

## Chapter 2

# Aging and its Consequences

### 2.1 The Dynamics of Population Aging

To understand why population aging strains pension systems and puts their reform on the political agenda, it is paramount to grasp the different dynamics and implications of this process. What is often not fully understood by the layman is that a fall in the population growth rate alone would not pose so much of a problem if the age structure remained the same, i.e. if the relation between young and old<sup>1</sup> would roughly stay constant. In this case, the relative size of the working age population to the non-working population (the retired and children) would not change. This, however, is not what we currently observe in the industrialized nations. Not only does the population growth rate decline there, but the populace also grows older. Hence, the relative number of working age people is steadily declining.

A useful indicator to describe the relative size of the work force is the old-age dependency ratio which measures the ratio of the population of retirement age (defined as those aged 65 or over) to the population of working age (defined as those aged 15-64).<sup>2</sup> It is widely used because it is easy to compute and straightforward to interpret. Table 2.1 shows the development of this indicator in selected OECD countries and provides future projections that have been estimated by the United Nations' Pop-

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<sup>1</sup> Unless explicitly stated otherwise, in this dissertation “young” refers to those of working age while “old” denotes the retired population.

<sup>2</sup> This indicator is not be confused with the “Dependency Ratio” which includes in the numerator not only those aged 65 and over but also those under the age of 15.

ulation Division (United Nations (2010)). In all countries exhibited in the table, the old-age dependency ratio was well below 20 in 1955, highlighting the existence of a relatively large work force compared to the number of people aged 65 and above. Most notable is the small ratio of 9 in Japan. Except for Ireland, these numbers steadily increased until the year 2010, exceeding 20 in almost all countries.

**Table 2.1:** Projected development of old-age dependency ratios in selected countries

	1955	2000	2010	2020	2030	2040	2050
Austria	17	23	26	30	41	50	53
Belgium	17	26	27	32	39	44	44
Czech Republic	13	20	21	30	34	38	49
Denmark	15	22	25	31	37	42	41
Finland	11	22	26	37	44	44	45
France	18	25	26	33	39	43	43
Germany	16	24	31	36	48	56	57
Greece	11	25	28	32	37	47	55
Hungary	12	22	24	30	32	36	44
Ireland	18	17	17	23	28	34	41
Italy	13	27	31	36	44	57	62
Japan	9	25	35	48	53	63	70
Luxembourg	15	21	20	22	28	35	40
Netherlands	13	20	23	31	41	48	46
Poland	9	18	19	27	35	37	48
Portugal	12	24	27	32	40	52	64
Spain	12	25	25	29	37	50	62
Sweden	17	27	28	34	38	41	42
United Kingdom	17	24	25	29	34	39	40
USA	14	19	20	25	33	35	35

Note: Old-age dependency ratio is defined as the age ratio  $\frac{65+}{15-64}$ . The projections are based on the UN's "medium variant" scenario.

Data Sources: United Nations Population Division: *World Population Prospects: The 2010 Revision* (<http://esa.un.org/unpp>)

Looking ahead until the year 2050, the UN's projections<sup>3</sup> predict an even more dramatic rise in old-age dependency ratios, which will almost more than double in most countries of the EU within the next 40 years. Japan and Portugal will suffer the most remarkable increases from 35 and 27 in 2010 to respectively 70 and 64 in the year 2050. But also other countries like Germany, Italy and Spain are reckoned to exhibit ratios above 50, implying that there will be less than two workers per retiree in 2050. Looking at the Czech Republic, Hungary and Poland, we find that these trends are prevalent also in the transition economies of Eastern Europe. Hence, these developments are not confined to the "old" Western countries but mark a general trend in the developed world.

It is worth pointing out that the old-age dependency ratio is actually understating the problem, however. For one, most countries provide ample opportunities to retire before the age of 65, thus increasing the size of the numerator. And second, the fact that not everyone aged between 15 and 64 is actually part of the labor force strongly reduces the denominator. Many pursue an education beyond the mere age of 15 and there is a significant number of people that are unemployed or voluntarily outside the labor force. As a result, the employment rate lies not at 100 per cent but significantly below that. In 2011, according to the OECD's Economic Outlook data (OECD (2012)), employment rates in the countries under consideration ranged from 55.6 per cent (Greece) to 74.9 per cent (Netherlands).<sup>4</sup> The picture is thus much bleaker than Table 2.1 conveys.

It is very clear, therefore, that population aging entails a dramatic relative reduction in the size of the active labor force vis-à-vis the retired. There are several dynamics that drive this decline. First of all, population growth rates are falling. However, up to now almost all countries considered here still had positive population growth rates (with the exception of Germany in the mid-eighties). This will change in the future, however. In most EU countries and Japan population growth will turn negative within the next 40 years. This trend is explicated in Figure 2.1 which displays the developments and projected trends in the five big EU countries along with Sweden, the Netherlands, Japan and the United States. Of these nations,

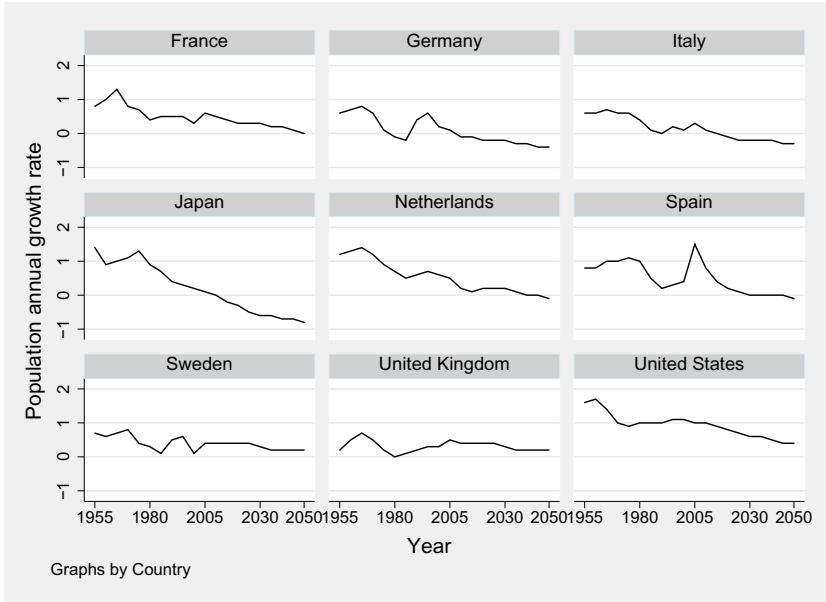
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<sup>3</sup> All projections are based on the UN's "medium variant" scenario. The underlying assumptions vary for different country groups. For developed countries it is being assumed that fertility rates increase slightly to on average 1.79 in 2050, mortality rates continue to improve and the flow of immigration stays at current levels.

<sup>4</sup> Of course, many countries (especially Greece) suffered reductions in their employment rates since 2009 due to the global financial crisis and the subsequent economic downturn.

only Sweden, Britain and the U.S. will continue to have positive albeit low population growth rates.

**Fig. 2.1:** Long-term projections of population growth rates

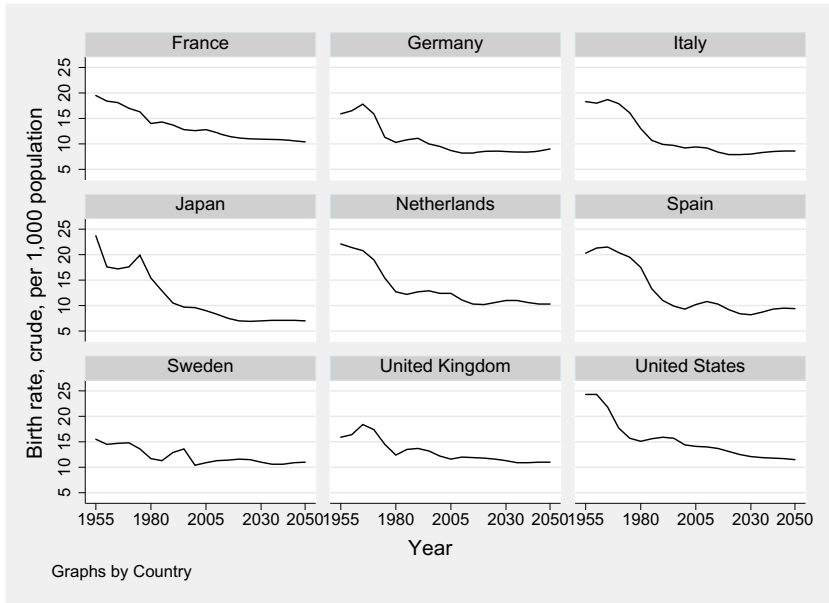


Note: Projections based on "medium variant" scenario.

Data Source: United Nations Population Division: *World Population Prospects: The 2010 Revision* (<http://esa.un.org/unpp>).

The culprit behind this downward shift are falling fertility rates. The average number of children of a woman until the end of her reproductive period is steadily declining. This can also be seen by looking at crude birth rates. Figure 2.2 graphs these for the same sample of countries as before. In 1955 all countries had birth rates well above 15 or even 20 (Japan, Netherlands, U.S.). By 2050, these will have fallen below 12 in most states (except France and the U.S.).

It should be noted that *some* part of the plunge in fertility rates will be a transitory phenomenon. The reason is that women nowadays tend to have children at a later age than women of previous generations. Table 2.2 underscores this development. Until 2050 the average childbearing

**Fig. 2.2:** Long-term projections of crude birth rate, per 1000 population

Note: Number of births in a given period divided by the person-years lived by the population over that period, per 1000 population; based on "medium variant" scenario.

Data Source: United Nations Population Division: *World Population Prospects: The 2010 Revision* (<http://esa.un.org/unpp>).

age of a women will have increased to above 30 in all countries under consideration. As a result, the current data reflects the coexistence of previous cohorts of women with earlier peaks of fertility and later cohorts that have their peaks at a higher age. This would suggest that taking *completed* fertility rates into account somewhat reduces the size of projected old-age dependency ratios. But as has been estimated by other studies such as Calmfors et al. (2005), there is only a minor impact of this qualification on projected population trends.

Concomitant to the decline in fertility is a steady increase in longevity which can mainly be attributed to improvements in public health provisions and medical innovation.<sup>5</sup> It is this rise in life expectancy that really aggravates the problem of falling fertility rates because it increases the rel-

<sup>5</sup> See Lichtenberg (2004) for an empirical study using U.S. time series data.

**Table 2.2:** Projected development of average childbearing age in selected countries (in years)

	1995-2000	2010-2015	2030-2035	2045-2050
France	29,23	29,91	30,50	30,50
Germany	28,05	29,84	30,50	30,50
Italy	29,52	30,65	31,24	31,39
Japan	29,02	29,63	30,22	30,53
Netherlands	30,19	30,56	30,50	30,50
Spain	29,92	30,41	30,50	30,50
Sweden	29,00	29,99	30,50	30,50
United Kingdom	27,82	29,17	30,50	30,50
United States	26,60	28,52	30,50	30,50

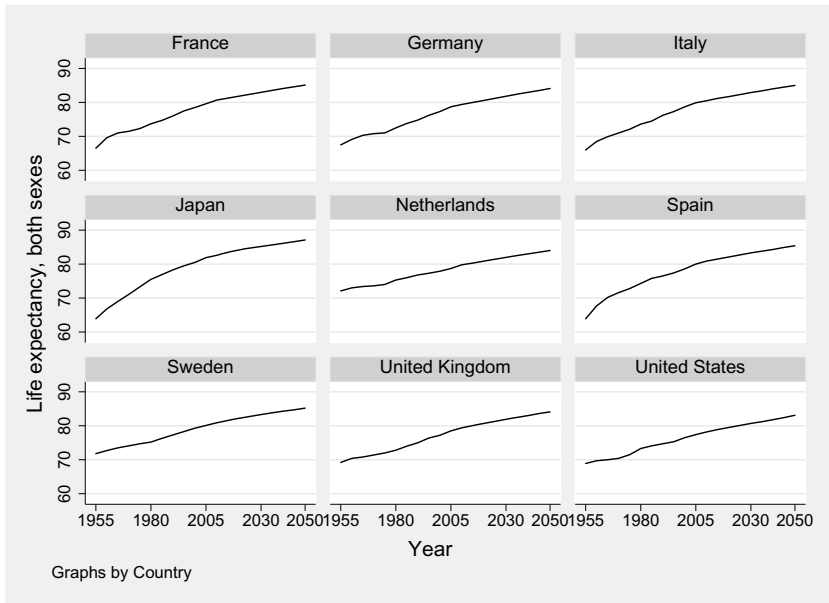
Note: Average childbearing age of a woman in years.

Data Sources: United Nations Population Division: *World Population Prospects: The 2010 Revision* (<http://esa.un.org/unpp>)

ative size of the retired population vis-à-vis the young. On the other hand, of course, it prevents a stark fall in the overall population size, since to some extent it counteracts the fact that fewer people are being born. The increase in longevity has been quite steady in the past, raising average life expectancy from around 64-72 in 1955 to approximately 80 in 2005. Figure 2.3 again shows the UN's future projections based on the "medium variant" scenario. All countries are expected to continue to observe steady increases in longevity albeit at a somewhat decreasing pace. These estimates thus suggest diminishing returns to medical innovations and health care spending. Nevertheless, by the year 2050 projected life expectancy will hover around 85. In other words, given a retirement age of 65 people will spend on average 20 years in retirement, around 5 years more than in 2005.

In sum, falling fertility rates and rising longevity combine to lead to a "graying" of the population.<sup>6</sup> To give a final taste of this development and to convey its magnitude, figure 2.4 displays the past and future shares of people aged 65 and over. While in 1955 the share of elderly thus defined was still around or below 10 per cent, it is expected to increase to 25-30

<sup>6</sup> Of course, net migration also affects population aging. This is not discussed here, for immigration policy is driven by other factors than aging developments. Furthermore, immigrants tend, over time, to converge in their fertility rates and life expectancy towards those prevailing in the host nation.

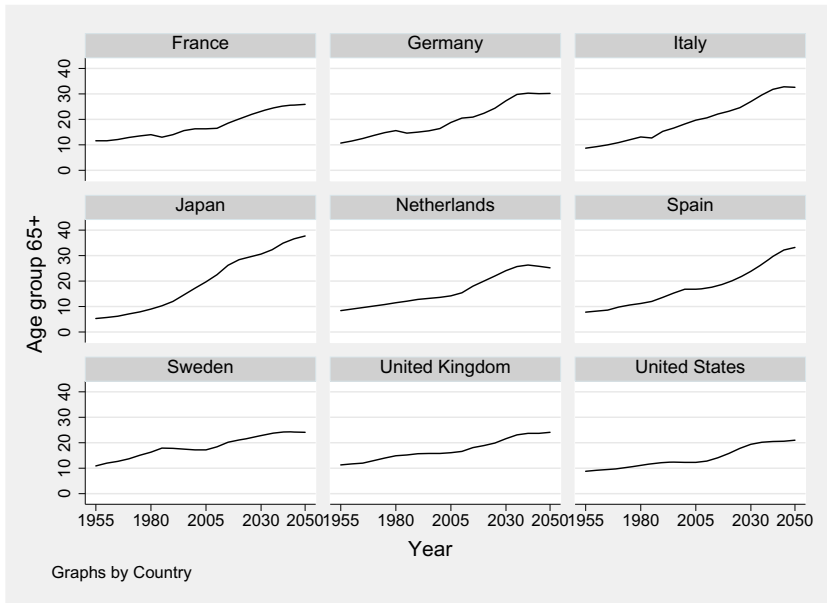
**Fig. 2.3:** Long-term projections of life expectancy, both sexes

Note: Average number of years of life expected by individuals of a hypothetical cohort, subject during all their lives to the mortality rates of a given period; based on “medium variant” scenario.

Data Sources: United Nations Population Division: *World Population Prospects: The 2010 Revision* (<http://esa.un.org/unpp>).

per cent of the whole population. Japan once again leads the pack with a whopping 38 per cent.

Of course, as with any long-term projections, results are dependent on the underlying assumptions and on past and current data. Furthermore, future policy measures that affect migration or the incentive to have children cannot appropriately be factored in. There is certainly a lot of truth in the often heard adage that predictions are uncertain, especially about the future. Maddaloni et al. (2006) illustrate these uncertainties by pointing out the recurrent significant revisions in Eurostats’ population growth projections. Yet even with these caveats in mind, the qualitative results are beyond doubt for three reasons. First, the underlying factors such as fertility tend to change very slowly. Even if a sudden hike in fertility occurred, it would only gradually affect old-age-dependency ratios. Second, when comparing these UN projections with, for example, those of Euro-

**Fig. 2.4:** Long-term projections of share of population aged 65 or over

Data Sources: United Nations Population Division: *World Population Prospects: The 2010 Revision* (<http://esa.un.org/unpp>).

stat, we find very similar results. Moreover, there are also other scenarios provided by the UN's Population Division that do take into account abrupt changes in the underlying variables: besides the "medium variant", there are also low, high and constant fertility scenarios. Third, projections of life-expectancy notoriously underestimate true trends which leads to regular upward revisions of earlier projections. In case of Great Britain, for instance, projections made in 2004 about the number of people aged 65 and over in the year 2050 were 65% higher than projections made in 1981 (OECD (2011): 85). No matter which prediction we look at, however, while the magnitudes may differ the general pattern and thus the qualitative conclusions remain robust. The aging of societies in industrialized countries is an ongoing process and it is expected to continue for the foreseeable future.



## 2.2 The Macroeconomic Consequences of Aging

Although this dissertation focuses on aging and its impact on pension systems, it is worthwhile to look at the broader economic picture. Aging affects not only the functioning of systems of old-age provision but has macroeconomic ramifications that require substantial adjustments in both the public and the private sector. These macroeconomic implications in turn directly affect the stability and sustainability of pension systems, while pension systems in turn affect macroeconomic variables like labor supply, private saving and capital accumulation. Hence, it is also the general equilibrium effects that make pension systems such an important policy field. Quite a number of studies have analyzed and estimated the effects of aging on per capita economic growth, financial market development, fiscal policy and the financial viability of pension systems. Some of the results will be reviewed in this section to convey an idea about the (expected) macroeconomic environment. It is some of these consequences of aging that explain why pension reform is considered such a salient policy issue among policy makers and in academia.

### 2.2.1 *Aging and Economic Growth*

A number of organizations have attempted to project the impact of population aging on per capita incomes and growth rates, among them the European Central Bank (ECB (2006)), the Economic Policy Committee of the ECOFIN Council<sup>7</sup> (Carone et al. (2006)), the European Economic Advisory Group at the CESifo institute (Calmfors et al. (2005)), the International Monetary Fund (Batini et al. (2006)) and the OECD (Martins et al. (2005)). These estimates have to be taken with even more caution than demographic projections, however. They are highly dependent on the underlying assumptions about future labor productivity growth, expected changes in labor force participation rates and labor utilization. Nevertheless, while the exact magnitudes involved may be doubtful, these projections can at least convey the qualitative nature of future developments.

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<sup>7</sup> The Economic Policy Committee is a body composed of senior officials from central banks, national economics and finance ministries, whose task is to prepare the ECOFIN Council.

The channels by which aging affects economic growth can be easily sketched without having to get into the details and intricacies of standard growth theories.<sup>8</sup> Looking at a general production function, where  $Y$  denotes an economy's output,  $L$  labor input,  $K$  capital input and  $A$  productivity allows to identify these channels:

$$Y = AF(L, K) \quad (2.1)$$

Rewriting (2.1) in terms of growth rates yields

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + a_K \frac{\Delta K}{K} + a_L \frac{\Delta L}{L} \quad (2.2)$$

where  $\Delta$  denotes the respective rates of change and  $a_K$  and  $a_L$  the respective output elasticities with regard to capital and labor. This growth accounting equation suggests that aging affects output growth directly via a reduction in labor input  $L$ . If the relative size of the working age population decreases and this is not fully compensated by an increased participation rate, per capita growth will fall. Empirically, this channel is expected to have the strongest adverse impact. Columns 1-4 of Table 2.3 present estimates carried out by Carone et al. (2006) who use the long-term projections conducted by the Economic Policy Committee's Working Group on Aging. These estimations show how employment growth, which is a measure of  $\Delta L$ , will contribute to changes in GDP. For all countries under consideration<sup>9</sup> the impact of employment on economic growth falls rapidly between the period 2004-2010 and 2011-2030, going to around zero or becoming even slightly negative. Between 2031-2050 employment growth is weakest and thus exerts a sizeable negative effect on GDP growth for all states but Sweden. A slight improvement is discernable after 2040, however. The message from these numbers is unambiguous: employment growth will contribute less and less to GDP growth and will even retard it in most countries between 2031 and 2050.

In addition, aging not only affects the size of the work force but increases the share of older workers. If labor productivity is age-specific with older workers being less productive, then an aging work force will lead to lower overall labor productivity and thus lower economic growth. However, the question of how large this effect is and at what precise age

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<sup>8</sup> For an overview of modern theories of economic growth see Barro and Sala-i Martin (2003) and Mankiw (1995).

<sup>9</sup> Note that projections for Japan and the U.S. were not carried out.

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