (people are then dependent on the assistance of another person to perform essential daily activities) (Wood and Badley, 1978; OMS, 1980; Verbrugge and Jette, 1994). The diagram below is an illustration of one of these models. The benefit of the approach is that these various dimensions can be broken down to explore separately the risk of having diseases (prevention and primary care), the risk that these diseases will lead to functional limitations (secondary care), and the likelihood of being able to prevent these limitations from generating activity restrictions, through the use of effective technical aids, for example, or a sufficiently adapted environment (Verbrugge et al., 1997; Agree, 1999). Lastly, it can be used to measure the situations and needs of individuals who have lost some of their functional independence or (decisional) autonomy.

Question grids were developed in the 1980s to incorporate functional health into health surveys and provide information that could be used at the population level: grids identify functional limitations (going up and down a flight of stairs, clearly recognizing the face of someone on the other side of the road, clearly hearing what is said in a conversation in a quiet room, etc.) (Nagi, 1976), and other restrictions in elementary activities of daily living ([ADLs] grooming, feeding, etc.) (Katz et al., 1963) or in instrumental activities of daily living ([IADLs] shopping, laundry, administration, etc.) (Lawton and Brody, 1969). These functional health models have been widely used to describe the health status of populations. At the individual level, they have also been used to understand trajectories of functional decline. The aim is to estimate the risks of moving from one level of the disability development process to another (deterioration or improvement) in order to identify the associated determinants and disparities.

Illustration of the disability development model



Source: Authors' construction based on Cambois et al. (2020).

The following conclusions emerge. The most complex (and rarest) situations of self-care activity restrictions represent about 5 years of total life expectancy, in all countries.[18] These years occur at advanced ages, and this figure appears to be fairly stable over time, from the 1980s to the early 2000s. These results, which are relatively consistent from one country to another, indicate that years of life expectancy gained have not been years of so-called severe disability,

(18) These restrictions correspond to situations of loss of functional independence, often defined as the need for help with personal care activities, such as washing, feeding, bathing, etc.

since the latter have not increased along with life expectancy. However, the most recent studies show less homogeneous trends (Robine et al., 2020). In England and the United States, the number of years lived with severe disabilities (i.e. difficulty or need for assistance with basic personal and domestic care activities) has increased slightly.

As for less severe disabilities (restrictions in activities other than the essential ones), levels and trends are much more varied from country to country. This is particularly noticeable with the measure used for the European indicator: 'activity limitations' are situations in which people perceive they have been limited in usual activities for more than 6 months due to a health problem. These disabilities cover a variety of situations as thought by the respondents: difficulty doing shopping or going out in general, doing housework, working (for those in the labour market), managing everyday administrative tasks, etc. Across Europe, in 2018, women who had reached 65 years of age could expect to live a further 10 years without activity limitation (called Healthy Life Years), and men a further 9.9 years (Figure 16); but as life expectancy for women is higher, they spend, on average, longer living with these limitations (11.5 years) than men (8.3 years). Between countries, we see considerable variation: about a 10-year difference in Healthy Life Years at age 65 in Sweden or Norway (almost 16 years for women and men) and those of Latvia, Slovakia, or Croatia (around 5 years). Overall, activity limitations affect between 8 and 15 years of life expectancy for women and between 5 and 12 years for men.

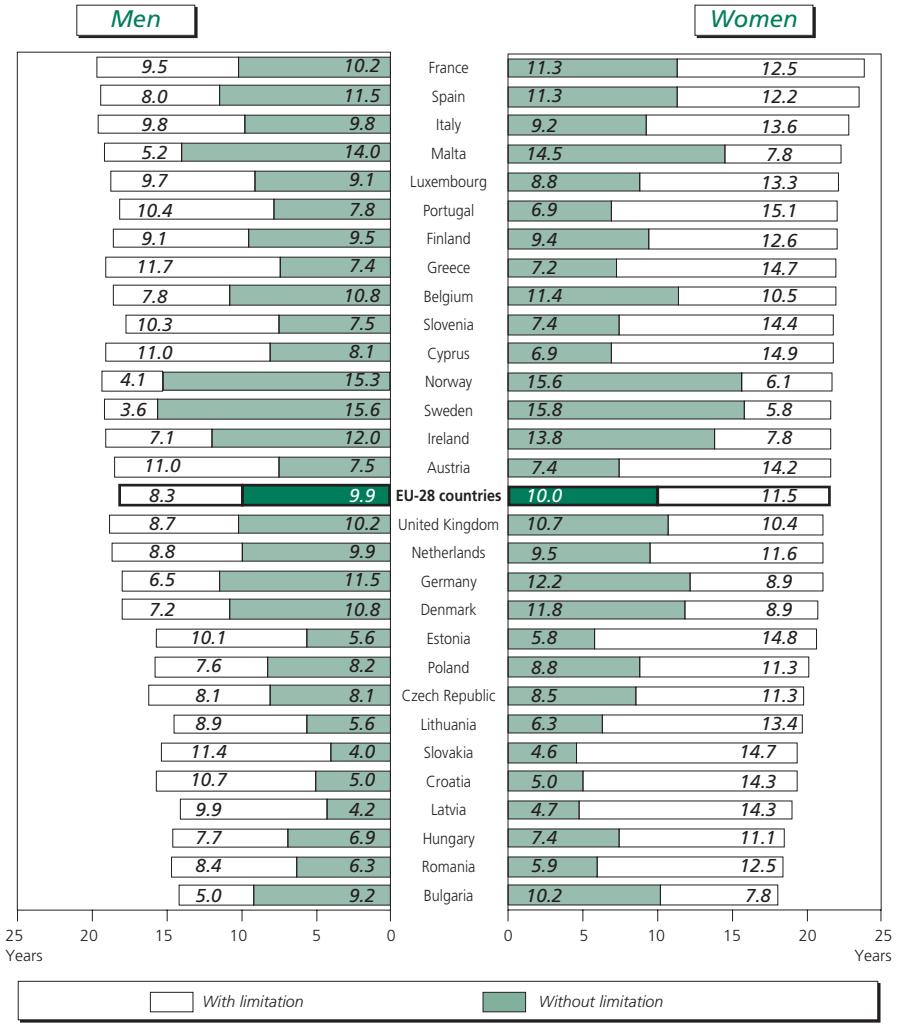
Some countries saw an increase in the indicators for life expectancy with moderate disability around the turn of the 21st century (Japan, Belgium, Spain, Sweden, France, and USA), particularly in the latter three countries where this disability expansion reached people in their 50s and 60s.

Lastly, regarding life expectancy with and without functional limitations (sensory, motor, or cognitive), the last 3 decades have seen an upward trend in the number of years lived with these difficulties, which are frequent at advanced ages (Robine et al., 2020). In the mid-2010s, we also saw a decline in the number of years lived with cognitive functional limitations (remembering, being oriented in time and space, etc.), which illustrates the trend towards lower prevalence of the signs of dementia, for example in the United Kingdom (Jagger et al., 2016).

Explaining the differences between countries and their trends

Levels of disability-free life expectancy vary significantly between European countries (Figure 16), particularly when considering disabilities that are not the most severe. These differences are partly related to the way health and disability are measured: the wording of questions, range of responses, cultural variations in the understanding of one's own health, etc. (Cambois and Robine, 2017; Robine et al., 2020). Even when the measures are relatively similar, differences remain not only between the countries of Europe, but also between the 50 US states (Karas Montez et al., 2017). These differences raise questions about the impact

Figure 16. Life expectancy at age 65 with and without activity limitation in European countries in 2018



Source: Eurostat, authors' construction; https://ec.europa.eu/eurostat/data/database

of health and social contexts, with health and social protection systems resulting in situations that may be more or less conducive to the prevention and management of diseases and their consequences (Rechel et al., 2013). Two analyses of the association between the level of health expectancy and macroeconomic indicators in EU countries around 2010 showed that variations in the level of poverty and material deprivation partly explained these disparities, particularly between older and newer EU countries (Fouweather et al., 2015).[19]

(19) Macroeconomic indicators are European structural indicators (such as unemployment, poverty, and health expenditure).

These macroeconomic indicators, such as the poverty level, reflect the living conditions that affect disability-free life expectancy. These indicators undoubtedly have a strong social dimension and are linked to public policies that can limit the consequences of social situations that are critical to health, specifically through poverty reduction, universal access to care, education, unemployment benefits, etc. Therefore, we also find connections between public policies and inequalities in disability-free life expectancy within countries.

Health inequalities among older people within each country

As for total life expectancy, differences in life expectancy with and without disability can be observed between men and women and between social groups. Women live for longer than men, but for many women, some or all of these additional years are lived with disabilities, regardless of how it is measured. Figure 16 shows, for example, that while, for the 28 European countries, average life expectancy for women is 3.3 years longer than for men (21.5 vs. 18.2), they also experience 3.2 additional years with disabilities (11.5 vs. 8.3). This female disadvantage, sometimes described as a paradox if we consider that longevity and health go together (Luy and Minagawa, 2014), is the result of disease 'profiles' that appear specific to each sex. On average, women are more likely than men to have chronic disabling diseases, such as anxiety or depression and musculoskeletal conditions, while men are more likely to experience life-threatening disabling diseases, such as heart disease, cancer, or traumatic injuries (Nusselder et al., 2020).[20] Differences in the life circumstances and trajectories of men and women may also contribute to these disparities in the risk of disability at advanced ages (Cambois et al., 2017): standard of living, career, circumstances, and family backgrounds are all factors that impact health and that differ between men and women at advanced ages.

Social inequalities, already significant for LEB, increase still further when we look at years of good and poor health. In France, in the early 2000s, manual workers aged 35 lived on average 6 years less than management-level workers and experienced on average 10 more years of life with functional disorders, a phenomenon referred to as the 'double penalty' for manual workers (Cambois et al., 2008). Such social inequalities in years of disability exist in both men and women, among the oldest (65 and over) and younger groups (50–65). They are found in all countries, regardless of how social status is defined (occupation, level of education, etc.), as shown by a recent literature review (Cambois et al., 2020). Social differences in health are linked to living and working in harmful conditions, more common among the less qualified, less educated, and less financially well-off groups. These conditions expose people to higher risks of illness, particularly disabling and/or life-threatening diseases

(20) 'Chronic diseases' are long-term illnesses that are usually difficult to cure but can be treated to minimize their progression. These diseases (hypertension, diabetes, neurodegenerative diseases, mental illness, etc.) are prevalent in the older population.

such as cardiovascular and musculoskeletal disorders (Palazzo et al., 2019). Precarious living conditions also limit options for adapting an individual's environment or lifestyle to functional impairments, thereby accelerating the risk that functional difficulties will translate into activity restrictions and lead to a loss of functional independence.

Indicators incorporating multiple dimensions of health

The Global Burden of Disease

This programme aims to incorporate the full spectrum of diseases into summary measures to describe the health of different regions of the world (Murray et al., 2000).[21] The prevalence, incidence, and mortality risks associated with a number of diseases are combined to assess the health status of a population. In the context of population ageing, this programme aims to compare different age groups, countries, country regions, or population groups. One of the summary indicators is the disability-adjusted life year (DALY), or life expectancy minus the years of disability associated with the various diseases prevalent in the populations. To estimate this, a weighting system is used for each disease, based on the opinion of experts who quantify the 'loss of good health' each disease is likely to cause. By employing an approach based on prevalent diseases rather than disabilities directly, these indicators provide insight into the 'exposure and health care' dimension. They supplement disability-free life expectancies, which shed light on the long-term care side (by analysing the nature and severity of disabilities). Calculating DALYs requires different data, such as the prevalence of diseases and their mortality risk. Data that are not available for some countries are modelled on a regional basis. The measurement of the 'quality' of years lived, based on expert opinion on a disease-by-disease basis, may change over time or from country to country. This programme reveals the difficulty of providing internationally comparable measures. It nevertheless benefits from a high capacity to produce estimates based on large data sets and powerful modelling, but this should not obscure the role of the modelling and assumptions used to arrive at the indicators (Mathers, 2020).

Frailty

In parallel with conceptual advances in measuring the health of older population groups, particularly with the notion of disability, the concept of frailty has gained importance in the field of gerontology: it is based on the observation of situations of multimorbidity, functional decline, loss of physiological reserves, and reduced chances of protecting oneself or recovering from an illness

(21) Initially supported by the World Health Organization, the programme has evolved into the Institute for Health Metrics and Evaluation (IHME), which 'has distilled large amounts of complicated information into a suite of interactive data visualizations that allow people to make sense of the over 1 billion data points generated'.

(Rockwood et al., 1994). The frailty of individuals is measured based on a combination of many medical, functional, and psychosocial characteristics. From a prevention perspective, the aim is to detect situations before functional deterioration and loss of functional independence occur. When these dimensions are measured using population-based surveys, it is possible to produce a frailty indicator for a population. However, the large number of characteristics required in the approach proposed by Rockwood et al. (1994) makes it difficult to measure through surveys. Another approach, used by Fried et al. (2001), is based on the functional motor dimension, which requires less information that can be more easily collected in general population surveys. These variables include grip strength or walking speed, weight loss, fatigue, or sedentary lifestyle. Along with the measurement of disabilities, which aims to break down the various stages of functional decline, the notion of frailty summarizes an 'at-risk' situation by incorporating all dimensions of the functional decline process.

Ageing and biodemography in health studies

Biodemography is an area of study that has emerged strongly over the last 20 years with the rise of chronic diseases and frail states of health (Robine, 2011). It was introduced in the eighth edition of the *Handbook of Aging and the Social Sciences* (Crimmins and Vasunilashorn, 2016). In the field of health, biodemography uses demography, epidemiology, and biology, adding the biological component to the disability development model described above. The human body has resources and reserves that determine whether a disease occurs, whether it can be recovered from, and the risk of experiencing functional decline. These resources and reserves are measured by markers (or biomarkers) identified via biological samples (blood samples, urine samples, etc.); these include, for example, indicators of inflammatory processes closely linked to cardiovascular diseases. These markers vary depending on living conditions throughout the life course and the accumulation of harmful situations endured. Biomarkers enable us to analyse the links between age, gender, and social situation, and health and mortality risks. The data available in this area include the Health and Retirement Study and the sister studies in Europe (SHARE): in the latter, a biological sample was collected during Wave 6 of the survey in 12 countries, providing a number of biomarkers among the individual variables.

2. Support for older people with loss of functional independence

Older people are more vulnerable to functional disorders, disabling diseases, and complex health situations (multimorbidity). Support or long-term care may be necessary should they experience restrictions in essential activities.

In OECD countries, almost 11% of over-65s received long-term care in 2017 (OECD, 2020). Long-term care is defined as all the assistance received regularly by people who cannot perform certain elementary activities independently. It covers help with personal care (bathing, dressing, using the toilet,

etc.), defined as activities of daily living (ADLs), but may also extend, depending on the definition used (which varies from country to country), to so-called instrumental activities of daily living (preparation of meals, laundry, washing-up, shopping, etc.) and assistance with these IADLs (help with transport, scheduling appointments, managing medications, administrative tasks, etc.).

Long-term care is not just for older people because disabling conditions or accidents can occur at any age. However, the prevalence of activity restrictions increases sharply with age. In OECD countries, more than half of the individuals receiving long-term care are aged 80 or over, making population ageing a significant driver of care demand (Colombo et al., 2011). In many countries, the increase in the number and proportion of older adults is posing a profound challenge to the social protection systems designed to cover the support needs of this population group. But population ageing is not the only factor. The desire for better quality of support, both for the people being cared for and their family or professional caregivers, requires an increase in the resources provided by society (OECD, 2020). Social protection systems are thus required to develop public policies on prevention and support for people whose functional independence is threatened.

Care costs and the sustainability of social protection and assisted living systems

Despite low salaries across the sector, the professional assistance provided to people with activity restrictions is expensive, requiring lengthy interventions. Most people would not be able to cover the costs of their needs without a social protection system that makes using all or some of the support services financially viable. Muir (2017) shows, for example, that in 14 OECD countries, the cost of care is greater than or equal to the median income of over-65s. In 2013, a study of a sample of nine European countries estimated the mean cost of long-term care at nearly €115,000 for the total time spent in dependency (Bonnet et al., 2019), an amount that only 6% of people, on average, would be able to finance on their income alone.[(22)] Unless they have substantial assets or family support, most individuals depend on the existence of social support systems to meet their needs.

Government schemes vary. Public spending on long-term care accounts for 1% to 1.5% of GDP in most OECD countries, but some allocate more than 2% or even 3% (the Netherlands and Sweden), while others (Portugal and Hungary) spend less than 0.5% (Colombo et al., 2011). Furthermore, for a given level of public expenditure, social protection systems vary significantly according to the nature of the aid, the criteria for entitlement to public aid, the sources of funding, the place of residence (home or institution), and the extent to which management of social aid is decentralized (Colombo et al., 2011). In general,

(22) The authors' analysis focuses on over-65s in the following countries: Austria, Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, and Sweden.

however, the public resources dedicated to mitigating loss of functional independence fall far short of those allocated to cover other social risks. In France, for example, for all funding sources combined, these resources represented around 1.4% of GDP in 2014,[23] nearly 6 times lower than health care expenditure (8.6% in 2018) (DREES, 2019a) and nearly 10 times lower than spending on retirement pensions (13.7% in 2017) (DREES, 2019b). The ageing of the population is expected to lead to an increase in public spending on assisted living to accommodate both the numbers and the need for improvement.

According to projections, however, this expenditure is likely to remain limited: 2.7% of GDP by 2070 in the European Union, according to the demographic and epidemiological reference scenario, compared to 1.6% in 2016 (OECD and EU, 2018). According to these financial projections, greatly dependent on their assumptions (regarding trends in life expectancy with and without disability, labour costs in the sector, care-seeking behaviours, and indexation of social benefits), the increases induced by the ageing of the population will ultimately remain modest in absolute terms (approximately 1% of GDP over a period of 30 or 40 years).

Beyond these estimates, an important issue remains: the distribution of effort between what falls under the direct responsibility of users and their family caregivers, and the responsibility of state welfare systems. This distribution varies enormously between countries, and even within countries, depending on the degree of dependency, place of residence (home or institution), the type and level of assistance required, and the individual's resources (Muir, 2017). In many countries, the out-of-pocket expenses for the user remain high and prompt many older people to fall below the poverty line once the cost of care is deducted from their income. This is the case in the Republic of Korea, Canada, France, and Croatia, for example, particularly in situations of severe activity restrictions (Muir, 2017). In France, in 2011, 1 in 2 nursing home residents did not have sufficient income to finance their living expenses (Fizzala, 2016). Many are forced to use their savings, sell their homes, or depend on the financial help of their family. How the cost of long-term care hinders access to support remains largely unexplored.[24] Nonetheless, we can assume that the issues surrounding long-term care are similar to those associated with refusal of medical care, which have been well documented in health economics (Jusot et al., 2013) and which show that financial barriers limit the use of care by the most vulnerable populations.

The use of long-term care also depends on the quantity and quality of the supply. The demand for long-term care is growing as the population ages and increasing numbers of people lose their independence. Concern about the capacity of long-term care facilities to meet the demand is widespread. In

(23) For the over-60s only.

(24) Some analyses do look at unmet needs (Casado et al., 2011; Vlachantoni, 2019) and the price sensitivity of demand for home care (Roquebert and Tenand, 2017).

France, for example, occupancy rates in these facilities are increasing, now at 98%, with waiting lists often several months long (Muller, 2017). What will happen when the baby boom generations reach advanced ages? The supply of home care is also under pressure in many regions, with the in-home care sector suffering from a significant lack of appeal on the labour market (OCDE, 2020).[25] In Australia, for example, just over a third of vacancies for in-home caregivers go unfilled due to lack of applicants (Government of Australia, 2017).

However, once again, the issue is not only quantitative. Future generations of older people facing activity restrictions will potentially demonstrate new behaviours and a different demand for long-term care than previous generations, particularly when it comes to deciding whether to rely on their children's help or seek professional assistance. The experience of generations who were caregivers for their own parents may well influence their demand; they might, for example, organize professional assistance for certain activities or make arrangements that will enable them to postpone their need for help. To meet changes in demand, new technologies and modes of assisted living will undoubtedly be developed (robotics, home improvements, new services, etc.), but it is not currently possible to anticipate the repercussions of these developments on the cost of care.

The role of family support

How much support is provided by families?

As previously mentioned, particular attention is paid to family caregivers looking after their dependent spouse or parents. In the early 1980s, in the introduction to a special issue of the French journal *Gérontologie et société* devoted to 'family and generations', Paul Paillat emphasized the lack of data on the 'hidden families' caring for frail or disabled people. For a long time, support for loss of functional independence remained confined to the domestic sphere, excluded from any recognition as socially useful (Maisonnasse, 2016). Today, the situation is quite different. For nearly 20 years, various national and international surveys conducted in the general population have highlighted the major role of family support for older people who can no longer perform certain ADLs alone.[26] As well as extensive research, family caregivers now form the subject of specific public policies in many countries.

Research on caregivers has shown that in all OECD countries, regardless of the specific social protection models and family support norms of each country, family and friends (family in particular) are the main source of assistance for older people unable to live independently (OECD, 2019). This

(25) A recent study conducted by a major French home help federation estimates that nearly 10% of requests for home help from older adults could not be met in full due to a lack of staff and financial resources (UNA, 2018).

(26) The many surveys that have contributed to a better understanding of individual and family caregiving behaviours include the SHARE survey in Europe, the HRS and NLTCS surveys in the United States, and the JSTAR survey in Japan.

'informal' caregiving is, in most countries, more frequent, more time-intensive, and more diversified than the 'formal' caregiving provided by professionals. In 2015 in France, 3 million people aged 60 and over living at home reported they were regularly assisted with ADLs because of their age or a health problem (Brunel et al., 2019); 48% of them received help from family and friends only, 34% from family and friends and from professionals, and 19% from professionals only.[27] The (median) duration of informal caregiving is 5 hours per week compared to 55 minutes of professional care. The latter is generally limited to housekeeping, bathing, dressing, and meal preparation, while informal caregiving also includes shopping, medical appointments, travel, administrative tasks, coordinating professional interventions and, very often, supervising medical treatment as instructed by medical professionals.

Informal caregiving is a major pillar of the social protection system for dependent older people in all European countries, although it may take different forms (Colombo et al., 2011). Fontaine (2017) shows that almost 80% of dependent older people receive informal care, across Germany, Spain, France, Italy, the Netherlands, and Sweden. Informal caregiving increases with the severity of disabilities in a similar way in all six countries. Modes of care, however, vary significantly. In Southern Europe (Spain and Italy), older people unable to live independently are more likely to cohabit with one of their children than elsewhere (27% in Italy and 35% in Spain compared to around 10% in France and Germany and less than 5% in the Netherlands and Sweden in 2004). When care is organized remotely, it mostly occurs at least once a week and very often daily. In Northern Europe, more dependent older people live alone (63% in Sweden and 58% in the Netherlands compared to 46% in Germany, 40% in France, 37% in Italy, and 32% in Spain). Remote support is more frequent than in Southern Europe, but in most cases it is occasional. The countries of 'continental' Europe (Germany and France) are in an intermediate situation.

The significance of family support has led to the development of social science research aimed at better understanding helping behaviours, their determinants, and their implications. How is support organized within the family? Why do some individuals in the same family become involved in care and others not? How is assistance shaped by family configurations, the characteristics of potential caregivers, the needs of the parent, or the available professional assistance? What are the consequences for caregivers? In the context of an ageing population, a better understanding of family caregiving patterns is crucial to our comprehension of two issues: the role that social protection

(27) Based on the DREES EHPA nursing home survey conducted in 2015, it is estimated is that 72,800 people were residing in a nursing home (Muller, 2017) and that 80% of those receiving regular assistance were living in ordinary housing and 20% in residential facilities. This distribution, however, depends greatly on the need for assistance. The proportion of people in institutions increases sharply with level of dependency: among the most dependent people receiving the personalized functional independence allowance in 2018, 32% were cared for at home and 68% in an institution (DREES Welfare Survey).

systems attribute to family support in care provision and the possible mismatch between the supply of and demand for informal care.

The role of family support within the social protection system

The first issue concerns the role that social protection systems attribute to family support for older adults provided alongside state assistance. Because family support generally takes the form of unpaid services, there is a risk that informal caregiving is equated with costless production and that the burden of dealing with activity restrictions in advanced age is placed, to an excessive extent, on families (Fontaine, 2017). Research focuses on the consequences of informal caregiving by looking at two aspects of caregivers' quality of life: their health status and their participation in the labour market. Economic and epidemiological studies have highlighted the negative effects of caregiving on the mental health of caregivers, such as stress, anxiety, depression, etc. (Coe and Van Houtven, 2009; Do et al., 2015). According to the literature,[28] there is a substitution effect between working hours and informal caregiving, but it mainly affects relatives closely involved in caregiving—and mostly women. Most often, professional life is preserved at the cost of a reduction in family and social time (Bihan-Youinou and Martin, 2006).

These results, as well as findings pointing to the social inequalities created by intra-family transfers,[29] have contributed to making family caregivers a target of social policies. There are two possible public policy approaches to reducing the burden on family and friends. The first would aim to support informal caregivers by reducing the indirect costs they bear, such as leave, compensation, specific medical monitoring, and development of respite services.[30] This line of public action is not intended to reduce family support but to 'help carers to provide care' by reducing the cost of caregiving on their professional life, health, and overall quality of life. The second approach would aim to reduce the involvement of caregivers by significantly increasing the accessibility of professional care.

Mismatch of supply and demand for informal care

The second issue associated with demographic ageing is the potential for increasing divergence between demand for and supply of informal support. On the one hand, population ageing results in an increase in older people requiring daily assistance.[31] On the other hand, the supply of informal assistance may

(28) See, for example, the international literature review by Bauer and Sousa-Poza (2015).

(29) See, for example, the analysis by Déchaux (1994) on the anti-redistributive nature of family transfers and the more recent analysis by Fontaine (2019) on the social inequalities specific to the informal care of dependent older adults.

(30) Respite care services give caregivers the opportunity to free up some time by hosting the person they care for during certain periods of the day or night or for several consecutive days (temporary accommodation). Some services also offer the option of providing respite care at the home of the person being looked after.

(31) The expected increase in the demand for informal caregiving should, however, be confirmed, as family-care-seeking behaviours may change from one generation to the next.

decrease due to rising divorce and separation rates, a fall in the number of children, the increasing participation of women in the labour market, and the growing geographical distances between children and parents (Colombo et al., 2011).

The assumption that informal caregiving is decreasing should certainly be put into perspective. If we look at family environment, the projections made in Europe tend to contradict conventional wisdom. In the medium term, in Europe, care-dependent older people will have a larger family network than they do today (Gaymu, 2008). Froment et al. (2013) for France and Carrière (2008) for Canada reach similar conclusions. The reduced risk of widowhood resulting from the increase in life expectancy would more than compensate for the increasing frequency of divorces and separations, and would mitigate the impact of fewer children per family on the size of the family circle.

However, having a larger family only offers potential resources for informal caregiving. As mentioned above, various socio-economic developments may reduce the actual involvement of potential caregivers, such as the increasing female employment rate or increasing geographical distances between children and their parents. There is relatively little prospective research aimed at anticipating trends in actual informal caregiving. While the research that does exist points to a decrease in family support, socio-economic changes seem to have only a very limited effect on the ability of family members to be closely involved in caregiving (Pickard, 2008; Janus and Doty, 2018). Demographic and socio-economic changes in potential caregivers may have only a modest effect on the overall amount of help actually provided by the family group if, within the same family group, the lower involvement of some members is compensated by the higher involvement of others.

3. Changes in family configurations at advanced ages

Longer life expectancy, lower fertility, and the arrival of baby boom cohorts at retirement age are profoundly changing the family configurations of older people. The increase in life expectancy lengthens the time horizon of individuals and increases the number of periods spent in different family configurations during the latter part of the life cycle. It leads to families in which four generations can coexist. As for the decline in fertility, it reduces the size of families. Finally, the arrival of post-war cohorts at retirement age, as well as having a numerical effect, contributes to these changes because their family trajectories are different from those of previous generations, with more divorces, cohabitation, and blended families (Bonvalet et al., 2015; Agree, 2018). In the United States, about 30% of women born in the 1930s and married once were divorced by age 60 compared to nearly 40% of the baby boom cohorts (Kreider and Ellis, 2011). In France, 1 in 10 women were divorced before the age of 60 in the mid-1990s and more than 3 in 10 in 2018.[32] Moreover, these cohorts have new

(32) Two in 10 women were still divorced at age 60, with some having remarried by that age.

marital behaviours at older ages. Union dissolutions (excluding widowhood) and remarriages, previously uncommon, have become more frequent.

These changes in family structure have important implications. Being in a couple[33] and having children affect standard of living, institutionalization,[34] mortality,[35] and intergenerational relations. Family configurations and social protection systems influence each other. A certain degree of support and responsibility exists within couples and families (Weiss, 1994), in coordination with public policies. As such, family support and state assistance can be complementary and/or substitute one another, depending on the situation. The diversification of family structures may also give rise to new forms of support systems within families, on which research remains to be done. The consequences may vary according to gender and social category (due to different life expectancies but also to different behaviours) and may produce inequalities among older people.

Fertility trends across cohorts and their implications

The decline in fertility

In France, the mothers of early generations of baby boomers (born in the 1930s) had an average of 2.6 children, and nearly a quarter of them had four or more. Thirty years later, their daughters (born in the 1960s) had an average of 2.0 children, and 9% of them had four or more. This decline in the number of large families has been accompanied over the generations by a convergence of family size around two children, with the share of women with one or three children remaining relatively stable at around 20% (Brée, 2017).

The decline in the number of children per family is not necessarily associated with a reduction in informal caregiving since the latter is impacted not only by the number of children but also by their relationships and how they organize themselves to assist their parents. The problem of future informal care arises particularly for individuals without children, whose proportion is increasing. Childlessness increases the likelihood of institutionalization (Freedman, 1996). It also seems to be associated with poorer well-being at older ages (Dykstra, 2009). Over the period 1998–2010, 6.6% of Americans aged 55 and over had no spouse or biological children, and this proportion is increasing in the most recent cohorts (Margolis and Verdery, 2017).

More specifically, in France the proportion of women without children fell slightly between the 1930s and 1940s before rising again to 14% in the 1960s (Brée, 2017). This upward trend from the 1940–1945 generations onwards can be observed in many neighbouring countries, although the rate of growth and

(33) Due to economies of scale.

(34) The spouse is the primary informal caregiver in the event of loss of functional independence. In his or her absence, the probability of entering an institution is higher.

(35) It has long been observed that married persons have a lower mortality rate than those not married at a given age (Manzoli, 2007). Whether this is a selection or causal effect remains unresolved.

the levels reached vary between generations. For cohorts born in the late 1960s, the proportion of women without children is similar in France and Sweden (around 14%) and slightly lower in Norway, Denmark, and Portugal (around 12%). The ratio is 1 in 5 women in Italy, Spain (16%), Switzerland, and Austria, and it is almost 1 in 4 in the former West Germany (Sobotka, 2017). In the United States, the proportion of childless women is 10% for the 1943 cohort and roughly 16% for the cohorts born in the late 1950s (Frejka, 2017). At the global level, in an analysis of 34 countries comprising 70% of the world's over-50 population, Verdery et al. (2019) also highlight the wide variability in the share of adults without a biological child or partner, from 10% in Canada, Ireland, the Netherlands, and Switzerland to less than 2% in the Republic of Korea.

Finally, while the generations now entering retirement may have fewer traditional sources of support (spouses or biological children), they have more surviving ex-spouses, stepchildren, and siblings (Agree, 2018; Seltzer, 2019). The question of how support is organized in these new family configurations remains largely open and poses new research challenges.

More coexisting generations within families

The fall in numbers of siblings is accompanied by an increase in the number of coexisting generations within families because of longer life expectancy (Bengtson, 2001). More individuals approaching retirement age now have children and grandchildren as well as parents who are still living. In France, the coexistence of four generations increased from 26% for women aged 50 born in 1920 to 44% for those born 30 years later in 1950 (Pennec, 1996). In the United States, over the period 1998–2010, 40% of adults in their 50s had a four-generation family (Margolis and Wright, 2017). Also in the United States, the share of children aged 10 with four living biological grandparents rose from 6% in 1900 to 41% in 2000 and was expected to reach 48% by 2020 (Uhlenberg, 2005). This vertical extension of families leads, among other things, to the potential diversification of support systems within them. Interactions and support can be multidirectional: between grandparents and grandchildren, and between parents and adult children, and not solely between adult children and dependent parents or parents and young children (Margolis and Verdery, 2017).

Higher prevalence of late-life couples

If behaviours remain unchanged, the decline in mortality and the closing of the gender gap in life expectancy increase the likelihood of living with a partner, at all ages. While in France in 1980, 2.1% of married men aged 75 became widowers in that year, 20 years later the risk was only 1.2%. For women, at the same age, this risk fell from 7.0% to 5.1% (Delbès and Gaymu, 2003). The phenomenon is accentuated by a greater fall in mortality among married individuals than others (Valkonen et al., 2004; Kravdal et al., 2018). However,

changes in certain marital behaviours, such as the rise in divorce, could work in the opposite direction. This could be the case for men aged 75–84, among whom the proportion of married men is predicted to fall slightly by 2030 (Kalogirou and Murphy, 2006; Gaymu et al., 2008a). On the other hand, for older men aged 85 and over and for all women aged 75 and over, the significant decline in widowhood is likely to more than offset this behaviour change and would therefore result in a significant increase in the proportion of married individuals. Married individuals benefit from the presence of their spouse in situations of dependency. These developments might therefore reduce the strong gender imbalance in the care of dependent spouses. In 2000, for example, in people aged 85 and over, the age at which the gender differences in marital status are greatest, men were almost 5 times more likely than women to be living with a partner (50% vs. 9%). By 2030, this ratio is expected to decrease to 2.5 (Gaymu et al., 2008a).

A significant increase in divorce rates

One of the key features concerning partnerships over the last 2 decades is the sharp increase in divorce at late ages, prompting demographers to coin the term *grey divorce revolution* (Brown and Lin, 2012). Brown and Lin (2012) showed that in the United States, more than a quarter of individuals who had divorced in 2010 were over 50 compared to only 10% in 1990. The explanation lies not only in large generations reaching these ages but also in the increased risk of divorce. The divorce rate has doubled in the last 20 years, from 5 to 10 divorces per 1,000 married individuals aged 50 or over. In France, while the risk of divorce remains lower after age 50 than at younger ages, it is in this age group that it has increased the most over recent years. During the 2000s, the relative increase in risk of divorce was correlated with advancing age, up to the age of 70 (Prioux and Barbieri, 2012). Risk of divorce is 2.8 per 1,000 and 2.0 per 1,000 for men and women aged 60 and over. This appears to be relatively low but has increased by a factor of 1.5 at ages 50–54 and by a factor of 1.9 after age 60 since 2000 (Solaz, 2021).

This strong increase in divorce is prompting new research on the determinants and implications of marital behaviours at advanced ages (Brown et al., 2016, 2019). Divorces at older ages appear in many respects quite different from those at younger ages: fewer dependent children, greater difficulty in returning to the labour market, less repartnering, and more often associated with poor health, concomitant transition to retirement, etc.

Rise in partnering and repartnering

Divorce among older people has increased, as has partnering and repartnering. Recent literature has focused on the type of union (cohabitation or marriage), on the determinants of such (Vespa, 2012; Brown et al., 2019) in a context where cohabitation is now more widespread (De Jong Gierveld,

2004), and on whether these new relationships are a way of mitigating the consequences, particularly the financial consequences, of divorce, especially for women.(36)

Here again, partnering behaviour at these ages is different from that at younger ages (Bonnet et al., 2019a) and markedly different in women and men. In particular, due to longer female life expectancy, the ratio of men to women in the marriage market becomes more favourable to men over time. This may be one of the reasons why they are more likely to repartner. Women are also more reluctant to repartner due to the persistent asymmetry in family and domestic activities; they are much more involved in domestic or caregiving tasks (Brown et al., 2018; Lewin 2018). Those who repartner after age 50 are more likely not to cohabit than at intermediate ages, primarily to maintain their independence (Régnier-Loilier et al., 2009; Liefbroer et al., 2015).(37) In France, around 6% of men and 5% of women in a relationship aged 55–64 are in non-cohabiting relationships (Régnier-Loilier, 2019). This proportion is 4 times higher than in Italy for women aged 60 and over (Régnier-Loilier and Vignoli, 2018).

Changes in the living arrangements of older people

When looking at the living arrangements of older adults, we have to distinguish between ordinary and collective households, i.e. residential institutions for older people.

Older people in institutions

Making international comparisons of the proportions of older people living in institutions is not straightforward. The definition of care institutions for older people can vary between countries, primarily due to the varying diversity of housing types and the scope of residents considered. OECD data (OECD Health Statistics, 2020), for instance, discloses the social model of long-term care for older adults rather than other types of collective residences with services. For France, the proportion of over-65s living in institutions is estimated at 4% by the OECD, which only takes dependent older people into account.(38) If we expand the population to include all institutions for old people, we conclude that 5.6% of the over-65s live in an institution. In the United States and Spain, depending on the scope of the population, the proportion of older people in institutions may double.(39) According to the OECD definition, the share of over-65s in institutions is lower in countries such as Spain and Italy (around 2%) and

(36) On average, divorce is accompanied by a decline in women's standard of living. Repartnering could be considered a way to limit the decline in financial resources.

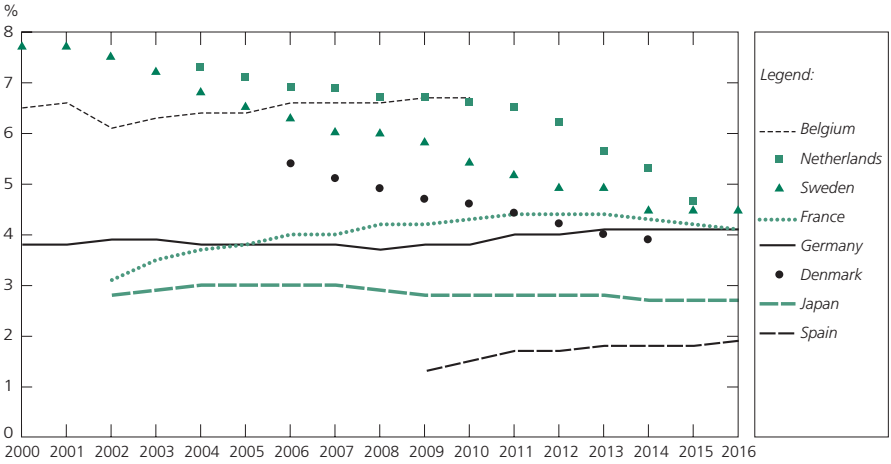
(37) These non-cohabiting couples are referred to in the international literature as 'living apart together'.

(38) Residents of institutions for older people receiving the personalized functional independence allowance (*allocation personnalisée d'autonomie*).

(39) It doubles if all the over-65s living in assisted-living settings in the United States are included (Freedman and Spillman, 2014) and if all retirement-home residents in Spain (2011 data) are included.

slightly higher in the United States (2.5%). The share in Sweden, Denmark, and Germany is close to that of France (around 4%), as shown in Figure 17. A notable phenomenon is the downward trend in this share in northern countries (Denmark, the Netherlands, and Sweden), which have long been 'deinstitutionalizing', a phenomenon introduced in Sweden in the post-war period.

Figure 17. Trends in the share (%) of over-65s in institutions in 8 high-longevity countries, 2000–2016



Note: The OECD reports a number of series breaks in the definition of institutionalized persons. This justifies taking only isolated points into account for some countries.

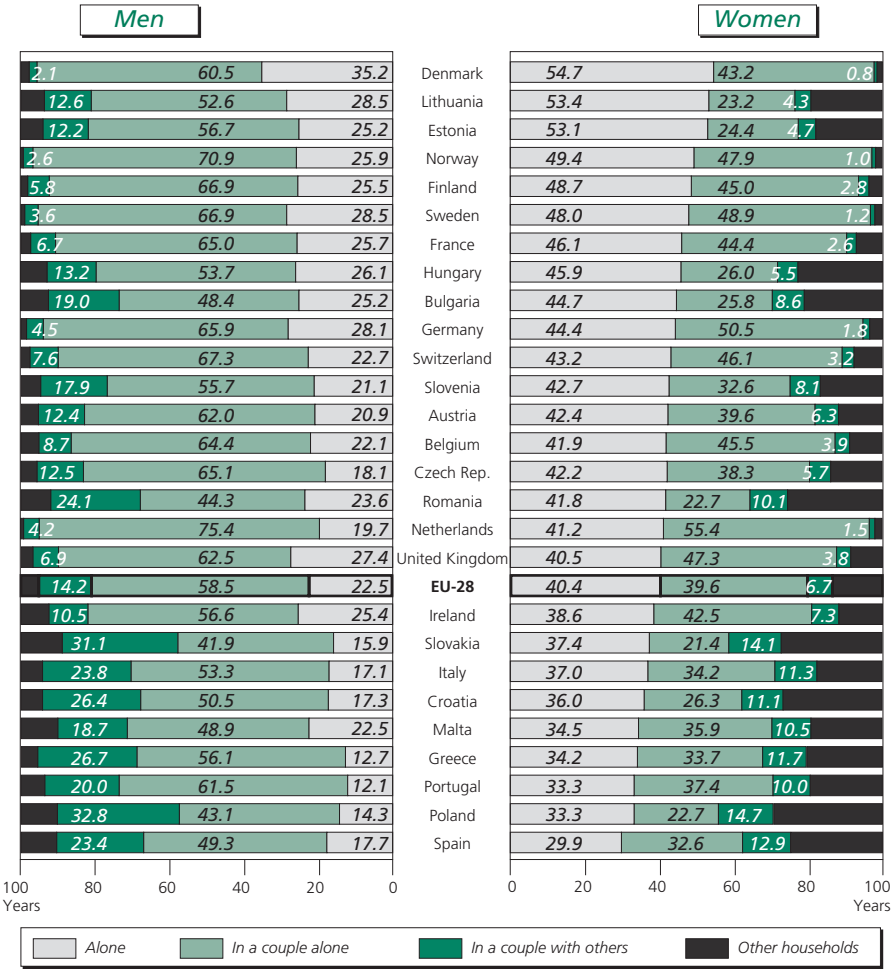
Source: OECD Health Statistics, 2020.

While the proportion of over-65s in institutions is relatively low, it increases rapidly with age. In France, according to the census, in 2013, 3% of 70- to 74-year-olds, 12% of 80- to 89-year-olds, and 30% of 90- to 99-year-olds lived in institutions for old people, and 1 in 2 centenarians lived in an institution (Blanpain and Buisson, 2016a). While there is a great deal of research on the informal caregiving provided by families in later life, most of it focuses on ordinary households. Very few studies address family connections and informal help in the context of institutionalization, mainly due to the lack of data (Agree, 2018).

Family configurations of older persons in ordinary households

The family configurations of over-65s vary greatly by gender, country (Figure 18), and age (Figure 19). In the EU-28, in 2017, 4 in 10 women aged 65 or over live alone, and the same proportion live with a partner. The other women live with children or in complex households. These proportions are very different for men, who are twice as likely to live alone (22.5%), and nearly 6 in 10 live with a partner. Differences between countries are significant. The share of women aged 65 and over living alone is lowest in Spain (29.9%) and highest in Denmark (54.7%), followed closely by Lithuania and Estonia.

Figure 18. Family configurations of men and women aged 65 and over in EU countries, 2017

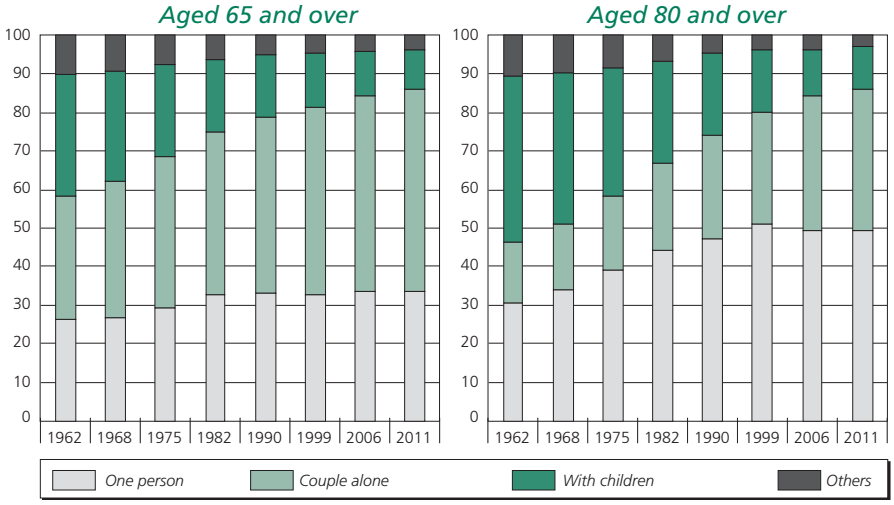


Source: Eurostat from EU-SILC.

All developed countries experienced an increase in the proportion of older persons living either alone or with a partner, during the 20th century. In the United States, for example, in the mid-19th century, nearly 70% of over-65s coresided with their adult children; by the end of the 20th century, less than 15% did so (Ruggles, 2007). In France, in the 23 municipalities (*communes*) studied by Bourdieu et al. (2013), the coresidence of over-60s (in couples or alone) with at least one person under 60 (whether a family member or not) fell from 68% in 1846 to 53% in 1931.[40] In France, the proportion of over-65s living alone has increased by almost 30% since 1960, and the share of over-65s

(40) The municipalities surveyed included four towns/cities and 19 rural districts.

Figure 19. Trends in the living arrangements of over-65s and over-80s in France, 1962–2011



Source: United Nations (2019a). United Nations Database on the Living Arrangements of Older Persons, United Nations Population Division (Department of Economic and Social Affairs).

in couple-only households has risen by more than 60% (Figure 19). These changes are even more marked among the over-80s. There has been a sharp decline in coresidence with children.

Various determinants explain the changes in these cohabitation patterns: changes in marital behaviour, the longer survival of couples (associated with the closing of gender gaps in life expectancy), lower number of children, and improvements in the health of older adults (McGarry and Schoeni, 2000). But economic factors also play a part. The greater financial independence of older people, particularly because of the development of pension systems, is also a factor in the decline in intergenerational coresidence (Costa, 1999; McGarry and Schoeni, 2000). Ruggles (2007) attributes part of this decline to the decline of farming families, an environment in which intergenerational coresidence was widespread.

4. Ageing, pension systems, and transfers

At the macroeconomic level, the growing proportion of older people raises questions about the financial sustainability of social protection systems, particularly those closely linked to age, such as pensions, health care, and long-term care for the older population. At the individual level, as mentioned above, the increase in life expectancy significantly affects the 'timings' of the life cycle, the needs associated with various ages, and individual behaviours regarding savings and intergenerational transfers: the decision to save or not in the face of an increasing period of retirement; behaviours concerning monetary or time transfers to other generations; and labour market behaviours (including

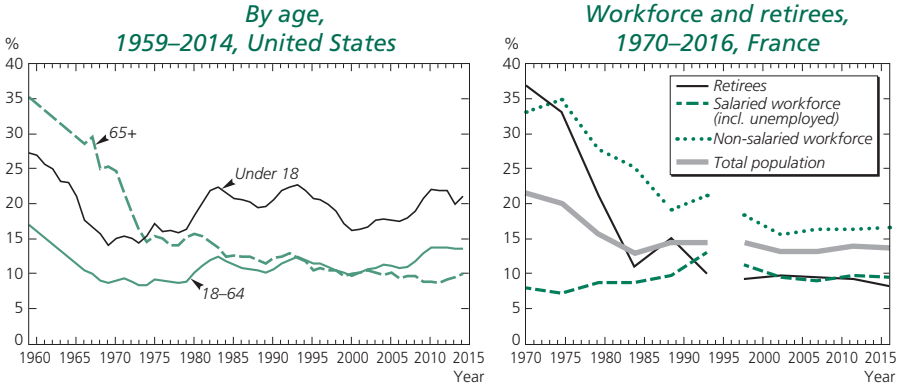
retirement). There is no doubt that the diversification of professional, family, and health trajectories, and of the situations of individuals in retirement will force changes to social protection systems. However, the extent and nature of the changes required remain uncertain. This issue calls for a better understanding of the financial situations of older people and their needs.

Improvements in the financial situation of retirees

Poverty rate among retirees

The 20th century was marked by the development and progress of pension systems, both in coverage and pension levels. The poverty rate among older people fell sharply in the 1960s and 1970s in many countries, as seen in the United States and France (Figure 20). In the early 1970s, poverty affected more than a third of retirees in France compared to just over 20% of the general population. By 2016, it had dropped to 8% compared to nearly 14% of the general population. Retired people are now in the same situation as employed people, 6 points below the national average. This situation has been broadly stable since 2000. The decline in poverty among the over-65s is of roughly the same magnitude in the United States, where the rate fell from 35% in 1959 to 10% in 2014.

Figure 20. Changes in poverty rate

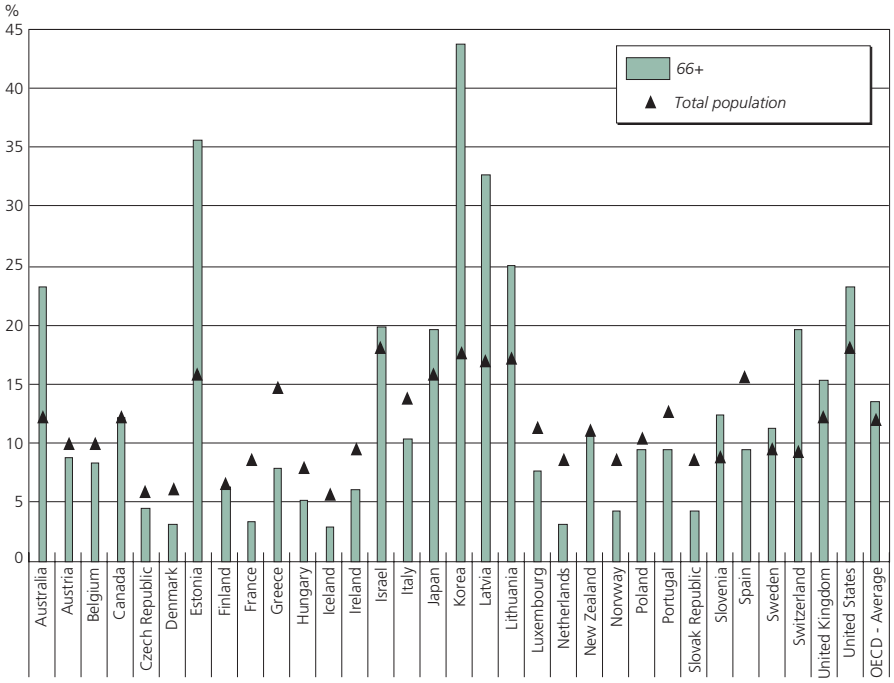


Note: In the United States, the poverty rate is defined in absolute terms based on a minimum consumption basket using data from the Current Population Survey Annual Social and Economic Supplements produced by the Census Bureau. In France, it is defined by INSEE as the proportion of ordinary households (before 1996) or of individuals living in ordinary households (after 1996), whose standard of living is below the poverty line (equal to 60% of the median standard of living of the entire French population) based on the Tax and Social Income Surveys from 1970 to 2016. As such, the poverty levels of the two countries are not directly comparable.

Source: Marchand and Smeeding (2016) for the United States; COR (2019) for France.

The relative position of retirees compared to the national average is not favourable everywhere, however, and situations vary widely across OECD countries (Figure 21). In half of the 32 countries, people aged 66 and over are slightly less poor than the national average; in around 10 their situation is

Figure 21. Poverty rates for people aged 66 and over and the total population in 32 OECD countries, 2016



Note: The poverty rate threshold here is 50% of the median standard of living.
Source: OECD (2019).

comparable; and in six countries they are significantly worse off (Australia, Estonia, Republic of Korea, Switzerland, Lithuania, and Latvia).

While poverty among retirees has generally declined, some groups remain economically disadvantaged. Smeeding (2003), using data from the Luxembourg Income Study for European countries and the United States, notes that poverty is generally higher at older ages and higher among women and individuals living alone than among those living with a partner. Marital status is also associated with different levels of poverty. From the European Community Household Panel (1994–2001), de Santis et al. (2008) observe that among women aged 65 and over, those who have divorced and separated and, to a lesser extent, those who have remained single have a higher probability of being poor than widows.[41] The latter often benefit from a survivor's pension which limits the reduction in their resources upon the death of their spouse (Thompson and Carasso, 2002).

(41) Income level and marital status may be related. The lesser disadvantage of never-married women compared to separated or divorced women is partly related to the higher educational attainment of currently retired women who have remained single.

Several factors are behind this generally favourable trend in the situation of retirees. The increase in the share of retirees in a union may be one of them, but there is no doubt that the development of pension systems has played an important role. Public transfers (including earnings-related pensions) represent the most important component of the income of over-65s in many countries (OECD, 2019b), although the proportion may vary between countries, depending mainly on the organization of social protection systems. For the over-65s in Germany, Italy, and France, it represents more than 70%, while it only constitutes 40% of their income in the United States. Other resources come from work, income from assets, or company pensions. However, this rather favourable situation for retirees could be under threat. Given pressures on public spending, particularly on pensions, it is likely that developments will be less favourable. The European Commission's projections indicate a likely downward trend in the ratio of average pension to average wage in many European countries, primarily because of the reforms implemented to ensure the financial balance of pension schemes (European Commission, 2018). As pensions represent a significant proportion of older people's resources, this would normally result in a decline in the relative standard of living of retirees compared to the rest of the population.(42)

Longer retirements: the financial sustainability of pension systems

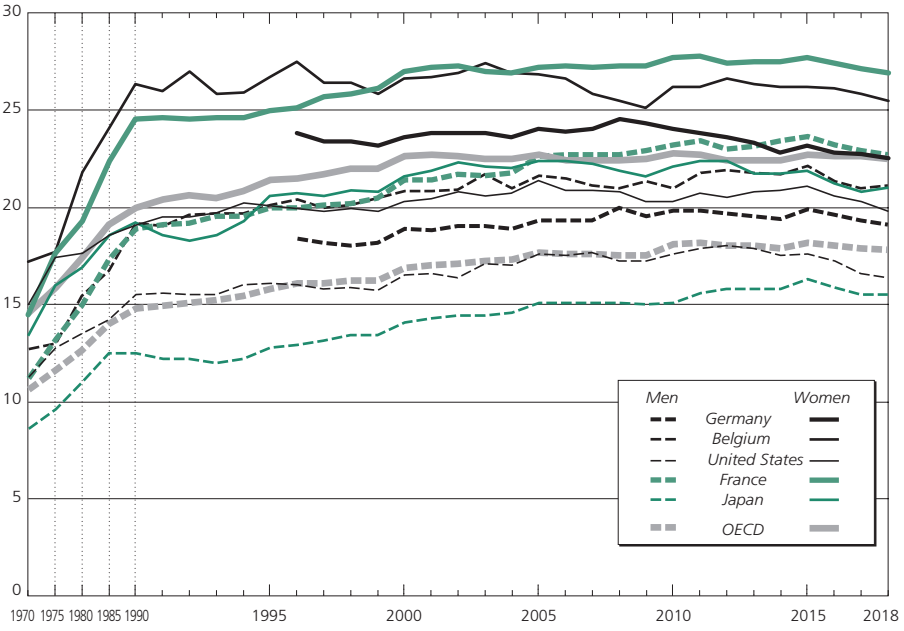
Because of longer life expectancy and activity patterns at older ages, the expected years in retirement has been steadily increasing. Calculated here as residual life expectancy at the age of effective labour market exit, in 2018 in France it was 22.7 years for men and 26.9 years for women, one of the longest in developed countries. In 1970, it was only 11.2 and 14.5 years (Figure 22), a near doubling of duration in 4 decades (OECD, 2019).

This extension of the retirement period and the relative rise in pension levels (compared to salaries), coupled with the arrival at retirement age of the large baby boom cohort, have for many years raised the question of the financial sustainability of current pension systems. Pension expenditure as a share of GDP has risen almost everywhere since 1990 (Figure 23), particularly in France (27% increase) where it rose from 11% of GDP in 1990 to 14% in 2015.

Two key factors explain the differing trends between countries: the increase in the older population (demographic effect) and the scale of the state's relative efforts in favour of the over-60s (ratio between pension and survivor's pension expenditure per person aged 60 years and older and GDP per capita). The 2.5 percentage-point increase in pensions expenditure as a share of GDP in France over the period 2000–2016 is mainly explained by this demographic effect. In

(42) The economic crisis following the COVID-19 health crisis may affect this somewhat. The more significant worsening of the financial situations of the workforce compared to retirees could lead to a short- or medium-term increase (depending on economic forecasts) in the standard of living of retirees relative to that of working people.

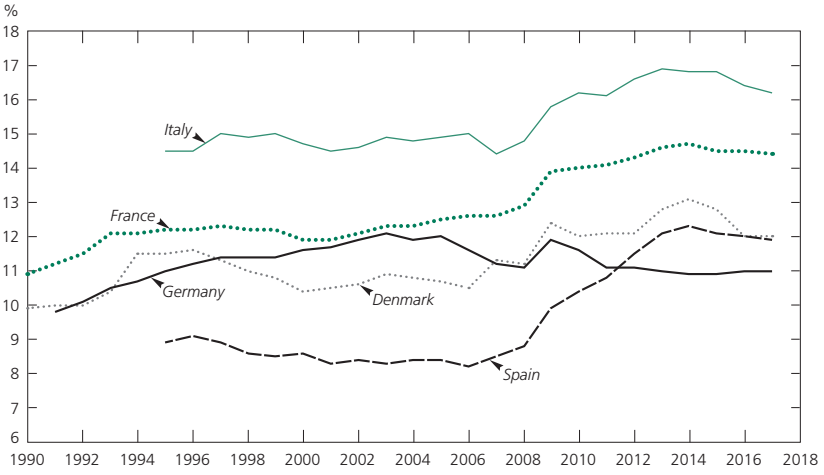
Figure 22. Trends in expected years in retirement* in 5 OECD countries, 1970–2018



* Length of expected remaining life expectancy from the time of average labour market exit

Source: OECD (2019), based on national labour force surveys and the European Union Labour Force Survey (EU-LFS, 1970–2018).

Figure 23. Share of pension expenditure in GDP (%) in 5 European countries, 1990–2017



Note: Expenditure on retirement and survivor's pensions.

Source: Eurostat, SESPROS.

Germany, the demographic effect over the same period is a bit less pronounced, and reforms undertaken to control pension expenditure led to a decrease in the relative effort made in favour of the over-60s, resulting in a slight fall in pension expenditure as a share of GDP. In Spain, on the other hand, both factors work in the same direction, contributing to a 3 percentage-point increase in the share of expenditure (Gonzalez et al., 2019).

The question of the financial sustainability of pension systems in the context of demographic ageing is not new. In France, it was raised in the earliest issues of *Population*, notably by Paul Vincent (1946). He mentioned three factors associated with the balance of the pension system that remain relevant today: the contribution rate, which, applied to the wage bill, has consequences on the level of resources; the pension level, which has an impact on expenditure; and the retirement age, which can affect the other two factors by increasing contributions and decreasing expenditure. In an analysis of Vincent's article 50 years later, Blanchet (2016) mentions the change in the nature of ageing and the problems facing the pension system. In 1946, Vincent talked about 'bottom-up ageing', which could be slowed down by an increase in fertility or immigration, but current ageing in developed countries with low mortality is more like 'top-down ageing', linked to longer life expectancy. Whereas the large baby boom generations temporarily masked the top-down ageing that was under way by making the population younger, they are now accelerating the population ageing process as they retire (Blanchet and Le Gallo, 2013).

Most countries have implemented reforms to contain expenditure. These reforms have consisted of activating the three levers for balancing pension systems, to a different extent depending on each country's strategic choices. The key question is, to what extent is it possible to use the lever of an extended working life?

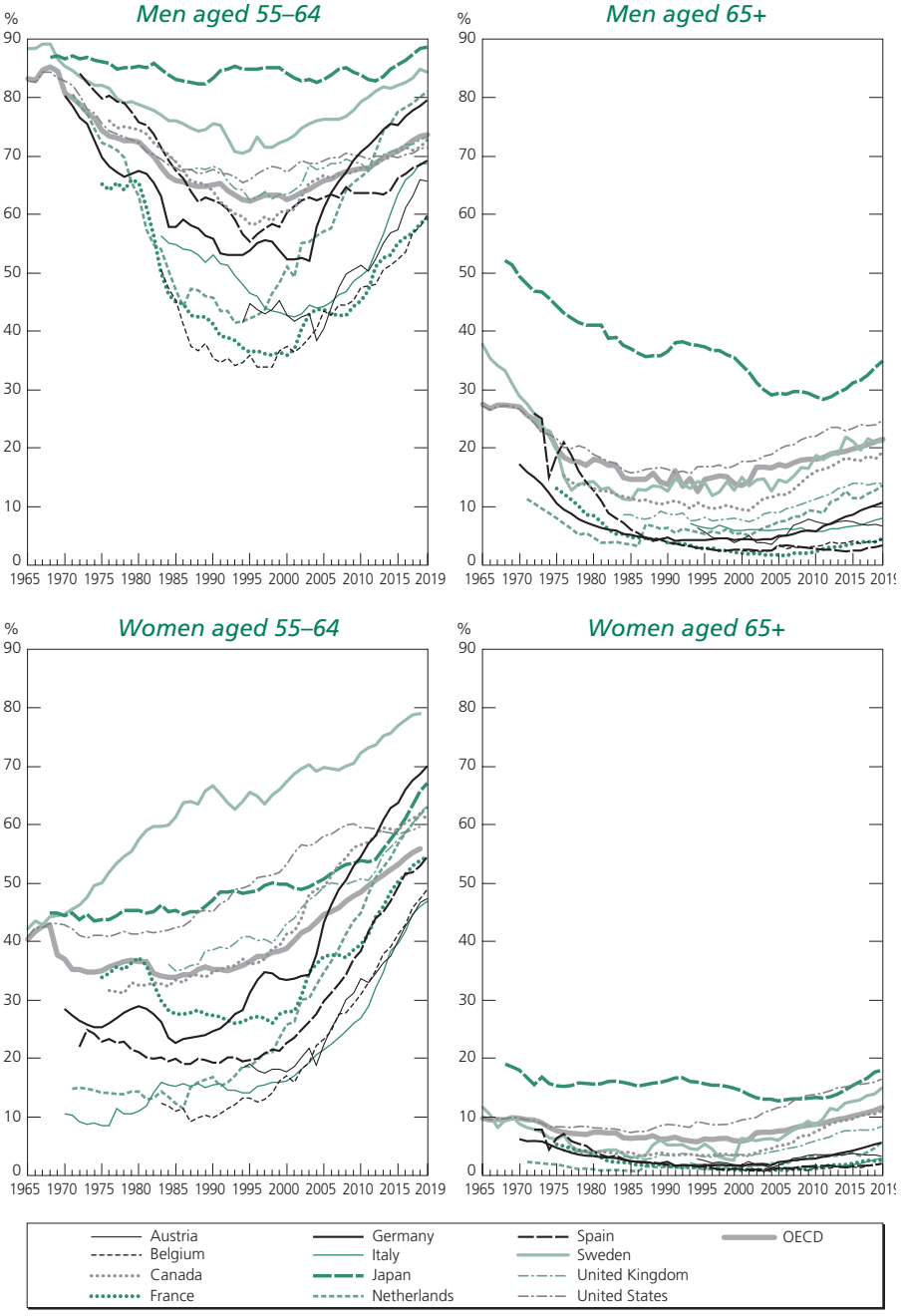
Work longer?

Since the early 1970s, the labour force participation rates of people aged 55–64 and the over-65s have followed a U-shape, falling until the mid-1990s and then showing an upturn (Figure 24). These trends are similar in many countries (Blundell et al., 2016).

This U-shaped effect is more pronounced in men than women (Figure 24), with the decline observed for men offset by a significant generation effect for women (Goldin and Katz, 2018). Women have been participating massively in the labour market since the 1970s thanks to rising educational attainment, changing gender norms, and the transformation of careers.

The literature has identified determinants of these changes in labour market participation at older ages. First, the decline in the participation rate observed until the early 2000s was linked to the development of pension systems and in particular to the increase in the 'generosity' of these systems and the absence

Figure 24. Labour force participation rate (%) in the over-55s in 12 OECD countries, 1965–2019



Note: The labour force participation rate is calculated as the labour force divided by the total working-age population.

Source: https://data.oecd.org/emp/labour-force-participation-rate.htm

of incentives to raise the retirement age (Gruber and Wise, 1999, 2004). The fall in the participation rate is also linked to mechanisms that enable people to leave the labour market before they actually retire (e.g. unemployment, early retirement, or disability). Next, the determinants of the reversal in participation rate of older persons have been analysed, but quantification of the effects remains complex (Blanchet et al., 2019). Besides the effects of institutional reforms[43] on pension systems and early retirement schemes, rises in levels of education and changing retirement age norms also have an impact (Seibold, 2019), as do the growing labour market participation of women, health improvements at later ages, companies' demand for labour, and age discrimination. Over the past 30 years, understanding retirement behaviour has become a major field of research (Coile, 2015). The objective has been to produce an *ex ante* evaluation of the implications and effectiveness of any pension system rules change on these behaviours.

Shifting the retirement age is one of the preferred paths of reform to balance the funding systems in almost all countries. With longer retirement periods ahead, it may seem justified to divide life expectancy gains between longer working lives and longer retirement periods. However, this raises questions about the individual's ability to continue working, particularly from a health perspective. A recent international comparison[44] evaluated health-related work capacity after age 55 (Coile et al., 2017): in general, health status does not hinder the extension of working life in older adults. This result becomes less conclusive, however, when the subpopulations are disaggregated by level of education or social category (Cazenave-Lacroutz and Godet, 2016). As such, policies to raise the retirement age should take this heterogeneity into account (Blanchet et al., 2017b).

The issue of the inequalities associated with an extension of working life echoes the question raised in recent years by the observation that inequalities in life expectancy associated with socio-economic status remain, or have even increased (Blanpain, 2016; Chetty et al., 2016), possibly resulting in unequal periods of time spent in retirement. Social groups with higher pension levels benefit, on average, from longer periods of retirement, which may reduce, to varying degrees, the redistributive nature of the pension system (Liebman, 2002; US National Academy of Sciences, 2015; Ponthière and Pestieau, 2016; Auerbach et al., 2017).

This finding shows that the entire life course has an impact on the health and retirement situations of the older population. Understanding these situations

(43) Here, the role of pension calculation scales (financial incentives to postpone one's retirement or the size of the penalty for early retirement).

(44) In the mid-1990s, the National Bureau of Economic Research in the United States launched an international programme to compare pension systems along various dimensions (Social Security Programs and Retirement Around the World) in a dozen developed countries (European countries, the United States, and Japan). The most recent phase of the project focused on the effects of pension reforms on the employment of older people (Börsch-Supan and Coile, 2021).

provides a complete picture of the public policy systems associated with the various stages of life.

Ageing and transfers between age groups and generations

An intergenerational approach is essential in analysing the situations of older people and the consequences of population ageing. The funding of pay-as-you-go pension systems, i.e. the financing of retirement pensions, at a given point in time, by current workers, raises the issue of how resources are allocated between age groups. Looking beyond pensions, population ageing also poses questions about the redistribution of resources between age groups, how significant this is, how it is organized, and the potential for competition between age groups (or generations) for these public resources. In a 1984 address to the Population Association of America in the United States, Preston (1984) contrasted the relative improvement in the economic situation of older people with the deterioration of that of younger people and children in the United States, noting a rise in the poverty rate of the latter groups. One of the reasons he gave for this was that public spending was more favourable to older people than to children. Other authors have deepened this analysis of the trade-offs—and potentially conflicts—in the allocation of resources between age groups and generations, opening up numerous debates (Bonnet, 2011). This has given rise to the concept of generational equity (Williamson and Watts-Roy, 1999).

Transfers between age groups are primarily aimed at reallocating the wealth produced at certain ages of life (working ages) to non-productive ages (youth and retirement), to allow all individuals to consume. Funding of consumption at non-productive ages is sourced through three channels: the family (via intrahousehold transfers, parent–child and child–parent transfers), the state (via public transfers, budgetary expenditure, and national social security contributions and income tax), and the individual (via savings). The size of these transfers, whether family, public, or individual, depends on age and life span, which determine the length of productive and non-productive periods (education, career, retirement, etc.) and the number of people within these periods at a given point in time. Transfer capabilities will be profoundly affected by ageing and more specifically by the changing age structure of populations (Lee, 1980). Two methodologies have been used to analyse transfers and the evolution of balances: generational accounting and national transfer accounts.

Generational accounting

Generational accounting, first implemented in the United States 30 years ago by Auerbach et al. (1991) and Kotlikoff (1992), calculates net transfers to or from the state for each generation: the difference between all benefits received (retirement, health, unemployment, family, etc.) and taxes and contributions paid. Assuming that social and tax legislation remains unchanged for all generations currently living, we can calculate what future generations will have

to pay to ensure the financial sustainability of public spending in the long term.[45] Generational accounting generally leads to the conclusion that future generations will have a strong disadvantage, with a particularly high tax burden. While this approach has been applied in many countries (Raffelhuschen, 1999), it has been met with a number of criticisms[46] (Masson, 2002; d'Albis and Moosa, 2015). It is less widely used today. It this context, a second methodology was developed: national transfer accounts.

National transfer accounts: a measure of economic flows between age groups

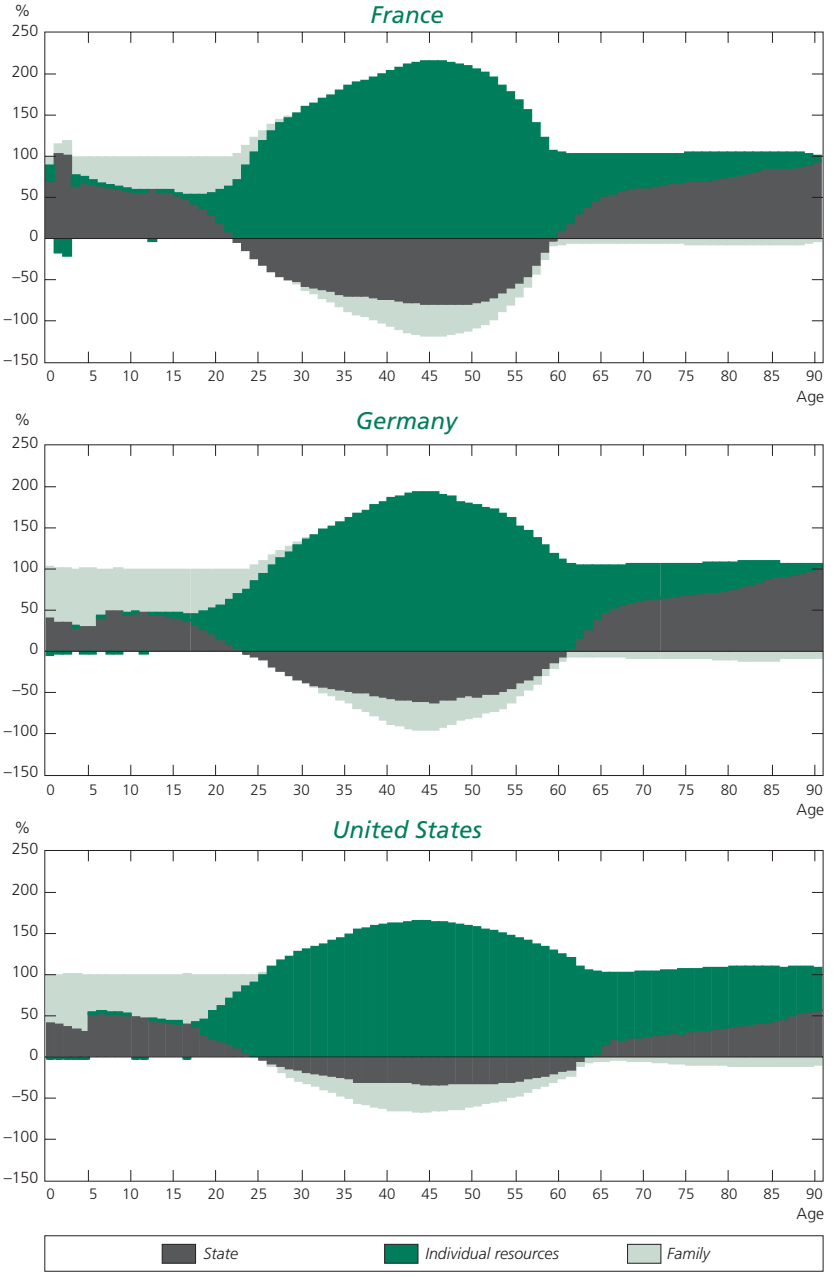
Initiated in the United States, the purpose of the national transfer accounts (NTA) is to quantify flows of production, consumption, savings, and resource sharing by age. The method is based on an accounting equation that equates private and public resources and consumption. An individual's resources (income from work and capital, and public and private transfers received) must be equal to the uses made of them (consumption, savings, or public and private transfers paid). The various elements of this equation are calculated for each age group, with total flows being consistent with the national accounts aggregates. We can also identify the channels through which flows pass: family, state, or individual. Comparing age-group profiles allows us to identify periods/ages of surplus (when labour income exceeds expenditures) and deficit (when expenditures exceed labour income) and their nature. The funding of consumption that is not based on individual income can be calculated. The global and harmonized framework (forming part of the national accounts) of NTAs allows comparisons over time and across countries (Mason and Lee, 2011). This methodology has become widely used: 60 countries, including France (d'Albis et al., 2017), currently have NTAs.[47] Comparison between countries shows how periods of youth, working age, and retirement are organized in different countries, in connection with education, labour market, and retirement age policies and the various social protection systems. As Figure 25 shows, while consumption at older ages is mostly financed by public transfers in France and Germany, this is far less the case in the United States, where individual financing plays a more important role (d'Albis et al., 2019). In Germany, one-third of consumption is financed by public transfers between the ages of 63 and 64, but in France, where people leave the labour market earlier, this level of state funding occurs slightly sooner (from age 62).

(45) Technically, the method is based on the equilibrium of the government's intertemporal budget constraint.

(46) The method has been criticized on various points: from the significant sensitivity of the results, particularly the indicator of intergenerational imbalance, to the assumptions and conventions used (e.g. choice of discount rate, assumption of constancy of legislation for all generations currently living); the partial equilibrium reasoning; the absence of behavioural reaction from individuals; and the failure to take private transfers into account.

(47) The website of the national transfer accounts network lists all work carried out using this methodology. See: https://www.ntaccounts.org/web/nta/show/

Figure 25. Sources of funding for consumption by age in France, Germany, and United States



Interpretation: The consumption of 65-year-olds in France and Germany is mainly financed by the state (public transfers). In the United States, at these same ages, individuals finance nearly the main part of their consumption from their individual income, with the government contributing only a limited fraction.

Sources: d'Albis et al. (2019), INSEE Household Budget Survey 2011, permanent sample of social security contributors 2008, and public statistics data; authors' calculations.

Conclusion

1. The social challenges of population ageing

Well-established socio-economic and welfare issues

In view of the growing numbers of older people and oldest-old, the issue of their needs regarding living standards, health care, and assistance is a public policy priority (Rechel et al., 2013). A holistic view is needed, taking into account the multiple factors underlying population ageing. Generations of older people are characterized by their past trajectories: professional careers, marital and family histories, and national or international residential mobility. An analysis of the older population in its great diversity is required if we hope to understand the dynamics of this population, identify resources, and assess needs, both met and unmet.

The social structure of the generations reaching advanced ages has changed over the decades and will continue to change in areas such as education, professional careers, and lifestyle habits, all likely to affect the circumstances of ageing. The links between the population's social structure, resources, and needs are also changing. Is there more inequality among older generations than among more recent ones? The answer is probably not unequivocal, since it depends on the social categorization criterion used to compare subpopulations. Population ageing is subject to dynamics that are specific to the ageing process and to the periods and cohorts concerned, the effects of which are difficult to disentangle. As we have seen, the pioneering baby boom cohorts raise specific ageing issues due to their unique trajectories: longer periods of education and less linear or longer careers, particularly for women; diversified marital and family lives; longer life expectancy; and provision of support for parents as retirees. Trends specific to these generations were also uncovered. In France, for example, it has recently been shown that the generations from 1941 to 1955, including some of the baby boom generations, experienced less progress in life expectancy than preceding or following generations, regardless of the age in question (Blanpain and Buisson, 2016). This finding has prompted the revision of certain demographic projections.

Population ageing and the diversification of trajectories raise many questions. Some of these have long been the subject of debate and remain so, such as the limit of human longevity, ageing in the workplace, standards of living among older people, functional decline, and the need for informal care. Other issues have emerged in relation to new forms of partnership or residential mobility at older ages. The lengthening of life expectancy, particularly in retirement, is forcing us to rethink forms of social participation among older people, in terms of intergenerational support, support for dependent relatives, and civic, voluntary, and political commitment. We need better knowledge and recognition of the contributions made by older generations, while taking

into account their needs. This article has put into perspective a number of demographic issues, which are either the subject of other work (Wahl et al., 2013) or remain to be explored.

Questions still to be explored

Much analysis remains to be done to understand the dynamics of ageing and the phenomena driving them, as well as those they generate. Research on some areas, such as the links between ageing and migration, remains sparse. Economic immigration policies have sought to slow the increase in the old-age dependency ratio (number of retirees compared to working-age people). We now face the issue of the choices and living conditions of people with an immigrant background who have spent their working life in a host country. Do they spend their retirement there? Do they return to their country of origin and at what point? Remigration (return to country of origin or departure to other countries) must be taken into account when considering migration and ageing, whether it is undertaken to return to a familiar place, to rejoin relatives, or for health reasons.

Migration and ageing also overlap when many countries mobilize a poorly qualified foreign workforce to occupy the undervalued and arduous jobs of the old-age care sector (Browne and Braun, 2008; Christensen et al., 2017). At the same time, the international or domestic mobility of working people has an impact on the ageing of their regions of origin, which are then confronted with the problems of support for their older populations. This is particularly applicable to the French overseas territories, which are experiencing extremely rapid ageing driven by the dual effects of longer life expectancy and significant emigration of the population at younger ages, in a context that was unprepared for such (Breton and Temporal, 2019). In these situations, the issue of family support for older people, who are geographically isolated from their potential carers, becomes even more acute (Imbert et al., 2018).

Another topic of interest is the mobility of older people, particularly residential mobility. Its various factors, determinants, and consequences could be compared with mobility at younger ages (Bonnet et al., 2010; Bonvalet and Ogg, 2011; Nowik and Thalineau, 2014; Hillcoat-Nallétamby and Sardania, 2019). It is sometimes driven by optimization of quality of life, such as returning to one's place of origin, being closer to family members, or moving into a more comfortable home or location. Other moves are driven by one's financial situation or state of health, such as moving to a cheaper home or one more suitable to one's state of health, or moving closer to health care facilities. Residential mobility can also involve a move from ordinary housing to collective housing, or even housing with medical support, in connection with functional limitations or with a change in social or family situation, such as widowhood, the moving-away of family or friends, the rekindling of family ties, etc. (Grundy and Glaser, 1997; Laferrère et al., 2013; Renaut et al., 2015). In contrast, lack

of mobility can be associated with the risk of isolation and living in housing that becomes unsuitable as functional capacities diminish, but it should be analysed in the light of developments in devices and technologies that allow everyone to remain in their own environment if they so wish, i.e. to remain 'living in place' (McHugh and Mings, 1996). These reflections on mobility and migration demonstrate the complexity of the dynamics of ageing and call for a multidisciplinary approach to explore these dynamics fully.

Society's adaptation to ageing: topics under development

In France, the questions and debates surrounding ageing over the previous 75 years led, in 2015, to the proposal of a social contract enshrined in law: 'Adapting Society to Ageing'.[48] It commits to improving the protection of individuals to preserve functional and decisional independence. It aims to provide the means to prevent the consequences of functional decline (by disseminating technical aids and collective preventive actions, making social action accessible, and combating isolation), to prolong people's social participation (by developing the voluntary sector, diversifying collective housing, and rethinking territories, environment, and transport), and to adapt legal protection systems. It is also committed to supporting dependency by improving the financial assistance, supply of services, and support offered to informal carers, as well as strengthening the governance of both national and regional systems. These provisions echo the various developments aimed at improving the living conditions of older adults. Action programmes at the national and international levels are being developed to ensure urban, architectural, technological, and civic adaptation that is more inclusive of people at risk of exclusion (Scharlach and Lehning, 2013). These provisions lead to multidisciplinary reflections on age and social participation, social and environmental barriers to the independence of people with functional difficulties, and the protection of individuals. The impact of these developments must be analysed from an international perspective.

2. Research challenges

Developing sources

A good understanding of the diversity of conditions for ageing populations requires reassessment of information sources. Aside from targeted operations in the older population, traditional data sources such as public surveys and statistics are, by their very nature, limited. The size and representativeness of the samples used are frequent constraints both for measuring trends and for studying the diversity of situations at older ages. When samples include all ages, there are often not enough older respondents to focus on them or to

(48) Law 2015-1776 of 28 December 2015 on the adaptation of society to ageing (JORF no. 0301 of 29 December 2015).

stratify the analyses by variables of interest. One of the reasons why older people are not always represented in surveys is the complexity and quality of data collection from older people, which often leads to their virtual exclusion from these surveys on health, work history, family, or living conditions. Some older people are not able to respond for health reasons or no longer live in ordinary housing but in an institution. Their living conditions (e.g. poor health, isolation) mean that they are less contactable, less inclined to participate, or require specific interview conditions.

From this point of view, the development of approaches based on civil registry data or other administrative sources, in particular those that consist in matching data collected by an ad hoc survey with formatted registry data, is promising.[49] These administrative data have the advantage of covering the population much more comprehensively than surveys, and of providing information that is difficult to collect via the latter (income, medical consumption, etc.). On the other hand, they often lack the sociodemographic information needed for research purposes (e.g. education level). Coupling these data with survey samples reveals aspects of the conditions of ageing that are still poorly documented. Such data, if they provide a retrospective view, can be used to try to identify, from the life course, reasons for disparities in needs and resources. These sources remain a rare commodity in most countries, but they are under development. In the opinion of many researchers, research on ageing requires a holistic approach, taking into account life courses that are not, or only marginally, captured in traditional surveys (Schoeni and Ofstedal, 2010; Kuh and Ben-Shlomo, 2016). As such, it requires the use of various available data sources, improving the quality of the data for older ages.

Research on population ageing has been marked by a questioning of indicators and their components. Should thresholds and key ages be adjusted when describing the older population? Do we need to rethink the very concept and definition of ageing? Should we change the paradigm? Should we observe older people's situation or their life course, move from life expectancy at a given age to the age corresponding to a given life expectancy, or favour distribution of deaths by age rather than mean age at death? These issues have not been fully addressed. Sophisticated projection models aim to factor in the mechanisms that link the determinants of population change with population structure, e.g. by age, level of education, or family configuration.[50] These models form the basis for assessing family configurations, the care and assistance needs of those with loss of functional independence, and the sustainability of pension systems. It is likely that the issues surrounding ageing and the development of new data

(49) In France, matching has been done between census data and tax data, health survey data and health insurance consumption data, and health cohorts and administrative data (e.g. pension funds).

(50) For more information on population projection and microsimulation models, see Van Imhoff and Post (1998); Murphy et al. (2006); Gaymu (2008a, 2008b); Pennec and Gaymu (2011); Astolfi et al., (2012); Thiébaut et al. (2013); Legare et al. (2014); Bozio et al. (2015); Turci et al. (2015); Eggink et al. (2016); Blanchet et al. (2017b); Kingston et al. (2018); and Legendre (2019).

sources will make it possible to extend reflections and to feed the complex models that incorporate the various components of the dynamics of ageing.

Promoting multidisciplinarity to improve knowledge

Understanding the dynamics of ageing and their family, social, and economic consequences requires different disciplinary approaches that complement the demographic approach: biology and epidemiology, economics, geography, sociology, and history are all important in contextualizing major demographic trends and putting them into perspective. Cross-disciplinary interactions add to the structural development of questions on what advancement in age represents from one period to another or from one country to another, on the impact of social or geographical mobility, on changes in behaviour, choices, and family, social, or professional constraints, on intergenerational links, and on the 'stretching' of life cycles and the increase in possible trajectories.

Ageing is a major societal concern that must be approached from different angles because it affects most social protection policies: policies on living conditions from childhood onwards, which partly determine living conditions in old age (involving combating poverty in families, health inequalities, and educational inequalities); polices on work, on which retirees' resources and health will depend; policies on housing; polices on managing situations of dependency and vulnerability; and policies on social inclusion. In this sense, multidisciplinarity is unavoidable, and we must ensure that the criteria for facilitating its development are met (data, method sharing, collaboration, training, etc.).

Lastly, research on population ageing must be intensified to gain a better understanding of the aspirations (choices, preferences, etc.) as well as the needs of the populations concerned. How will the older population of tomorrow take care of their health and how will they want to be helped if they lose their independence? How will they be able to maintain their daily activities? How will their life paths influence their resources and needs? These questions remain largely unanswered. First, the data currently available are not sufficiently informative about the determinants of transformations at advanced ages. Secondly, the transitions that current generations of young adults will experience in the longer term are largely unforeseeable. These findings call for the development of new sources and approaches that are holistic, multi-subject, longitudinal, and both quantitative and qualitative. Our knowledge must be equal to the challenges.

Appendix

Statistical indicators of population ageing in 40 high-longevity countries, 1950–2050

Table A.1. Change in proportions of over-65s and over-85s in 40 high-longevity countries

	Percentage of over-65s				Percentage of over-85s			
	1950	2000	2020 (p)	2050 (p)	1950	2000	2020 (p)	2050 (p)
Australia	8.2	12.3	16.2	22.8	0.4	1.3	2.1	4.7
Austria	10.4	15.4	19.2	29.4	0.3	1.8	2.5	6.3
Belgium	11.0	16.9	19.3	26.9	0.4	1.8	2.9	5.9
Bulgaria	6.7	16.6	21.5	28.6	0.2	1.0	1.9	3.7
Canada	7.6	12.6	18.1	25.0	0.4	1.3	2.3	5.8
Croatia	7.9	15.6	21.3	30.9	0.4	1.1	2.4	5.6
Cyprus	6.0	10.2	14.4	26.0	0.2	1.0	1.4	4.2
Czech Republic	8.4	13.8	20.1	28.9	0.3	1.2	2.0	4.4
Denmark	9.0	14.9	20.2	24.2	0.4	1.8	2.2	5.0
Estonia	10.6	15.0	20.4	28.7	0.6	1.3	2.7	5.8
Finland	6.6	15.0	22.6	27.6	0.2	1.5	2.7	6.4
France	11.4	16.1	20.8	27.8	0.5	2.1	3.4	6.7
Germany	9.7	16.5	21.7	30.0	0.3	1.9	3.1	7.1
Greece	6.7	16.5	22.3	36.2	0.4	1.5	3.8	7.6
Hong Kong	2.5	11.0	18.2	34.7	0.1	0.9	2.7	9.4
Hungary	7.8	15.1	20.2	28.0	0.3	1.3	2.0	4.2
Iceland	7.5	11.6	15.6	25.2	0.6	1.2	1.9	5.2
Ireland	11.0	10.5	14.6	26.6	0.4	1.0	1.4	4.3
Israel	3.9	10.0	12.4	16.6	0.1	1.0	1.6	2.9
Italy	8.1	18.3	23.3	36.0	0.3	2.2	3.7	8.1
Japan	4.9	17.0	28.4	37.7	0.1	1.7	4.8	9.3
Latvia	10.1	15.0	20.7	27.8	0.6	1.3	3.1	6.1
Lithuania	9.4	13.9	20.6	29.0	0.5	1.1	3.2	7.6
Luxembourg	9.8	14.1	14.4	24.5	0.4	1.5	2.0	4.5
Malta	5.8	12.4	21.3	30.4	0.2	1.1	2.2	6.7
Netherlands	7.7	13.6	20.0	28.0	0.3	1.4	2.3	6.3
New Zealand	9.0	11.8	16.4	23.9	0.4	1.2	1.9	5.2
Norway	9.6	15.3	17.5	24.0	0.6	1.9	2.1	4.6
Poland	5.2	12.0	18.7	31.1	0.3	0.9	2.3	6.1
Portugal	7.0	16.3	22.8	34.8	0.4	1.5	3.2	7.2
Republic of Korea	2.9	7.2	15.8	38.1	0.1	0.4	1.5	8.5
Romania	5.7	13.6	19.2	27.7	0.2	0.8	2.0	3.7
Singapore	2.4	6.4	13.4	33.3	0.1	0.5	1.1	7.7
Slovakia	6.6	11.3	16.7	28.9	0.2	0.9	1.5	4.3
Slovenia	7.0	14.1	20.7	32.1	0.4	1.2	2.6	6.6
Spain	7.2	16.7	20.0	36.8	0.4	1.8	3.5	7.6
Sweden	10.2	17.3	20.3	24.6	0.5	2.3	2.6	5.0
Switzerland	9.4	15.3	19.1	28.6	0.3	2.0	2.7	6.3
United Kingdom	10.8	15.9	18.7	25.3	0.5	1.9	2.5	5.2
United States	8.2	12.3	16.6	22.4	0.5	1.5	2.0	5.1

(p) Projection.
Source: Authors' calculations based on United Nations (2019).

Table A.2. Male and female life expectancy at birth in 40 high-longevity countries

	LEB (years)								Gender gap in life expectancy (years)			
	Females				Males							
	1950-1955	1995-2000	2015-2020 (p)	2045-2050 (p)	1950-1955	1995-2000	2015-2020 (p)	2045-2050 (p)	1950-1955	1995-2000	2015-2020 (p)	2045-2050 (p)
Australia	72.3	81.7	85.2	88.7	66.7	76.0	81.2	85.2	5.6	5.7	4.0	3.5
Austria	69.1	80.6	83.8	87.3	63.8	74.2	78.9	83.7	5.3	6.4	4.9	3.6
Belgium	70.4	80.6	83.7	87.3	65.3	74.1	79.0	83.9	5.1	6.5	4.7	3.4
Bulgaria	64.0	74.6	78.5	81.8	60.7	67.5	71.3	75.9	3.3	7.1	7.2	5.9
Canada	71.7	81.3	84.3	87.8	66.8	75.8	80.2	84.6	4.9	5.5	4.1	3.2
Croatia	63.1	78.1	81.4	85.1	59.3	70.9	75.0	80.7	3.8	7.2	6.4	4.4
Cyprus	68.7	79.8	82.8	86.4	64.8	75.6	78.7	83.7	3.9	4.2	4.1	2.7
Czech Republic	69.3	77.7	81.8	85.2	64.4	70.7	76.5	81.7	4.9	7.0	5.3	3.5
Denmark	72.4	78.6	82.7	86.1	69.7	73.7	78.7	83.6	2.7	4.9	4.0	2.5
Estonia	65.5	75.3	82.5	85.8	57.1	63.6	74.0	79.7	8.4	11.7	8.5	6.1
Finland	69.6	80.7	84.5	88.1	63.0	73.4	78.8	83.3	6.6	7.3	5.7	4.8
France	70.2	82.3	85.4	88.9	64.2	74.6	79.4	83.5	6.0	7.7	6.0	5.4
Germany	69.6	80.4	83.6	87.0	65.3	74.0	78.7	83.6	4.3	6.4	4.9	3.4
Greece	67.7	80.8	84.5	88.0	63.8	75.4	79.5	84.0	3.9	5.4	5.0	4.0
Hong Kong	66.4	82.9	87.5	91.2	59.0	77.2	81.8	85.4	7.4	5.7	5.7	5.8
Hungary	66.1	75.4	80.1	83.5	61.9	66.5	73.0	78.1	4.2	8.9	7.1	5.4
Iceland	74.5	81.3	84.3	87.8	70.0	77.0	81.2	85.4	4.5	4.3	3.1	2.4
Ireland	68.3	78.8	83.7	87.3	65.6	73.3	80.4	84.9	2.7	5.5	3.3	2.4
Israel	70.3	80.3	84.3	87.8	67.5	76.2	81.0	85.3	2.8	4.1	3.3	2.5
Italy	68.4	81.9	85.4	89.0	64.6	75.6	81.0	85.1	3.8	6.3	4.4	3.9
Japan	64.6	83.7	87.5	91.1	61.0	77.1	81.3	84.9	3.6	6.6	6.2	6.2
Latvia	65.9	74.5	79.8	83.1	58.2	62.9	69.9	75.4	7.7	11.6	9.9	7.7
Lithuania	64.0	76.1	81.1	84.4	57.3	64.5	70.0	76.2	6.7	11.6	11.1	8.2
Luxembourg	69.0	80.2	84.2	87.7	63.2	73.6	79.8	84.4	5.8	6.6	4.4	3.3
Malta	67.3	80.9	84.1	87.6	64.4	76.2	80.4	84.9	2.9	4.7	3.7	2.7
Netherlands	73.2	80.5	83.8	87.2	70.6	75.1	80.3	84.8	2.6	5.4	3.5	2.4
New Zealand	72.1	80.2	83.8	87.2	67.6	74.9	80.3	84.8	4.5	5.3	3.5	2.4
Norway	74.6	81.1	84.2	87.6	71.0	75.5	80.2	84.6	3.6	5.6	4.0	3.0
Poland	64.2	77.1	82.4	85.9	58.6	68.4	74.5	80.3	5.6	8.7	7.9	5.6
Portugal	62.9	79.6	84.6	88.4	57.6	72.4	78.7	83.3	5.3	7.2	5.9	5.1
Republic of Korea	47.3	78.8	85.7	89.7	37.7	71.0	79.6	83.9	9.6	7.8	6.1	5.8
Romania	62.8	73.6	79.3	82.8	59.4	66.1	72.4	77.3	3.4	7.5	6.9	5.5
Singapore	63.0	79.5	85.5	89.1	57.5	74.6	81.3	85.2	5.5	4.9	4.2	3.9
Slovakia	66.3	76.8	80.8	84.2	62.5	68.7	73.7	79.1	3.8	8.1	7.1	5.1
Slovenia	68.1	79.0	83.9	87.3	63.0	71.3	78.3	83.1	5.1	7.7	5.6	4.2
Spain	66.8	82.3	86.0	89.7	62.3	75.2	80.6	84.4	4.5	7.1	5.4	5.3
Sweden	73.3	81.8	84.4	87.8	70.4	76.8	80.8	85.0	2.9	5.0	3.6	2.8
Switzerland	71.6	82.2	85.4	88.9	67.0	76.1	81.6	85.5	4.6	6.1	3.8	3.4
United Kingdom	71.9	79.6	82.9	86.4	66.8	74.6	79.4	84.1	5.1	5.0	3.5	2.3
United States	71.8	79.3	81.3	84.8	65.9	73.5	76.3	81.4	5.9	5.8	5.0	3.4

(p) Projection.
Source: Authors' calculations based on United Nations (2019).

Table A.3. Male and female life expectancy at age 65 in 40 high-longevity countries

	Life expectancy at age 65 (years)								Difference between female and male life expectancy at age 65 (years)			
	Females				Males							
	1950–1955	1995–2000	2015–2020 (p)	2045–2050 (p)	1950–1955	1995–2000	2015–2020 (p)	2045–2050 (p)	1950–1955	1995–2000	2015–2020 (p)	2045–2050 (p)
Australia	15.0	20.1	22.7	25.2	12.3	16.4	20.0	22.7	2.7	3.7	2.7	2.5
Austria	13.9	19.0	21.4	23.9	12.0	15.3	18.1	21.7	1.9	3.7	3.3	2.2
Belgium	14.2	19.4	21.6	24.3	12.4	15.2	18.4	21.8	1.8	4.2	3.2	2.5
Bulgaria	14.3	15.3	17.7	19.9	13.3	12.6	14.1	16.6	1.0	2.7	3.6	3.3
Canada	15.4	20.0	22.2	24.6	13.5	16.2	19.3	22.2	1.9	3.8	2.9	2.4
Croatia	12.0	16.9	19.2	21.9	10.4	13.4	15.4	19.2	1.6	3.5	3.8	2.7
Cyprus	14.6	17.8	19.9	22.8	13.2	15.4	17.0	20.8	1.4	2.4	2.9	2.0
Czech Republic	13.3	16.7	19.6	22.2	11.6	13.2	16.4	20.0	1.7	3.5	3.2	2.2
Denmark	14.5	18.0	20.6	23.1	13.8	14.7	17.9	21.3	0.7	3.3	2.7	1.8
Estonia	14.8	16.5	20.6	23.0	11.9	12.2	15.7	19.4	2.9	4.3	4.9	3.6
Finland	13.3	19.0	22.1	24.7	11.1	14.9	18.5	21.6	2.2	4.1	3.6	3.1
France	14.7	20.9	23.2	25.9	12.1	16.3	19.4	22.2	2.6	4.6	3.8	3.7
Germany	13.8	18.9	21.3	23.8	12.6	15.1	18.3	21.6	1.2	3.8	3.0	2.2
Greece	13.8	18.9	21.9	24.6	12.0	16.2	19.2	22.3	1.8	2.7	2.7	2.3
Hong Kong	14.9	20.7	24.6	27.6	10.4	16.9	20.0	22.9	4.5	3.8	4.6	4.7
Hungary	13.1	16.2	19.0	21.4	11.9	12.4	14.9	18.2	1.2	3.8	4.1	3.2
Iceland	16.6	19.5	21.4	24.0	14.8	16.6	19.4	22.2	1.8	2.9	2.0	1.8
Ireland	13.7	17.6	21.4	23.8	12.3	14.1	19.2	22.0	1.4	3.5	2.2	1.8
Israel	14.3	18.7	21.6	24.2	13.2	16.5	19.6	22.6	1.1	2.2	2.0	1.6
Italy	14.2	20.1	22.5	25.3	13.0	16.0	19.3	22.2	1.2	4.1	3.2	3.1
Japan	13.5	21.7	24.7	27.5	11.4	17.0	19.9	22.5	2.1	4.7	4.8	5.0
Latvia	15.3	16.4	19.5	21.6	12.9	12.0	14.2	17.5	2.4	4.4	5.3	4.1
Lithuania	15.9	17.2	20.5	22.7	14.1	12.2	14.7	18.4	1.8	5.0	5.8	4.3
Luxembourg	13.4	19.2	21.7	24.3	11.7	14.9	18.7	21.8	1.7	4.3	3.0	2.5
Malta	13.4	18.9	21.5	24.3	12.9	15.8	19.0	22.4	0.5	3.1	2.5	1.9
Netherlands	14.9	19.1	21.2	23.8	14.1	15.0	18.8	21.9	0.8	4.1	2.4	1.9
New Zealand	15.2	19.4	21.7	24.1	13.0	15.9	19.4	22.4	2.2	3.5	2.3	1.7
Norway	16.0	19.5	21.7	24.2	14.8	15.6	18.8	21.9	1.2	3.9	2.9	2.3
Poland	13.1	16.8	20.7	23.3	11.2	13.0	16.3	20.1	1.9	3.8	4.4	3.2
Portugal	14.4	18.6	22.0	24.7	12.2	15.1	18.4	21.4	2.2	3.5	3.6	3.3
Republic of Korea	10.8	17.9	22.6	25.9	5.9	13.9	18.5	21.6	4.9	4.0	4.1	4.3
Romania	13.0	15.3	18.3	20.7	11.7	12.8	14.9	17.8	1.3	2.5	3.4	2.9
Singapore	13.3	18.2	22.6	25.6	9.8	14.9	19.4	22.5	3.5	3.3	3.2	3.1
Slovakia	13.5	16.4	19.1	21.5	12.7	12.7	15.2	18.5	0.8	3.7	3.9	3.0
Slovenia	13.2	18.0	21.4	23.9	11.2	13.9	17.6	20.9	2.0	4.1	3.8	3.0
Spain	14.4	20.3	23.2	25.9	12.4	16.3	19.4	22.0	2.0	4.0	3.8	3.9
Sweden	14.7	19.9	21.7	24.3	13.8	16.3	19.1	22.2	0.9	3.6	2.6	2.1
Switzerland	14.3	20.4	22.7	25.3	12.5	16.5	19.9	22.6	1.8	3.9	2.8	2.7
United Kingdom	14.5	18.4	20.9	23.5	11.8	15.1	18.7	21.9	2.7	3.3	2.2	1.6
United States	15.4	19.1	20.9	23.4	12.9	15.8	18.4	21.7	2.5	3.3	2.5	1.7

(p) Projection.
Source: Authors' calculations based on United Nations (2019).

Table A.4. Median ages and old-age dependency ratios in 40 high-longevity countries

	Median age (years)				Old-age dependency ratio (1)			
	1950	2000	2020 (p)	2050 (p)	1950	2000	2020 (p)	2050 (p)
Australia	30.4	35.4	37.9	41.8	12.5	18.5	25.1	37.7
Austria	35.7	38.2	43.5	49.3	15.6	22.7	28.9	51.4
Belgium	35.5	39.0	41.9	45.4	16.2	25.7	30.2	46.7
Bulgaria	27.3	39.7	44.6	48.1	10.1	24.5	33.6	50.0
Canada	27.7	36.8	41.1	45.5	12.2	18.4	27.4	41.3
Croatia	27.9	38.9	44.3	50.9	12.1	23.2	33.1	54.6
Cyprus	23.7	31.8	37.2	47.9	10.1	15.2	20.9	42.5
Czech Republic	32.5	37.5	43.2	46.9	12.4	19.8	31.4	51.2
Denmark	31.7	38.4	42.3	44.2	14.0	22.3	31.7	40.4
Estonia	29.9	38.0	42.4	48.2	16.6	22.3	32.3	50.5
Finland	27.8	39.4	43.1	47.3	10.4	22.4	36.6	47.2
France	34.5	37.7	42.3	45.9	17.3	24.7	33.7	49.3
Germany	35.2	40.1	45.7	49.2	14.4	24.3	33.7	53.2
Greece	25.5	38.0	45.6	53.4	10.4	24.0	34.8	69.5
Hong Kong	23.7	36.2	44.8	53.4	3.7	15.3	26.3	64.7
Hungary	30.1	38.5	43.3	48.0	11.6	22.2	30.8	48.2
Iceland	26.5	32.9	37.5	45.1	12.1	17.8	24.1	42.1
Ireland	30.0	31.8	38.2	44.2	18.1	15.5	22.6	46.2
Israel	25.5	28.0	30.5	34.2	6.1	16.2	20.8	27.6
Italy	28.6	40.3	47.3	53.6	12.4	27.1	36.6	68.8
Japan	22.3	41.2	48.4	54.7	8.2	24.9	48.0	74.3
Latvia	29.9	37.9	43.9	45.8	15.7	22.3	32.9	48.7
Lithuania	27.8	35.9	45.1	48.1	14.9	21.1	32.3	51.2
Luxembourg	35.0	37.3	39.7	45.0	13.9	21.0	20.5	40.2
Malta	23.7	36.5	42.6	51.0	9.7	18.3	33.2	53.4
Netherlands	28.0	37.5	43.3	47.4	12.2	20.0	31.2	48.6
New Zealand	29.4	34.3	38.0	43.7	14.5	18.0	25.5	39.7
Norway	32.6	36.9	39.8	44.1	14.5	23.6	26.9	39.6
Poland	25.8	35.0	41.7	51.2	8.0	17.6	28.4	55.6
Portugal	26.1	37.8	46.2	52.2	11.0	24.0	35.5	65.6
Republic of Korea	19.0	31.9	43.7	56.5	5.2	10.0	22.0	73.2
Romania	26.3	34.9	43.2	47.4	8.7	20.1	29.5	47.8
Singapore	20.0	34.8	42.2	53.4	4.2	8.5	18.0	58.8
Slovakia	27.0	33.9	41.2	49.1	10.3	16.4	24.6	50.2
Slovenia	27.7	38.1	44.5	49.6	10.7	20.1	32.3	59.6
Spain	27.5	37.6	44.9	53.2	10.9	24.3	30.4	72.2
Sweden	34.2	39.4	41.1	43.8	15.3	26.9	32.8	41.4
Switzerland	33.2	38.6	43.1	47.5	14.1	22.7	29.0	49.9
United Kingdom	34.9	37.6	40.5	44.5	16.2	24.4	29.3	42.9
United States	30.2	35.2	38.3	42.7	12.6	18.7	25.6	36.6

(1) Ratio of the population aged 65 and over to the population aged 15–64.
(p) Projection.
Source: Authors' calculations, based on United Nations (2019).

Table A.5. Ages homologous to age 65[1] and prospective ages[2] with reference to age 65 in 1950–1955 in 40 high-longevity countries

	Age homologous to age 65 in 1950 (years)			Prospective age with reference to age 65 in 1950-1955 (years)		
	2000	2020 (p)	2050 (p)	1995–2000	2015–2020 (p)	2045–2050 (p)
Australia	69.9	72.7	79.2	71.5	74.6	77.0
Austria	70.0	73.2	80.2	71.2	74.0	76.7
Belgium	69.9	71.8	78.5	70.6	73.9	76.7
Bulgaria	73.1	76.2	80.3	65.3	68.3	71.2
Canada	70.7	74.0	81.6	70.3	73.2	75.8
Croatia	70.8	76.0	81.6	71.5	73.8	77.1
Cyprus	70.7	74.0	81.5	68.6	70.9	74.7
Czech Republic	70.3	73.7	79.2	68.9	72.9	76.0
Denmark	71.3	73.8	79.5	68.4	71.8	74.9
Estonia	68.3	73.3	78.2	66.8	72.0	74.9
Finland	73.9	77.5	83.7	71.9	75.5	78.0
France	69.1	72.1	79.0	72.2	75.1	77.7
Germany	71.0	75.9	81.7	70.8	73.8	76.5
Greece	73.5	80.1	84.9	71.2	74.7	77.6
Hong Kong	78.1	84.5	91.9	72.7	76.5	79.6
Hungary	71.7	74.6	79.4	68.2	72.0	75.0
Iceland	69.9	72.6	81.0	68.1	70.8	73.5
Ireland	63.4	67.8	76.4	69.1	74.4	76.7
Israel	74.8	76.4	81.6	70.6	73.8	76.6
Italy	73.9	78.3	84.0	71.3	74.3	76.8
Japan	76.9	83.8	88.7	74.5	77.6	80.0
Latvia	68.8	74.3	79.0	65.6	69.8	73.0
Lithuania	68.7	75.3	81.9	64.9	69.6	73.1
Luxembourg	68.9	69.3	77.8	71.8	75.1	77.6
Malta	72.9	77.6	85.2	70.9	73.9	77.2
Netherlands	71.5	75.0	82.6	68.8	72.0	74.9
New Zealand	68.2	71.6	79.4	70.1	73.2	75.8
Norway	71.7	71.8	78.2	67.9	71.1	73.9
Poland	72.6	77.7	85.3	69.5	74.5	77.6
Portugal	73.7	78.6	84.2	69.8	73.7	76.4
Republic of Korea	72.6	80.5	90.0	78.7	82.8	85.7
Romania	72.4	77.4	81.6	67.7	71.4	74.3
Singapore	73.3	78.7	90.8	72.5	77.6	80.5
Slovakia	70.3	73.5	80.9	67.5	71.1	74.1
Slovenia	71.5	76.9	83.5	71.1	74.9	77.6
Spain	73.8	77.6	84.4	71.6	74.8	77.3
Sweden	72.4	73.4	78.2	70.2	72.8	75.6
Switzerland	70.9	73.7	81.0	71.8	74.7	77.2
United Kingdom	69.7	71.8	77.6	70.1	73.6	76.5
United States	70.2	72.3	79.5	69.9	72.7	75.8

(1) In a given year, the age homologous to 65 corresponds to the age above which the proportion of survivors is equal to the proportion of over-65s of the reference year or period (here 1950). In Germany, for example, 9.7% of individuals were aged 65 and over in 1950. In 2000, 2020, and 2050, this same proportion (9.7%) comprises people aged 71 and over, 75.9 and over, and 81.7 and over.
(2) In a given year, the prospective age of 65 corresponds to the age at which remaining life expectancy is equal to that of people aged 65 in the reference year or period (here 1950–1955). In Germany, for example, life expectancy at age 65 was 13.2 years in 1950–1955. In 2000, 2020, and 2050, this life expectancy (13.2 years) corresponds to that of people aged 70.8, 73.8, and 76.5 years.
(p) Projection.
Source: Authors' calculations based on United Nations (2019).

References

Agree E. M., 1999, The influence of personal care and assistive devices on the measurement of disability, *Social Science & Medicine*, 48(4), 427–443.

Agree E. M., 2018, Demography of aging and the family, in Hayward M., Majmundar M. K. (eds.), *Future directions for the demography of aging: Proceedings of a workshop*, Washington, DC, The National Academies Press, https://doi.org/10.17226/25064

Arnault F. (ed.), 2019b, *Les retraités et les retraites*, Paris, DREES.

Astolfi R., Lorenzoni L., Oderkirk J., 2012, Informing policy makers about future health spending: A comparative analysis of forecasting methods in OECD countries, *Health Policy,* 107(1), 1–10, http://www.sciencedirect.com/science/article/pii/S0168851012001352

Auerbach A. J., Gokhale J., Kotlikoff L. J., 1991, Generational accounts: A meaningful alternative to deficit accounting, in Bradford D. (ed.), *Tax policy and the economy*, Cambridge, NBER and MIT Press, Vol. 5, 55–110.

Auerbach A. J., Charles K. K., Coile C. C., Gale W., Goldman D., Lee R., Lucas C. M., Orszag P. R., Sheiner L. M., Tysinger B. et al., 2017, How the growing gap in life expectancy may affect retirement benefits and reforms, *The Geneva Papers on Risk and Insurance. Issues and Practice,* 42(3), 475–499.

Barbi E., Lagona F., Marsili M., Vaupel J. W., Wachter K. W., 2018, The plateau of human mortality: Demography of longevity pioneers, *Science,* 360(6396), 1459–1461, http://www.sciencedirect.com/science/article/pii/S0168851012001352

Barbieri M., 2019, The decrease in life expectancy in the United States since 2014, *Population & Societies,* 570, October.

Bauer J. M., Sousa-Poza A., 2015, Impacts of informal caregiving on caregiver employment, health, and family, *Journal of Population Ageing,* 8(3), 113–145, https://doi.org/10.1007/s12062-015-9116-0

Bengtson V. L., 2001, Beyond the nuclear family: The increasing importance of multigenerational bonds, *Journal of Marriage and Family,* 63(1), 1–16, https://doi.org/10.1111/j.1741-3737.2001.00001

Blanchet D., 2016, Pensions past and present: Same equation, new constraints, *Population,* 71(2), 327–330, https://www.cairn.info/revue-population-2016-2-page-345.htm

Blanchet D., Bozio A., Prost C., Roger M., 2019, Explaining the reversal in the trend of older workers' employment rates: The case of France, in Coile C. C., Milligan K., Wise D. (eds.), Social security programs and retirement around the world: Working longer, Chicago, University of Chicago Press, 87–115.

Blanchet D., Caroli E., Prost C., Roger M., 2017b, Health capacity to work at older ages in France, in Wise D. A. (ed.), *Social security programs and retirement around the world: The capacity to work at older ages*, Chicago, University of Chicago Press, 111–148.

Blanchet D., Le Gallo F., 2013, Baby-boom et allongement de la durée de vie: quelles contributions au vieillissement? *Insee Analyses,* 12, September.

BLANCHET D., LE MINEZ S., MARINO A., 2017a, Building and interpreting macro/micro estimates of accrued-to-date pension liabilities: French reforms as a case study, *Review of Income and Wealth,* 63(1), 70–94, https://onlinelibrary.wiley.com/doi/abs/10.1111/roiw.12207

BLANPAIN N., 2016, Les hommes cadres vivent toujours 6 ans de plus que les hommes ouvriers, *Insee Première,* 1584, February.

BLANPAIN N., BUISSON G., 2016a, 21 000 centenaires en 2016 en France, 270 000 en 2070, *Insee Première*, 1620, November.

BLANPAIN N., BUISSON G., 2016b, *Projections de population 2013-2070 pour la France: méthode et principaux résultats* (Working Paper No. F1606), INSEE.

BLOOM D. E., LUCA D. L., 2016, *The global demography of aging: Facts, explanations, future* (IZA Discussion Paper No. 10163), Bonn, Forschungsinstitut zur Zukunft der Arbeit / Institute for the Study of Labor.

BLUNDELL R., FRENCH E., TETLOW G., 2016, Retirement incentives and labor supply, in Piggot J., Woodland A., *Handbook of the economics of population aging*, Vol. 1B, Amsterdam, Elsevier, 457–566.

BONNET C., 2011, Un inévitable conflit des générations? In Meslé F., Toulemon L., Véron J. (eds.)*, Dictionnaire de démographie et des sciences de la population,* Paris, Armand Colin.

BONNET C., GOBILLON L., LAFERRÈRE A., 2010, The effect of widowhood on housing and location choices, *Journal of Housing Economics,* 19(2), 94–108.

BONNET C., GODET F., SOLAZ A., 2019a, *Gendered economic determinants of couple formation over 50 in France* (Working Paper No. G2019/13), INSEE.

BONNET C., JUIN S., LAFERRÈRE A., 2019b, Private financing of long term care: Income, savings and reverse mortgages, *Economics and Statistics*, 507–508, 5–24, https://doi.org/10.24187/ecostat.2019.507d.1972

BONVALET C., CLÉMENT C., OGG J., 2015, *Renewing the family: A history of the baby boomers*, Cham, Switzerland, Springer.

BÖRSCH-SUPAN A., COILE C., 2021, *Social security programs and retirement around the world: Reforms and retirement incentives*, Chicago, University of Chicago Press.

BOURDELAIS P., 1993, *Le nouvel âge de la vieillesse. Histoire du vieillissement de la population*, Paris, Odile Jacob.

BOURDIEU J., KESZTENBAUM L., POSTEL-VINAY G., 2013, Habiter ensemble, vieillir ensemble. Éléments d'une histoire de la corésidence au cours de l'industrialisation, in Marek Y., Réguer D. (eds.), *De l'hospice au domicile collectif. La vieillesse et ses prises en charge de la fin du XVIII^e siècle à nos jours*, Mont-Saint-Aignan, France, Presses Universitaires de Rouen et du Havre, 335–348.

BOZIO A., GUILLOT M., LAFFÉTER Q., 2015, Portée et limites du modèle Taxipp pour l'analyse redistributive des prélèvements obligatoires, *Économie et Statistique*, 481–482, 31–50.

BRÉE S., 2017, Changes in family size over the generations in France (1850–1966), *Population,* 72(2), 297–332.

BRETON D., TEMPORAL F., 2019, Décroissance démographique et vieillissement: une exception des Antilles françaises dans l'espace Caraïbes? *Études caribéennes*, 43–44, https://journals.openedition.org/etudescaribeennes/16864

BROWN S. L., LIN I. F., 2012, The gray divorce revolution: Rising divorce among middle-aged and older adults, 1990–2010, *The Journals of Gerontology: Series B,* 67(6), 731–741, https://pubmed.ncbi.nlm.nih.gov/23052366/

Brown S. L., Lin I. F., Hammersmith A. M., Wright M. R., 2016, Later life marital dissolution and repartnership status: A national portrait, *The Journals of Gerontology: Series B,* 73(6), 1032–1042, https://pubmed.ncbi.nlm.nih.gov/27131167

Brown S. L., Lin I. F., Hammersmith A. M., Wright M. R., 2019, Repartnering following gray divorce: The roles of resources and constraints for women and men, *Demography,* 56(2), 503–523, https://doi.org/10.1007/s13524-018-0752-x

Browne C. V., Braun K. L., 2008, Globalization, women's migration, and the long-term-care workforce, *Gerontologist,* 48(1), 16–24.

Brunel M., Latourelle J., Zakri M., 2019, Un senior à domicile sur cinq aidé régulièrement pour les tâches du quotidien, *Études et résultats,* 1103, February.

Calot G., Sardon J.-P., 1999, Les facteurs du vieillissement démographique, *Population,* 54(3), 509–552.

Calot G., Sardon J.-P., 2000, La mesure du vieillissement démographique, *Espace populations sociétés,* 3, 475–481.

Cambois E., Robine J.-M., 2017, L'allongement de l'espérance de vie en Europe: quelles conséquences pour l'état de santé, *Revue européenne des sciences sociales,* 55(1), 41–67, http://www.cairn.info/revue-europeenne-des-sciences-sociales-2017-1-page-41.htm

Cambois E., Laborde C., Robine J.-M., 2008, A double disadvantage for manual workers: More years of disability and a shorter life expectancy, *Population & Societies,* 441, January.

Cambois E., Garrouste C., Pailhé A., 2017, Gender career divide and women's disadvantage in depressive symptoms and physical limitations in France, *SSM: Population Health,* 3, 81–88.

Cambois E., Brønnum-Hansen H., Hayward M., Nusselder W., 2020, Monitoring social differentials in health expectancies, in Jagger C. et al. (eds.), *International handbook of health expectancies*, Cham, Switzerland, Springer.

Carrière Y., Keefe J., Légaré J., Lin X., Rowe G., Martel L., Rajbhandart S., 2008, *Projecting the future availability of the informal support network of the elderly population and assessing its impact on home care services* (Research Paper, Catalogue No. 91F0015M), Ontario, Statistics Canada.

Casado B. L., van Vulpen K. S., Davis S. L., 2011, Unmet needs for home and community-based services among frail older Americans and their caregivers, *Journal of Aging and Health,* 23(3), 529–553.

Case A., Deaton A., 2015, Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century, *Proceedings of the National Academy of Sciences USA,* 112(49), 15078–15083, https://pubmed.ncbi.nlm.nih.gov/26575631/

Cazenave-Lacroutz A., Godet F., 2016, L'espérance de vie en retraite sans incapacité sévère devrait être stable pour les générations nées entre 1960 et 1990, *France, portrait social,* Insee références, 107–120.

Chetty R., Stepner M., Abraham S., Lin S., Scuderi B., Turner N., Bergeron A., Cutler D., 2016, The association between income and life expectancy in the United States, 2001–2014, *JAMA,* 315(16), 1750–1766, https://pubmed.ncbi.nlm.nih.gov/27063997/

Christensen K., Hussein S., Ismail M., 2017, Migrants' decision-process shaping work destination choice: The case of long-term care work in the United Kingdom and Norway, *European Journal of Ageing,* 14(3), 219–232, https://doi.org/10.1007/s10433-016-0405-0

Coe N. B., Van Houtven C. H., 2009, Caring for mom and neglecting yourself? The health effects of caring for an elderly parent, *Health Economics,* 18(9), 991–1010.

COILE C., 2015, Economic determinants of workers' retirement decisions, *Journal of Economic Surveys,* 29(4), 830–853, https://doi.org/10.1111/joes.12115

COILE C., MILLIGAN K., WISE D. A.,2017, Health capacity to work at older ages: Evidence from the United States, in Wise D. A. (ed.), *Social security programs and retirement around the world: The capacity to work at older ages,* Chicago, University of Chicago Press, 359–394.

COLOMBO F., LLENA-NOZAL A., MERCIER J., TJADENS F., 2011, *Help wanted? Providing and paying for long-term care*, Paris, OECD, https://doi.org/10.1787/9789264097759-en

CONSEIL D'ORIENTATION DES RETRAITES, 2001, *Retraites: renouveler le contrat social entre les générations* (Report), Paris, Conseil d'orientation des retraites.

COSTA D. L., 1999, A house of her own: Old age assistance and the living arrangements of older nonmarried women, *Journal of Public Economics,* 72(1), 39–59, http://www.sciencedirect.com/science/article/pii/S0047272798000942

CRIMMINS E. M., VASUNILASHORN S. M., 2016, Biodemography: Adding biological insight into social, economic, and psychological models of population and individual health change with age, in George L. K., Ferraro K. F. (eds.), *Handbook of aging and the social sciences* (8th Ed.), San Diego, Academic Press, 55–75, https://doi.org/10.1016/B978-0-12-417235-7.00003-2

D'ALBIS H., COLLARD F., 2013, Age groups and the measure of population aging, *Demographic Research,* 29(art. 23), 617–640, https://www.demographic-research.org/volumes/vol29/23/

D'ALBIS H., MOOSA D., 2015, Generational economics and the National Transfer Accounts, *Journal of Demographic Economics,* 81(4), 409–441, https://hal.archives-ouvertes.fr/hal-01305151

D'ALBIS H., BONNET C., NAVAUX J., PELLETAN J., WOLFF F.-C., 2017, Le déficit de cycle de vie en France: une évaluation pour la période 1979-2001, *Économie et Statistique,* 491–492, 51–75, https://www.insee.fr/fr/statistiques/2647402?sommaire=2647454

D'ALBIS H., BONNET C., CHOJNICKI X., EL MEKKAOUI N., GREULICH A., HUBERT J., NAVAUX J., 2019, Financing the consumption of the young and old in France, *Population and Development Review,* 45(1), 103–132, https://onlinelibrary.wiley.com/doi/full/10.1111/padr.12204

DAHOO U., GAUDY L., 2020, En France, comme en Europe, un pic de surmortalité lié à la Covid-19 fin mars-début avril, *Insee focus,* 200, July.

DE JONG GIERVELD J., 2004, Remarriage, unmarried cohabitation, living apart together: Partner relationships following bereavement or divorce, *Journal of Marriage and Family,* 66(1), 236–243, https://doi.org/10.1111/j.0022-2445.2004.00015.x

DE SANTIS G., SEGHIERI C., TANTURRI M. L., 2008, Poverty trends among the elderly: What will the future hold? In Gaymu J., Le Bihan-Youinou B., Martin C. (eds.), *Future elderly living conditions in Europe*, Paris, INED, 117–137.

DÉCHAUX J.-H., 1994, Les échanges dans la parenté accentuent-ils les inégalités? *Sociétés contemporaines*, 17, 75–90, https://www.persee.fr/doc/socco_1150-1944_1994_num_17_1_1155

DELBÈS C., GAYMU J., 2003, More unions surviving after 60? *Population & Societies,* 389, April.

DÉSESQUELLES A., DEMURU E., SALVATORE M. A., PAPPAGALLO M., FROVA L., MESLÉ F., EGIDI V., 2014, Mortality from Alzheimer's disease, Parkinson's disease, and dementias in France and Italy: A comparison using the multiple cause-of-death approach, *Journal of Aging and Health,* 26(2), 283–315, https://pubmed.ncbi.nlm.nih.gov/24667337/

DO Y. K., NORTON E. C., STEARNS S. C., VAN HOUTVEN C. H., 2015, Informal care and caregiver's health, *Health Economics,* 24(2), 224–237.

DYKSTRA P., 2009, Childless old age, in Uhlenberg P. (ed.), *International handbook of population aging*, Dortrecht, Springer, 671–690, http://hdl.handle.net/1765/39642

EGGINK E., WOITTIEZ I., RAS M., 2016, Forecasting the use of elderly care: A static micro-simulation model, *European Journal of Health Economics,* 17(6), 681–691.

EUROPEAN COMMISSION, 2018, *The 2018 ageing report: Economic & budgetary projections for the 28 EU Member States (2016–2070)* (European Economy Institutional Paper No. 79), Brussels, EU Directorate-General for Economic and Financial Affairs.

FINCH C. E., BELTRAN-SANCHEZ H., CRIMMINS E. M., 2014, Uneven futures of human lifespans: Reckonings from Gompertz mortality rates, climate change, and air pollution, *Gerontology,* 60(2), 183–188.

FIZZALA A., 2016, Dépendance des personnes âgées: qui paie quoi? L'apport du modèle Autonomix, *Les Dossiers de la Drees, Grand âge et autonomie*, 1, March.

FONTAINE R., 2017, Approche économique de l'aide informelle. Analyse des comportements de prise en charge et de la place du soutien familial dans notre système de protection sociale, *Dialogue*, 216(2), 67–80.

FONTAINE R., 2019, Quelles solidarités vis-à-vis des proches aidants? *Actualité et dossier en santé publique,* 109, 40–42.

FOUWEATHER T., GILLIES C., WOHLAND P., VAN OYEN H., NUSSELDER W., ROBINE J.-M., CAMBOIS E., JAGGER C., 2015, Comparison of socio-economic indicators explaining inequalities in Healthy Life Years at age 50 in Europe: 2005 and 2010, *European Journal of Public Health,* 25(6), 978–983, https://academic.oup.com/eurpub/article/25/6/978/2467385

FREEDMAN V. A., 1996, Family structure and the risk of nursing home admission, *The Journals of Gerontology: Series B,* 51B(2), S61–S69, https://doi.org/10.1093/geronb/51B.2.S61

FREEDMAN V. A., SPILLMAN B. C., 2014, The residential continuum from home to nursing home: Size, characteristics and unmet needs of older adults, *Journal of Gerontology: Series B,* 69(Suppl. 1), S42–S50.

FREJKA T., 2017, Childlessness in the United States, in Kreyenfeld M., Konietzka D. (eds.), *Childlessness in Europe: Contexts, causes, and consequences*, Cham, Springer, 159–179, https://doi.org/10.1007/978-3-319-44667-7_8

FRIED L. P., TANGEN C. M., WALSTON J., NEWMAN A. B., HIRSCH C., GOTTDIENER J., SEEMAN T., TRACY R., KOP W. J., BURKE G. ET AL., 2001, Frailty in older adults: Evidence for a phenotype, *Journal of Gerontology: Series A,* 56(3), M146–156, http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11253156

FRIES J. F., 1980, Aging, natural death, and the compression of morbidity, *The New England Journal of Medicine,* 303(3), 130–135, https://pubmed.ncbi.nlm.nih.gov/7383070/

FROMENT O., MARBOT C., ROY D., 2013, Projection des trajectoires et de l'entourage familial des personnes âgées dépendantes à l'horizon 2040, *Dossier solidarité santé,* 43, 19–28.

FUCHS V. R., 1984, 'Though much is taken': Reflections on aging, health, and medical care, *The Milbank Memorial Fund Quarterly, Health and Society*, 62(2), 143–166.

GAYMU J., EKAMPER P., BEETS G., 2008a, Future trends in health and marital status: Effects on the structure of living arrangements of older Europeans in 2030, *European Journal of Ageing,* 5(5), 5–17.

GAYMU J., EKAMPER P., SPRINGER S., PENNEC S., BEETS G., DÉSESQUELLES A., VAN WISSE L., 2008b, Future family networks and living arrangements of disabled elders, in Gaymu J., Festy P., Poulain M., Beets G. (eds.), *Future elderly living conditions in Europe*, Paris, INED.

GEORGE L. K., FERRARO K. F. (EDS.), 2015, *Handbook of aging and the social sciences* (8th Ed.), San Diego, Academic Press.

GOLDIN C., KATZ L. F., 2018, Women working longer: facts and some explanations, in Goldin C., Katz L. F. (eds.), *Women working longer: Increased employment at older ages*, Chicago, University of Chicago Press, 11–54.

GONZALEZ L., HÉAM J.-C., MIKOU M., FERRETI C. (EDS.), 2019a, Les dépenses de santé en 2018: Résultats des comptes de la santé, Paris, DREES.

GONZALEZ L., HÉAM J.-C., MIKOU M., FERRETTI C., RHOMARI M., 2019b, *La protection sociale en France et en Europe en 2017. Résultats des comptes de la protection sociale* (édition 2019), Paris, DREES.

GOVERNMENT OF AUSTRALIA, 2017, The Labour Market for Personal Care Workers, in *Aged and disability care: Australia 2017*, Canberra, Australian Government Department of Jobs and Small Business.

GRUBER J., WISE D. A., 1999, Introduction and summary, in Gruber J., Wise D. A. (eds.), *Social security and retirement around the world*, Chicago, University of Chicago Press.

GRUBER J., WISE D. A., 2004, Introduction and summary, in Gruber J., Wise D. A. (eds.), *Social security programs and retirement around the world: Micro-estimation*, Chicago, University of Chicago Press.

GRUNDY E., 2006, Ageing and vulnerable elderly people: European perspectives, *Ageing & Society,* 26(1), 105–134.

GRUNDY E., GLASER K., 1997, Trends in, and transitions to, institutional residence among older people in England and Wales, 1971–91, *Journal of Epidemiology and Community Health,* 51(5), 531–540, https://jech.bmj.com/content/51/5/531.abstract

HELMER C., GRASSET L., PÉRÈS K., DARTIGUES J.-F., 2016, Évolution temporelle des démences: état des lieux en France et à l'international, *Bulletin épidémiologique hebdomadaire,* 28–29, 467–473.

HENRIPIN J., 1995, Réplique, *Population*, 50(6), 1627–1629, https://www.persee.fr/doc/pop_0032-4663_1995_num_50_6_5890

HILLCOAT-NALLÉTAMBY S., SARDANI A. V., 2019, Decisions about the 'if', 'when' and 'how' of moving home: Can a relocation service help? A Welsh case study, *Journal of Housing for the Elderly,* 33(3), 275–297.

IMBERT C., LELIÈVRE E., LESSAULT D. (EDS.), 2018, *La famille à distance: Mobilités, territoires et liens familiaux*, Paris, INED.

JAGGER C., CRIMMINS E.M., SAITO Y., DE CARVALHO YOKOTA R. T., VAN OYEN H., ROBINE J.-M. (EDS.), 2020, *International handbook of health expectancies*, International Handbooks of Population, Cham, Switzerland, Springer.

JAGGER C., GILLIES C., MOSCONE F., CAMBOIS E., VAN OYEN H., NUSSELDER W, ROBINE J.-M., EHLEIS TEAM, 2008, Inequalities in Healthy life expectancies in EU25: A cross-national meta-regression analysis, *Lancet,* 9656(372), 2124–2131.

JAGGER C., MATTHEWS F. E., WOHLAND P., FOUWEATHER T., STEPHAN B. C., ROBINSON L., ARTHUR A., BRAYNE C., MEDICAL RESEARCH COUNCIL COGNITIVE FUNCTION, AGEING COLLABORATION, 2016, A comparison of health expectancies over two decades in England: Results of the Cognitive Function and Ageing Study I and II, *Lancet,* 387(10020), 779–786, https://pubmed.ncbi.nlm.nih.gov/26680218/

Janus A. L., Doty P., 2018, Trends in informal care for disabled older Americans, 1982–2012, *The Gerontologist,* 58(5), 863–871.

Jasilionis D., Shkolnikov V. M., Andreev E. M., Jdanov D. A., Vågerö D., Meslé F., Vallin J., 2014, Do vanguard populations pave the way towards higher life expectancy among other population groups? *Population,* 69(4), 531–556.

Jusot F., Tubeuf S., Trannoy A., 2013, Les différences d'état de santé en France: inégalités des chances ou reflet des comportements à risques? *Économie et Statistique,* 455–456, 37–51.

Jylhä M., Luukkaala T., 2006, Social determinants of mortality in the oldest-old: Social class and individual way-of-life, in Robine J.-M., Crimmins E.M., Horiuchi S., Zeng Y. (eds.), *Human longevity, individual life duration, and the growth of the oldest-old population*, Dordrecht, Springer 271–295.

Kalogirou S., Murphy M., 2006, Marital status of people aged 75 and over in nine EU countries in the period 2000–2030, *European Journal of Ageing,* 3(2), 74–81, https://pubmed.ncbi.nlm.nih.gov/28794752/

Kannisto V., Lauritsen J., Thatcher R., Vaupel J. W., 1994, Reduction in mortality at advanced ages: Several decades of evidence from 27 countries, *Population and Development Review*, 20(4), 793–810.

Karas Montez J., Hayward M. D., Wolf D. A., 2017, Do U.S. states' socioeconomic and policy contexts shape adult disability? *Social Science & Medicine*, 178, 115–126.

Katz S., Ford A. B., Moskowitz R. W., Jackson B. A., Jaffe M. W., 1963, Studies of illness in the aged. The Index of ADL: A standardized measure of biological and psychosocial function, *JAMA,* 185(12), 914–919.

Kennedy S., Ruggles S., 2014, Breaking up is hard to count: The rise of divorce in the United States, 1980–2010, *Demography,* 51(2), 587–598, https://pubmed.ncbi.nlm.nih.gov/24399141/

Khieu T. Q. T., Pierse N., Telfar-Barnard L. F., Zhang J., Huang Q. S., Baker M. G., 2017, Modelled seasonal influenza mortality shows marked differences in risk by age, sex, ethnicity and socioeconomic position in New Zealand, *The Journal of Infection,* 75(3), 225–233, https://pubmed.ncbi.nlm.nih.gov/28579304/

Kotlikoff L. J., 1992, *Generational accounting: Knowing who pays, and when, for what we spend*, New York, Free Press.

Kingston A., Comas-Herrera A., Jagger C., Modem project, 2018, Forecasting the care needs of the older population in England over the next 20 years: Estimates from the Population Ageing and Care Simulation (PACSim) modelling study, *Lancet Public Health,* 3(9), e447–e455, https://pubmed.ncbi.nlm.nih.gov/30174210/

Kravdal O., Grundy E., Keenan K., 2018, The increasing mortality advantage of the married: The role played by education, *Demographic Research*, 38(art. 20), 471–512.

Kramer M., 1980, The rising pandemic of mental disorders and associated chronic diseases and disabilities, *Acta Psychiatrica Scandinavica,* 62(S285), 382–397.

Kreider R. M., Ellis R., 2011, Number, timing, and duration of marriages and divorces: 2009*, Current Population Reports*, P70–125, Washington DC, US Census Bureau.

Kuh D., Ben-Shlomo Y., 2016, Early life origins of adult health and aging, in George L. K., Ferraro K. F. (eds.), *Handbook of aging and the social sciences* (8th Ed.)*,* San Diego, Academic Press, 101–122.

Laferrère A., Van den Heede A., Van den Bosch K., Geerts J., 2013, Entry into institutional care: Predictors and alternatives, in Börsch-Supan A., Brandt M., Litwin H., Weber G. (eds.), *Active ageing and solidarity between generations in Europe: First results from SHARE after the economic crisis*, Berlin, De Gruyter, 253–264.

LARSON E. B., LANGA K. M., 2017, What's the 'Take Home' from research on dementia trends? *PLoS Med,* 14(3), e1002236.

LAWTON M. P., BRODY E. M., 1969, Assessment of older people: Self-maintenance and instrumental activities of daily living, *The Gerontologist*, 9(3), 179–186.

LE BIHAN-YOUINOU B., MARTIN C., 2006, Travailler et prendre soin d'un parent âgé dépendant, *Travail, genre et sociétés,* 16(2), 77–96.

LEE R., 1980, Age structure, intergenerational transfers and economic growth: An overview, *Revue économique*, 31(6), 1129–1156, https://www.persee.fr/doc/reco_0035-2764_1980_num_31_6_408572

LÉGARÉ J., DÉCARIE Y., BÉLANGER A., 2014, Using microsimulation to reassess aging trends in Canada, *Canadian Journal on Aging,* 33(2), 208–219.

LEGENDRE F., 2019, L'émergence et la consolidation des méthodes de microsimulation en France, *Économie et Statistique*, 510–512, 207–223, https://www.insee.fr/en/statistiques/4253154?sommaire=4253180

LESTHAEGHE R., 2014, The second demographic transition: A concise overview of its development, *Proceedings of the National Academy of Sciences,* 111(51), 18112–18115.

LEWIN A. C., 2018, Intentions to live together among couples living apart: Differences by age and gender, *European Journal of Population,* 34(5), 721–743, https://doi.org/10.1007/s10680-017-9446-0

LIEBMAN J., 2002, Redistribution in the current U.S. social security system, in Feldstein M., Liebman J. (eds.), *The distributional aspects of social security and social security reform*, National Bureau of Economic Research, Chicago, University of Chicago Press, 11–48, https://EconPapers.repec.org/RePEc:nbr:nberch:9747

LIEFBROER A. C., POORTMAN A.-R., SELTZER J., 2015, Why do intimate partners live apart? Evidence on LAT relationships across Europe, *Demographic Research,* 32(art. 8), 251–286, https://www.demographic-research.org/special/19/8/

LORIAUX M., 1995, Du vieillissement démographique à l'intégration des âges: la révolution de la géritude, *Population,* 50(6), 1611–1625.

LUY M., MINAGAWA Y., 2014, Gender gaps: Life expectancy and proportion of life in poor health, *Health Reports,* 25(12), 12–19.

MACKENBACH J., MENVIELLE G., DOMANTAS J., DE GELDER R., 2015, Measuring educational inequalities in mortality statistics (OECD Statistics Working Papers No. 2015/08), Paris, OECD.

MAIER H., JEUNE B., VAUPEL J. W. (EDS.), 2021, *Exceptional lifespans*, Springer.

MAIER H., GAMPE J., JEUNE B., VAUPEL J. W., ROBINE J.-M. (EDS.), 2010, *Supercentenarians*, Cham, Switzerland, Springer.

MAISONNASSE F., 2016, Égalité entre les femmes et les hommes: le cas des aidants familiaux, *Regard*, 50(2), 99–107.

MANTON K. G., 1982, Changing concepts of morbidity and mortality in the elderly population, *The Milbank Memorial Fundation Quarterly / Health and Society,* 60(2), 183–244.

MANTON K. G., GU X., LAMB V. L., 2006, Long-term trends in life expectancy and active life expectancy in the United States, *Population and Development Review*, 32(1), 81–105.

MANZOLI L., VILLARI P., PIRONE G. M., BOCCIA A., 2007, Marital status and mortality in the elderly: A systematic review and meta-analysis, *Social Science & Medicine,* 64(1), 77–94.

MARCHAND J., SMEEDING T., 2016, Poverty and aging, in Piggott J., Woodland A. (eds.), *Handbook of the economics of population aging,* 905–950, https://EconPapers.repec.org/RePEc:eee:hapoch:v1_905

MARGOLIS R., VERDERY A. M., 2017, Older adults without close kin in the United States, *The Journals of Gerontology: Series B,* 72(4), 688–693, https://pubmed.ncbi.nlm.nih.gov/28575387/

MARGOLIS R., WRIGHT L., 2017, Older adults with three generations of kin: Prevalence, correlates, and transfers, *The Journals of Gerontology: Series B*, 72(6), 1067–1072, https://doi.org/10.1093/geronb/gbv158

MARMOT M., FRIEL S., BELL R., HOUWELING T. A. J., TAYLOR S., 2008, Closing the gap in a generation: Health equity through action on the social determinants of health, *The Lancet,* 9650(372), 1661–1669.

MASON A., LEE R., 2011, Population aging and the generational economy: Key findings, in Lee R., Mason A. (eds.), *Population aging and the generational economy,* Cheltenham, Edward Edgar.

MASSON A., 2002, Méthodes et usages des comptes générationnels: un regard décalé, *Économie et prévision*, 154, 1–24.

MATHERS C. D., 2020, History of global burden of disease assessment at the World Health Organization, *Archives of Public Health,* 78(art. 77), https://doi.org/10.1186/s13690-020-00458-3

MCGARRY K., SCHOENI R. F., 2000, Social security, economic growth, and the rise in elderly widows' independence in the twentieth century, *Demography,* 37(2), 221–236, https://pubmed.ncbi.nlm.nih.gov/10836180/

MCHUGH K. E., MINGS R. C., 1996, The circle of migration: Attachment to place in aging, *Annals of the Association of American Geographers,* 86(3), 530–550.

MCMICHAEL A. J., MCKEE M., SHKOLNIKOV V., VALKONEN T., 2004, Mortality trends and setbacks: Global convergence or divergence? *The Lancet,* 363(9415), 1155–1159, https://www.sciencedirect.com/science/article/abs/pii/S0140673604159023

MESLÉ F., 2006, Causes of death among the oldest-old: Validity and comparability, in Robine J.-M., Crimmins E., Horiuchi, S., Zeng, Y. (eds.), *Human longevity, individual life duration and the growth of the oldest-old population*, Dortrecht, Springer, 191–214.

MESLÉ F., VALLIN J., 1989, Reconstitution de tables annuelles de mortalité pour la France au XIX[e] siècle, *Population,* 44(6), 1121–1158.

MESLÉ F., VALLIN J., 2019, Highest life expectancies: How long will Japan keep the lead? *Journal of Population Problems,* 75(2), 108–122.

MESLÉ F., VALLIN J., 2020, Les causes de décès aux grands âges en France, évolution récente, *Revue Quetelet,* 8(1), 37–72.

MUIR T., 2017, Measuring social protection for long-term care (OECD Health Working Papers No. 93), Paris, OECD, https://doi.org/10.1787/a411500a-en

MULLER M., 2017, 728 000 résidents en établissements d'hébergement pour personnes âgées en 2015, *Études et résultats*, 1015, July.

MURPHY M., MARTIKAINEN P., PENNEC S., 2006, Demographic change and the supply of potential family supporters in Britain, Finland and France in the period 1911–2050, *European Journal of Population,* 22(3), 219–240, https://link.springer.com/article/10.1007/s10680-006-9003-8

MURRAY C. J. L., SALOMON J. A., MATHERS C., 2000, A critical examination of summary measures of population health, *Bulletin of the World Health Organization,* 78(8), 981–994.

NAGI S. Z., 1976, An epidemiology of disability among adults in the United States, *Milbank Memorial Fund Quarterly / Health and Society,* 54(4), 439–467.

NOTESTEIN F. W., 1954, Some demographic aspects of aging, *Proceedings of the American Philosophical Society,* 98(1), 38–45.

Nowik L., Thalineau A., 2014, *Vieillir chez soi. Les nouvelles formes du maintien à domicile*, Presses universitaires de Rennes.

Nusselder W. J., Looman C., Van Oyen H., Yokota R., De Carvalho T., 2020, Attributing causes to disability, in Jagger C., Crimmins E. M. et al. (eds.), *International handbook of health expectancies*, Cham, Switzerland, Springer.

Nusselder W. J., Wapperom D., Looman C., Yokota R. T., Van Oyen H., Robine J.-M., Jagger C., Cambois E., 2019, Contribution of chronic conditions to disability in men and women in France, *European Journal of Public Health*, 29(1), 99–104, https://academic.oup.com/eurpub/article/29/1/99/5068682

OECD, 2015, *Ageing: Debate the issues*, Paris, OECD.

OECD, 2019a, *Health at a glance 2019*, Paris, OECD, https://www.oecd-ilibrary.org/content/publication/4dd50c09-en

OECD, 2019b, *Pensions at a glance,* Paris, OECD.

OECD, 2020, *Who Cares? Attracting and retaining care workers for the elderly*, Paris, OECD, https://www.oecd-ilibrary.org/content/publication/92c0ef68-en

OECD, European Union, 2018, *Health at a glance: Europe 2018, state of health in the EU cycle*, Paris/Brussels, OECD, https://www.oecd-ilibrary.org/content/publication/health_glance_eur-2018-en

Oeppen J., Vaupel J. W., 2002, Broken limits to life expectancy, *Science*, 296(5570), 1029–1031.

Ogg J., Bonvalet C. (eds.), 2011, *Baby boomers: A mobile generation*, Oxford/Paris, Bardwell/INED.

Palazzo C., Yokota R., Tafforeau J., Ravaud J.-F., Cambois E., Poiraudeau S., Van Oyen H., Nusselder W. J., 2019, Contribution of chronic diseases to educational disparity in disability in France: Results from the cross-sectional 'disability-health' survey, *Archives of Public Health,* 77(art. 2), https://archpublichealth.biomedcentral.com/articles/10.1186/s13690-018-0326-9

Papon S., Beaumel C., 2021, Bilan démographique 2020, *Insee Première,* 1834, January.

Parant A., 1992, Croissance démographique et vieillissement, *Population*, 47(6), 1657–1675.

Pennec S., 1996, La place des familles à quatre générations en France, *Population,* 51(1), 31–59.

Pennec S., Gaymu J., 2011, La durée de l'isolement conjugal et de la vie en couple chez les personnes âgées en France: quelles évolutions entre hommes et femmes au fil des générations? *Cahiers québécois de démographie,* 40(2), 175–208.

Pennec S., Gaymu J., Monnier A., Riou F., Aubry R., Pontone S., Cases C., 2013, In France, where do people live in their last month of life and where do they die? *Population,* 68(4), 503–531, https://doi.org/10.3917/popu.1304.0585

Pickard L., 2008, *Informal care for older people provided by their adult children: Projections of supply and demand to 2041 in England*, Report to the Strategy Unit (Cabinet Office) and the Department of Health, vol. 2515.

Pison G., 2009, *Atlas de la population mondiale*, Paris, Autrement.

Pison G., 2019, The population of the world (2019), *Population & Societies,* 569, September.

Pestieau P., Ponthière G., 2016, Longevity variations and the Welfare State, *Journal of Demographic Economics,* 82(2), 207–239.

Ponthière G., 2017, *Économie du vieillissement*, Paris, La Découverte, https://www.cairn.info/economie-du-vieillissement--9782707189554.htm

Preston S. H., 1984, Children and the elderly: Divergent paths for America's dependents, *Demography*, 21(4), 435–457.

Prioux F., Barbieri M., 2012, Recent demographic developments in France: Relatively low mortality at advanced ages, *Population,* 67(4), 493–550, https://www.cairn.info/revue-population-2012-4-page-597.htm

Raffelhuschen B., 1999, Generational accounting in Europe, *American Economic Review,* 89(2), 167–170, https://www.aeaweb.org/articles?id=10.1257/aer.89.2.167

Rechel B., Grundy E., Robine J.-M., Cylus J., Mackenbach J. P., Knai C., McKee M., 2013, Ageing in the European Union, *The Lancet,* 381(9874), 1312–1322, https://pubmed.ncbi.nlm.nih.gov/23541057/

Régnier-Loilier A., 2019, New partner, new living arrangements? The process of repartnering after separation, *Population,* 74(1–2), 71–100, https://www.cairn.info/revue-population-2019-1-page-73.htm

Régnier-Loilier A., Vignoli D., 2018, The diverse nature of living apart together relationships: An Italy–France comparison, *Journal of Population Research,* 35(1), 1–22, https://doi.org/10.1007/s12546-017-9197-0

Régnier-Loilier A., Beaujouan É., Villeneuve-Gokalp C., 2009, Neither single, nor in a couple. A study of living apart together in France, *Demographic Research*, 21(art. 4), 75–108.

Renaut S., Ogg J., Petite S., Chamahian A., 2015, Home environments and adaptations in the context of ageing, *Ageing & Society,* 35(6), 1278–1303.

Rendall M. S., Weden M. M., Favreault M. M., Waldron H., 2011, The protective effect of marriage for survival: A review and update, *Demography*, 48(2), 481–506, doi: 10.1007/s13524-011-0032-5

Reyniers T., Deliens L., Pasman H. R., Morin L., Addington-Hall J., Frova L., Cardenas-Turanzas M., Onwuteaka-Philipsen B., Naylor W., Ruiz-Ramos M., et al., 2015, International variation in place of death of older people who died from dementia in 14 European and non-European countries, *Journal of the American Medical Directors Association,* 16(2), 165–171, https://pubmed.ncbi.nlm.nih.gov/25544001/

Rincaz J., 1998, Les fondements imaginaires de la vieillesse dans la pensée occidentale, *L'Homme. Alliance, rites et mythes,* 147, 167–189.

Robine J.-M. (ed.), 2001, Biodemographic perspectives on human longevity, *Population: An English Selection*, 13(1).

Robine J.-M., Allard M., 1999, Jeanne Calment: Validation of the duration of her life, in Jeune B., Vaupel J. W. (eds.), *Validation of exceptional longevity*, Odense, Odense University Press, 145–172.

Robine J.-M., Cubaynes S., 2017, Worldwide demography of centenarians, *Mechanisms of Ageing and Development,* 165, 59–67, https://www.sciencedirect.com/science/article/abs/pii/S0047637416302548

Robine J.-M., Allard M., Herrmann F. R, Jeune B., 2019, The real facts supporting Jeanne Calment as the oldest ever human, *The Journals of Gerontology: Series A,* 74(Suppl. 1), S13–S20, https://doi.org/10.1093/gerona/glz198

Robine J.-M., Jagger C., Mathers C., Crimmins E., Suzman R. (eds.), 2003, *Determining health expectancies*, Chichester, John Wiley & Sons, Ltd.

Robine J.-M., Jagger C., Crimmins E., Saito Y., van Oyen H., 2020, Trends in health expectancies, in Jagger C., Crimmins E. M. et al. (eds.), *International handbook of health expectancies*, Cham, Switzerland, Springer.

Rockwood K., Fox R. A., Stolee P., Robertson D., Beattie B. L., 1994, Frailty in elderly people: An evolving concept, *CMAJ,* 150(4), 489–495, https://pubmed.ncbi.nlm.nih.gov/8313261/

ROQUEBERT Q., TENAND M., 2017, Pay less, consume more? The price elasticity of home care for the disabled elderly in France, *Health Economics,* 26(9), 1162–1174.

RUGGLES S., 2007, The decline of intergenerational coresidence in the United States, 1850 to 2000, *American Sociological Review,* 72(6), 964–989, https://pubmed.ncbi.nlm.nih.gov/21562613/

RYDER N. B., 1975, Notes on stationary populations, *Population Index,* 41(1), 3–28, https://www.jstor.org/stable/2734140

SANDERSON W., SCHERBOV S., 2005, Average remaining lifetimes can increase as human populations age, *Nature,* 435(7043), 811–813.

SANDERSON W., SCHERBOV S., 2008, Rethinking age and aging, *Population Bulletin*, 63(4), 1–16.

SAUVY A., 1944, *La population, ses lois, ses équilibres*, Paris, PUF.

SAUVY A., 1954, Le vieillissement des populations et l'allongement de la vie, *Population,* 9(4), 675–682.

SCHARLACH A. E., LEHNING A. J., 2013, Ageing-friendly communities and social inclusion in the United States of America, *Ageing & Society,* 33(1), 110–136.

SCHOENI R. F., OFSTEDAL M. B., 2010, Key themes in research on the demography of aging, *Demography,* 47(Suppl. 1), S5–S15, https://pubmed.ncbi.nlm.nih.gov/21302420/

SEIBOLD A., 2019, *Reference points for retirement behavior: Evidence from German pension discontinuities* (CESifo Working Paper No. 7799), Munich, Munich Society for the Promotion of Economic Research.

SELTZER J. A., 2019, Family change and changing family demography, *Demography,* 56(2), 405–426, https://read.dukeupress.edu/demography/article/56/2/405/167969/Family-Change-and-Changing-Family-Demography

SMEEDING T. M., 2003, Income maintenance in old age: Current status and future prospects for rich countries, *Genus,* 59(1), 51–83, https://www.jstor.org/stable/29788750

SOBOTKA T., 2017, Childlessness in Europe: Reconstructing long-term trends among women born in 1900–1972, in Kreyenfeld M., Konietzka D. (eds.), *Childlessness in Europe: Contexts, causes, and consequences*, Cham, Switzerland, Springer, 159–179.

SOLAZ A., 2021, More frequent separation and repartnering among people aged 50 and over, *Population & Societies*, 586, February.

SULLIVAN D. F, 1971, A single index of mortality and morbidity, *HSMHA Health Reports,* 86(4), 347–354.

THIÉBAUT S. P., BARNAY T., VENTELOU B., 2013, Ageing, chronic conditions and the evolution of future drugs expenditure: A five-year micro-simulation from 2004 to 2029, *Applied Economics,* 45(13), 1663–1672, https://doi.org/10.1080/00036846.2011.633895

THOMPSON L., CARASSO A., 2002, Social security and the treatment of the families: How does the United States compare with other developed countries, in Favreault M. M., Sammartino F. J., Steuerle C. E. (eds.), *Social security and the family: Addressing unmet needs in an underfunded system*, Washington, DC, Urban Institute Press, 123–171.

TOULEMON L., BARBIERI M., 2008, The mortality impact of the August 2003 heat wave in France: Investigating the 'harvesting' effect and other long-term consequences, *Population Studies,* 62(1), 39–53, https://pubmed.ncbi.nlm.nih.gov/18278672/

TURCI L., PENNEC S., TOULEMON L., BRINGÉ A., BAGGIO R., MORAND É., 2015, Agent-based microsimulation of population dynamics, in Bierlaire M., de Palma A., Hurtubia R., Waddell P. (eds.), *Integrated transport and land use for modeling for sustainable cities*, Lausanne, Switzerland, EPFL Press, 113–135.

Uhlenberg P., 2005, Historical forces shaping grandparent-grandchild relationships: Demography and beyond, *Annual Review of Gerontology and Geriatrics*, 24(1), 77–97.

Uhlenberg P. (ed.), 2009, *International handbook of population aging*, Dortrecht, Springer.

UNA, 2018, Communiqué de presse du 15 janvier 2019 – Aide et soins à domicile auprès des personnes en perte d'autonomie: 1 personne sur 10 nécessitant un service d'aide à domicile n'a pu avoir une prise en charge intégrale en 2018.

United Nations, 2019a, *Database on the households and living arrangements of older persons*, United Nations Population Division, Department of Economic and Social Affairs.

United Nations, 2019b, *World population prospects 2019*, United Nations Population Division, Department of Economic and Social Affairs.

US National Academy of Sciences, Engineering, and Medicine, 2015, The growing gap in life expectancy by income: Implications for federal programs and policy responses, Washington, DC, National Academies Press.

Valkonen T., Martikaninen P., Blomgren J., 2004, Increasing excess mortality among nonmarried elderly people in developed countries, *Demographic Research*, S2(12), 305–330.

Vallin J., Meslé F., 2009, The segmented trend line of highest life expectancies, *Population and Development Review,* 35(1), 159–187.

Van Imhoff E., Post W., 1997, Méthodes de micro-simulation pour des projections de population, *Population,* 52(4), 889–932.

Verbrugge L. M., Jette A. M., 1994, The disablement process, *Social Science and Medicine* 38, 1–14.

Verbrugge L. M., Rennert C., Madans J. H., 1997, The great efficacy of personal and equipment assistance in reducing disability, *American Journal of Public Health*, 87(3), 384–392.

Verdery A. M., Margolis R., Zhou Z., Chai X., Rittirong J., 2019, Kinlessness around the world, *Journal of Gerontology: Series B,* 74(8), 1394–1405.

Vespa J., 2012, Union formation in later life: Economic determinants of cohabitation and remarriage among older adults, *Demography,* 49(3), 1103–1125,

https://pubmed.ncbi.nlm.nih.gov/22549155/

Vincent P., 1946, Vieillissement de la population, retraites et immigration, *Population,* 1(2), 213–244, https://www.cairn.info/revue-population-1946-2-page-213.htm

Vlachantoni A., 2019, Unmet need for social care among older people, *Ageing & Society*, 39(4), 657–684.

Wahl H.-W., Deeg D. J. H., Litwin H., 2013, European ageing research in the social, behavioural and health areas: A multidimensional account, *European Journal of Ageing,* 10(4), 261–270, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5549214/

Weiss Y., 1994, Les économistes et la formation des couples. Le fonctionnement du mariage et du marché matrimonial, *Population*, 49(4–5), 1015–1039, https://www.persee.fr/doc/pop_0032-4663_1994_num_49_4_4251

White C., 2015, *Trend in life expectancy at birth and at age 65 by socio-economic position based on the National Statistics Socio-economic Classification, England and Wales: 1982–1986 to 2007–2011: Estimates of life expectancy by personal socio-economic position using the National Statistics Socio-Economic Classification based on occupation*, Statistical Bulletin, Office for National Statistics.

Williamson J. B., Watts-Roy D., 1999, Framing the generational equity debate, in Williamson J. B., Watts-Roy D., Kingson E. R. (eds.) *The generational equity debate*, New York, Columbia University Press, 3–37.

WILMOTH J. R., DEEGAN L. J., LUNDSTRÖM H., HORIUCHI S., 2000, Increase of maximum life-span in Sweden, 1861–1999, *Science,* 289(5488), 2366–2368.

WOOD P. H. N., BADLEY E. M., 1978, An epidemiological appraisal of disablement, in Bennett A. E. (ed.), *Recent advances in community medicine*, Edinburgh, Churchill Livingstone, 149–173.

WORLD HEALTH ORGANIZATION, 1980, *International Classification of Impairments, Disabilities, and Handicaps,* Geneva, WHO.

ZAK N., 2018, *Jeanne Calment: The secret of longevity*, doi:10.13140/RG.2.2.29345.04964

Carole Bonnet, Emmanuelle Cambois, Roméo Fontaine • **Population Ageing in High-Longevity Countries: Demographic Dynamics and Socio-economic Challenges**

In 2015, the French law on the adaptation of society to ageing signaled the country's political will to prepare comprehensively for the consequences of population ageing. It formalized the findings of international research and public debates that have long emphasized its scope and multiple implications. This article reviews these issues by drawing on the experience of 40 high-longevity countries. In 2020, there were 4 times as many people aged 65 and older as there were in 1950; in Japan, the 'oldest' country, their proportion has jumped from 5% to 28%, and life expectancy has nearly doubled. The first part of this article lays out the definitions and measures of population ageing, then describes the diversity of the dynamics of these high-longevity countries. The second part examines the multidimensional and intertwined issues at stake, regarding health (What is the limit to longevity? How is life expectancy in good health changing?), demography (How are family and partnership configurations changing?), and the economy via the problematics of social protection models (retirement, assisted living, intergenerational transfers).

Carole Bonnet, Emmanuelle Cambois, Romeo Fontaine • **Dynamiques, enjeux démographiques et socioéconomiques du vieillissement dans les pays à longévité élevée**

En 2015, la loi d'adaptation de la société au vieillissement marquait en France la volonté politique d'anticiper de manière globale les conséquences du vieillissement démographique. Elle formalisait les constats des recherches et débats publics internationaux qui, depuis longtemps, en soulignent l'ampleur et les multiples implications. Cette chronique fait le point sur ces questions en s'appuyant sur l'expérience de 40 pays caractérisés par une longévité élevée. En 2020, les personnes de 65 ans et plus y sont quatre fois plus nombreuses qu'en 1950 ; au Japon, pays le plus « vieux », leur proportion a bondi de 5 % à 28 % et leur espérance de vie a presque doublé. Une première partie présente les définitions et les mesures du vieillissement démographique, puis la diversité des dynamiques de ces 40 pays. La seconde partie décrit les enjeux multidimensionnels et imbriqués du phénomène en termes sanitaires (quelle limite à la longévité ? quelle évolution de l'espérance de vie en bonne santé ?), sociodémographiques (comment se modifient les configurations conjugales, familiales) et économiques, *via* la problématique des modèles de protection sociale (retraite, aide à l'autonomie, transferts intergénérationnels).

Carole Bonnet, Emmanuelle Cambois, Romeo Fontaine • **Dinámica, desafios demográficos y socioeconómicos del envejecimiento en los países con una elevada longevidad**

En 2015, la ley de adaptación de la sociedad al envejecimiento demostraba en Francia la voluntad política de anticipar de manera global las consecuencias del envejecimiento demográfico. Dicha ley formalizaba los resultados de investigaciones y de debates públicos internacionales que, desde hacia tiempo, subrayaban la amplitud y las multiples implicaciones de ese fenómeno. Esta crónica examina dichas cuestiones sobre la base de la experiencia de 40 países con una longevidad elevada. En 2020, las personas de 65 años o más son cuatro veces más numerosas que en 1950; en Japón, el país más «viejo», su proporción ha aumentado de 5 % al 28 % y su esperanza de vida casi se ha duplicado. La primera parte del artículo presenta las definiciones y medidas del envejecimiento y tambien la diversidad de las dinámicas del envejecimiento de esos 40 países. La segunda parte describe los retos multidimensionales e imbricados del fenómeno en términos sanitarios (¿qué límite a la longevidad? ¿qué evolución de la esperanza de vida en buena salud?), sociodemográficos (¿cómo se modifican las configuraciones conyugales, familiares?) y económicos, a través de la problemática de los modelos de protección social (jubilación, ayuda a la autonomía, transferencias intergeneracionales).

Keywords: ageing, life expectancy, retirement, dependence, assisted living, health inequalities, disability, families, old age

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