Master in Actuarial and Financial Sciences

MASTER THESIS

Title: Automatic adjustment mechanisms of the retirement age based on Healthy Life Expectancy

Author: Eduard de Rocafiguera Viladecans

Advisor: Mercedes Ayuso Gutiérrez

Academic year: 2021-2022

Universitat de Barcelona
Facultat d'Economia i Empresa

Màster de Ciències Actuarials i Financeres

Faculty of Economics and Business
Universitat de Barcelona

Master thesis
Master in Actuarial and Financial Sciences

Automatic adjustment mechanisms of the retirement age based on Healthy Life Expectancy

Author: Eduard de Rocafiguera Viladecans

Advisor: Mercedes Ayuso Gutiérrez

“The content of this document is the sole responsibility of the author, who declares that he/she has not incurred plagiarism and that all references to other authors have been expressed in the text”.

Automatic adjustment mechanisms of the retirement age based on Healthy Life Expectancy

Eduard de Rocafiguera Viladecans

June 2022

Abstract

The observed improvements in life expectancy have led to wonder whether elderly population live not only more years but also healthier or it is more a fact of quantity rather than quality. This Master Thesis analyses the effects of the increases in the number of years lived on the health status of population after retirement. Living longer does not automatically mean to spend more time in good health, which is a point that will take special relevance for its influence in people's decision to stop working. We explain how longevity developments are crucial to determine welfare but only if it goes hand in hand with keeping good mental and physical conditions. For this reason, healthy life expectancy will be introduced as an important policy measure to be considered when the objective is to adequate the retirement age to the best conditions for the worker to remain active.

Keywords: Healthy life years, longevity, self-perceived health, pension policy, retirement age

Index

1. Introduction

The objective of measuring healthy life expectancy is to assess population health and capture the relationship with the phenomenon of mortality in a population. It is a simple but powerful way of illustrating the developments in mortality whose tendency over the decades has been persistently rising. The remarkable improvements around the world in terms of longevity have brought a critical situation for countries that witness how their population ages. In some of them, life expectancy has recently shown ages over 83 years such as in Spain, Switzerland, Italy, Korea, and Japan with this last experiencing the highest mark with close to 85 years. It is evident that lives continue to get longer and such trend is predicted to continue in the long run (OECD 2021).

Back in the day, living more years was seen as a sign of good health and welfare given the lack of injuries or health issues. Nowadays, advances in medical care combined with greater access to quality health services and rising living standards are factors that explain people reaching advanced ages. However, while life expectancy at age 65 is currently considered as a health status indicator after retirement, the approximation of the number of healthy life years once receiving a pension is in an increasing debate.

Some organizations are already using healthy life expectancy (HLE) as a measurement in assessing health and well-being of a country. It provides the average number of years that a person can expect to live in a healthy condition, that is to say without limitation in functioning and without incapacities. Unlike life expectancy, HLE includes morbidity and disability conditions in its estimation as it indicates how many of those expected years of life are lived in good health. From another point of view, elderly population usually suffer from slight injuries or health issues that prevent them from living in “full health” even though they self-perceive a general well-being. This discusses the possibility that some of those years lived unhealthy could in fact be considered as healthy from the subjective perception of the individual (Croezen et al., 2016).

As a result of continuous longevity developments and population ageing, some countries have modified, or will soon, their national public pension schemes by adjusting the pension age with the aim to keep the period in retirement somehow constant, or adequate to the expected increase in the number of years of life (e.g., Portugal, Greece, Italy, or Netherlands). Introducing an automatic link of the retirement age and pension benefits to the increasing life expectancy has been one of the most common reforms to ensure national pension schemes’ long-term affordability and fiscal sustainability (Ayuso et al., 2021a; Bravo et al., 2021).

In this paper, our objective is to link retirement ages to healthy life expectancy. Therefore, differentiating from past works where the focus was on studying life expectancy of population, we will center our attention on measuring the expected years lived for an individual, especially after retirement, without any type of disability or health issues. We will create the base from which develop automatic adjustment mechanisms in the retirement age based only on those years lived in good health. For this purpose, we will use different technical methods and reach a more statistical actuarial approach. This paper presents an innovative way to link future retirement ages to increasing life expectancy but taking into account the existent gap between years lived in good mental and physical conditions and those where the individual live with activity limitations or any issue due to old age.

In the development of this work, one of the most important aspects is to analyze how much have life expectancies progressed over the recent years and how longevity development has encouraged pension schemes to modify the retirement age. Therefore, one of the focal points in which this study has revolved is in analyzing the historical data of both life expectancy evolution and retirement age estimation in all European countries and in other members of the OECD[1], quantifying the differences by year and gender. We will focus especially on life expectancy at age 65 so to specify the group of population we are most interested in. A brief study of the dependency ratio will also be made.

Additionally, studying how many of those expected number of years after retirement are lived in healthy or unhealthy conditions is going to provide evidence whether living longer is or it is not accompanied by improvements in health. Such differences will tell if longer life expectancies automatically lead to improvements in the welfare of a country and, therefore, will introduce the importance of health status among older workers when estimating the age to leave the labor market.

Against this background the structure of the paper is as follows. The second section highlights the increasing share of elderly people over total population and how this is translated into a higher dependency ratio. The third section explores the most common pension policy responds to population ageing, centering our attention specially on linking the retirement age to improvements in life expectancy. Changes in the retirement age over the last decades are also summarized in this section as well as future projections. Fourth section presents some of the most common health indicators like healthy life expectancy and self-perceived health, as well as a study of their trends along recent years compared to increasing life expectancy. Methodology used in this paper is explained in the fifth section, where life expectancy is defined and the calculations made at some points of the paper to forecast future trends and adjust retirement ages are described. Results are summarized in the sixth section offering an automatic adjustment mechanism of the retirement age based on healthy life expectancy and how this would affect population's dependence. The paper ends with conclusions and next steps in the seventh section.

2. Population ageing

One of the main characteristics of actual societies is the constant increase of population over 65, making the chances to reach advanced ages less challenging. Caused by longevity improvements, not only a greater number of individuals are reaching old ages but also elderly people are themselves living longer. Other factors like a better access to health care services, improvements in life standards and declines in mortality rates also allow older adults to live more years. However, a growing proportion of dependent people who perceive a regular pension is a concerning issue that leads countries to witness how their working-age population ages.

Different pension reforms have been formulated for years introducing several actuarial analyses in order to face the increasing life expectancy and population ageing (Martin et al., 2008; Bravo et al., 2021). Predictions in longevity developments also suggest future implications in health care systems and private insurance companies, as well as in the labor market as a consequence of possible changes in the retirement age in the long-run (Lloyd-Sherlock, 2000; Staudinger et al., 2016).

---

[1] Organization for Economic Co-operation and Development

The growing presence of elderly people within societies is clearly visible over time (Figure 1). According to *Eurostat*[2] database, in 2001 the share of people aged 65 or older in the total population of the EU was 15,8%, while in 2020 this share increased to 20,6%. Gender differences also show that the proportion of men aged 65 or older over total men was 13,1% in 2001 and 18,1% in 2020, while the proportion of women aged 65 or older over total women was 18,4% in 2001 and 22,9% in 2020. A more complete information about elderly population's growth in each European country by gender is graphically represented (see Annex 1).

Population ageing is a global phenomenon that has been apparent in many different societies for a long time. In recent decades, the share of elderly population has nearly doubled on average across OECD countries. The proportion of the population aged 65 or over increased from less than 9% in 1960 to 17,4% in 2017, and is projected to continue increasing in the coming decades reaching 27,1% by 2050. Japan in particular has experienced the most rapid ageing over the past three decades, while Korea is projected to turn into the most rapid population ageing among OECD members in the coming years (OECD 2019a).

This demographic change is visible in the age structure development, and is mainly reflected not only in an increasing share of older people but also in a declining share of working-age people in the total population. The indicator that compares both groups is called old-age dependency ratio, and in the last decade it has shown an increasing dependence of older people over active population. The old-age dependency ratio in the EU was 26,3% in 2010 and it increased to 32,5% in 2021, showing that there were just over 3 people of working age for every person aged 65 or over. Between 2020 and 2021, the old-age dependency ratio increased in general in all EU Member States, from the lowest values of 21% in Luxembourg and 22,6% in Ireland, to highs of 37% in Italy, 36,8% in Finland and 35,6 in Greece (Eurostat, 2022).

Another common indicator for measuring the age structure of population is the total age dependency ratio, which provides the ratio of dependent people, young and old, compared to the population considered to be in a working age. In the last decade, this indicator increased in the EU from 49,7% in 2011 to 56% in 2021, registering the lowest total age dependency ratio in Luxembourg with 44,1% and the highest in France with 62,2% (Eurostat, 2022). Despite increases in the share of inactive population, a longer life expectancy has let workers stay active for longer periods. Changes in the activity rate in each European country by gender are graphically represented (see Annex 1).

[2] https://ec.europa.eu/eurostat/web/main/data/database

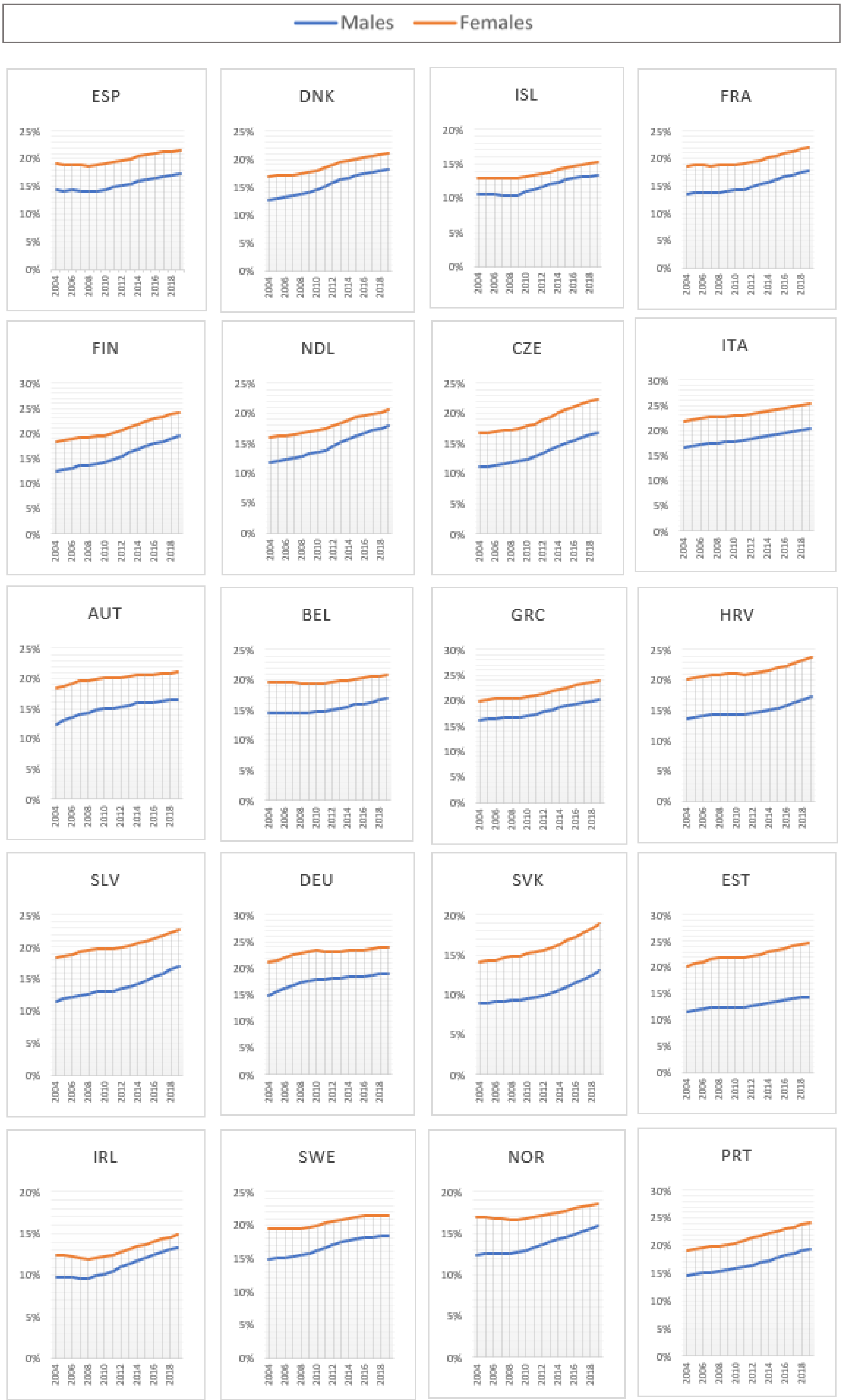


Figure 1. *Evolution of population aged 65 or over by gender, 2004-2019. Source: Own elaboration according to EUROSTAT data, 2022*

3. Indexation of the pension age to life expectancy

Continuous longevity improvements along with declines in fertility rates have made the uninterrupted ageing of population a global fact impossible to ignore. In recent decades, countries have responded to this with systematic and gradual parametric pension reforms. The objective for public pension schemes has been to achieve solvency and enhance their fiscal sustainability while introducing adequacy safeguards through automatic adjustments of retirement ages that keep pace with increasing life expectancy (Ayuso et al., 2021b).

Ageing of population constitute a major challenge for the affordability of pensions and financial sustainability of retirement-income systems. Due to longevity improvements, some working lives have been extended in order to receive additional pension entitlements. For this reason, policy designs show that one of the possible solutions is to update the pension age in order to keep the period in retirement somehow constant (Bravo et al., 2021). One of the most common reforms of countries to ensure national pension schemes' long-term affordability and fiscal sustainability has been increasing retirement ages in an automatic or scheduled way with increasing life expectancy (Bravo et al., 2021, Ayuso et al., 2021b).

The proper analysis of the LE (life expectancy) indicator has become lately extremely crucial as there has been a clear growing tendency in both life expectancy at birth and at age 65 in all EU countries since the beginning of the century (Figure 2 and 3). Statistical data shows that life expectancy at birth in the EU was situated at 80,9 years for women and 74,3 years for men in 2002, and almost two decades later, life expectancy was 84 years for women, showing an increase of 3,1 years, and 78,5 years for men with an increase of 4,2 years. On the other hand, life expectancy at age 65 has shown a very similar growth. In 2002, life expectancy at retirement was 19,5 years for women and 15,8 years for men, while in 2019 these numbers hit 21,8 years for women and 18,3 years for men, showing increases of 2,3 years and 2,5 years, respectively.

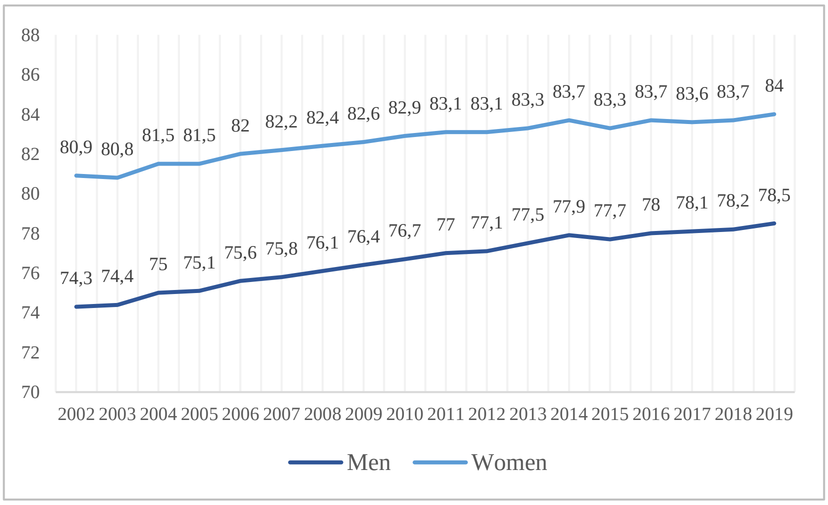


***Figure 2**. Life expectancy at birth by gender, 2002-2019, European Union (27 countries). Source: Own elaboration according to EUROSTAT data, 2022*

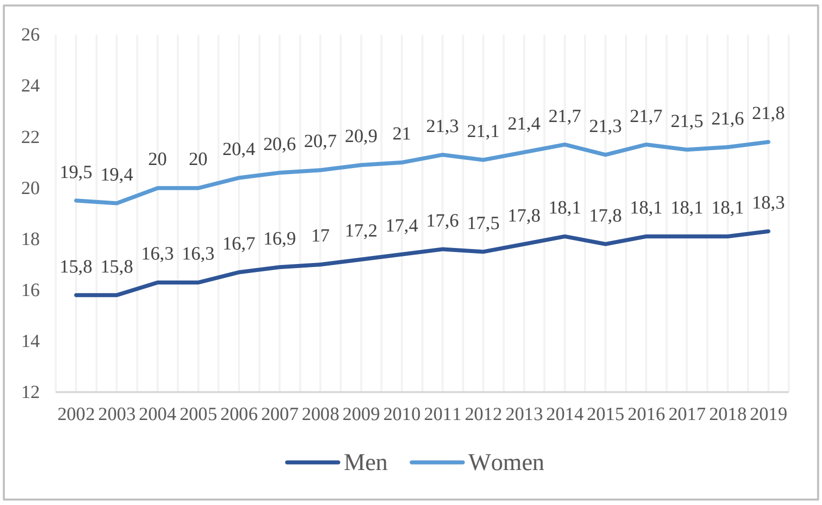


Figure 3. *Life expectancy at age 65 by gender, 2002-2019, European Union (27 countries). Source: Own elaboration according to EUROSTAT data, 2022*

These last incredible gains in life expectancy at age 65 are present not only in EU countries but also in many other regions. On average, across OECD countries life expectancy at age 65 increased by 2 years between 2004 and 2019. Three countries (Estonia, Korea, and Turkey) enjoyed gains of more than 3 years over the period and only one country (United States) experienced an increase of less than one year between 2004 and 2019. On the other hand, only one country (Mexico) experienced a decrease for both men and women of 0,6 years and 0,4 years, respectively. Despite this, on average, across all OECD countries remaining life expectancy at age 65 is projected to increase by 3,9 years among women and 4,5 years among men by 2065 (OECD 2019; OECD 2021).

Correct estimations of remaining life expectancy at retirement have become critical for pension policy around the world in order to determine the initial benefit or price retirement income products. The long-term decrease in mortality rates at advanced ages is also increasingly connected to public law and private sector contracts as it mainly affects the age of retirement. Therefore, proper estimates of life expectancy at that age are crucial for establishing the financial sustainability of public and private sector schemes and for developing new retirement products (Ayuso et al., 2021a). As a consequence of this, the link between life expectancy and pension benefits has been strengthened in at least seven different ways (Ayuso et al., 2021a).

The purpose of linking the retirement age to longevity development is mainly to minimize the impact of demographic and economic shocks on the financing of pension schemes. In addition, using actuarial rationality and introducing the biometric indicators in national pension schemes by adopting the required adjustments makes the system more credible and capable of preventing unexpected public finance crises in the future (Ayuso et al., 2021b).

3.1 Changes in the retirement age

Normal and early retirement ages in many OECD countries have experienced a continuous change across the years with the aim to adequate the retirement age to improvements in life expectancy (Table 1 and 2). Nevertheless, there are a few countries that have adopted to this day no modifications in the legal pension age like Iceland, Austria, or Finland, but which pretend to increment it soon. The former rise of pensionable ages is predictable in a number of different countries that have set either fixed increases in the future or have linked them to life expectancy.

In more than half of OECD countries, the standard retirement age has been roughly the same for men and women. In the few countries where there is still a gender difference, most are in the process of slowly remove it (Slovenia, Austria, the Czech Republic, Japan, Lithuania, and the United Kingdom). Based on current legislation, only Poland, Switzerland, Hungary, Israel, and Turkey will maintain a lower retirement age for women.

	1960	1971	1980	1990	2002	2010	2020	2030
Australia (AUS)	65	65	65	65	65	65	66	67
Canada (CAN)	69	68	*nd*	*nd*	65	65	65	
Denmark (DNK)	65	67	67	67	67	67	67	68*
Iceland (ISL)	67	67	67	67	67	67	67	
Netherlands (NDL)	65	65	65	65	65	65	66,3	67*
Poland (POL)	60	60	60	65	65	65	65	
Spain (ESP)	65	65	65	65	65	65	65	67
United Kingdom (UK)	65	65	65	65	65	65	66	67*
Austria (AUT)	65	65	65	65	65	65	65	65
Bulgaria (BGR)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	66,6	67
Czech Republic (CZE)	60	60	60	60	60,5	61	63,7	65
Estonia (EST)	*nd*	*nd*	*nd*	*nd*	*nd*	63	63,8	65*
France (FRA)	65	65	65	60	60	60,5	64,5	67
Hungary (HUN)	60	60	60	60	60	60	64,5	65
Ireland (IRL)	70	70	70	65	65	65	66	68
Japan (JPN)	*nd*	65	65	65	*nd*	64	65	65
Latvia (LVA)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	63,8	65
Lithuania (LTU)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	64	65
Slovakia (SVK)	60	60	60	60	60	62	62,7	64
Luxembourg (LUX)	65	65	65	65	60	60	62	
Sweden (SWE)	67	67	67	65	65	65	65	66*
Switzerland (CHE)	65	65	65	65	65	65	65	
U.S.A. (USA)	65	65	65	65	65	66	66	67
Belgium (BEL)	60	60	60	60	60	60	65	67
Finland (FIN)	65	65	65	65	65	65	65	65*
Norway (NOR)	70	70	70	67	67	67	67	
Cyprus (CYP)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	65	65*
Chile (CHL)	*nd*	*nd*	*nd*	*nd*	*nd*	65	65	
Croatia (HRV)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	65	67
Germany (DEU)	63	63	63	63	63,5	65	65,7	67
Greece (GRC)	57	57	57	57	57	60	62	67*
Israel (ISR)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	67	
Italy (ITA)	60	60	*nd*	55	57	65	62	67*
New Zealand (NZL)	60	60	60	60	64	65	65	
Portugal (PRT)	65	65	65	65	65	65	65,3	66*
Republic of Korea / South Korea (KOR)	*nd*	*nd*	*nd*	60	60	60	62	
Slovenia (SLV)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	62	
Turkey (TUR)	*nd*	*nd*	*nd*	*nd*	*nd*	60	52	
OECD38	*nd*	*nd*	*nd*	*nd*	*nd*	63,7	64,2	

Note: (*) means automatically linked to life expectancy
Source: Own elaboration according to Eurostat and OECD data, 2022

***Table 1**. Observed and expected legal retirement ages (1960-2030), Men*

	1960	1971	1980	1990	2002	2010	2020	2030
Australia (AUS)	60	60	60	60	61	62	66	67
Canada (CAN)	69	68	*nd*	*nd*	65	65	65	
Denmark (DNK)	60	62	62	67	67	67	67	68*
Iceland (ISL)	67	67	67	67	67	67	67	
Netherlands (NDL)	65	65	65	65	65	65	66,3	67*
Poland (POL)	60	60	60	60	60	60	60	
Spain (ESP)	65	65	65	65	65	65	65	67
United Kingdom (UK)	60	60	60	60	60	60	66	67*
Austria (AUT)	60	60	60	60	60	60	60	65
Bulgaria (BGR)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	66,6	67
Czech Republic (CZE)	60	55	56	57	58	58,7	63,7	65
Estonia (EST)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	63,8	65*
France (FRA)	65	65	65	60	60	60,5	64,5	67
Hungary (HUN)	55	55	55	55	55	59	62	65
Ireland (IRL)	70	70	70	65	65	65	66	68
Japan (JPN)	60	60	60	60	60	62	65	65
Latvia (LVA)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	63,8	65
Lithuania (LTU)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	63	65
Slovakia (SVK)	60	55	55	57	57	62	62,7	64
Luxembourg (LUX)	65	65	65	65	60	60	62	
Sweden (SWE)	67	67	67	65	65	65	65	66*
Switzerland (CHE)	60	60	60	62	62	64	64	
U.S.A. (USA)	65	65	65	65	65	66	66	67
Belgium (BEL)	60	60	60	60	60	60	65	67
Finland (FIN)	65	65	65	65	65	65	65	65*
Norway (NOR)	70	70	70	67	67	67	67	
Cyprus (CYP)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	65	65*
Chile (CHL)	*nd*	*nd*	*nd*	*nd*	*nd*	60	65	
Croatia (HRV)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	62	67
Germany (DEU)	60	60	60	60	60,5	65	65,7	67
Greece (GRC)	57	57	57	57	57	60	62	67*
Israel (ISR)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	62	
Italy (ITA)	55	55	55	55	57	60	62	67*
New Zealand (NZL)	60	60	60	60	64	65	65	
Portugal (PRT)	65	65	65	62	65	65	65,3	66*
Republic of Korea / South Korea (KOR)	*nd*	*nd*	*nd*	60	60	60	62	
Slovenia (SLV)	*nd*	*nd*	*nd*	*nd*	*nd*	*nd*	62	
Turkey (TUR)	*nd*	*nd*	*nd*	*nd*	*nd*	58	49	
OECD38	*nd*	*nd*	*nd*	*nd*	*nd*	62,7	63,4	

Note: (*) means automatically linked to life expectancy
Source: Own elaboration according to Eurostat and OECD data, 2022

***Table 2**. Observed and expected legal retirement ages (1960-2030), Women*

4. Health after retirement

Given these pension reforms that go along with improvements in life expectancy, advocates have argued that individuals will probably respond by extending their working lives as successive cohorts live longer and benefits for a given retirement age are consequently lower (OECD 2011). Therefore, working longer in order to finance adequate pension benefits creates strong incentives among workers for delaying the actual retirement age. However, while life expectancy is known as an indicator of health, it is becoming increasingly recognized that measuring the quality of remaining years of life is also crucial (Zaninotto et al., 2020).

For many individuals, the relationship between health and work is positive and bidirectional, with empirical studies suggesting that there are benefits of working at older ages on physical, mental, and cognitive health (Staudinger et al., 2016). However, despite improvements in life expectancy that lead individuals to continue working at old ages, there is uncertainty on whether the increase in healthy years has kept the same rate of progress. Empirical data show that longer life expectancy does not automatically translate into more years spent in good health (Jivraj et al., 2020). In addition, other empirical studies highlight that the healthy condition of population's working life is not homogenous across socioeconomic groups and that such inequalities in health continue to widen (Chetty et al., 2016; Jivraj et al., 2020; Zaninotto et al., 2020).

Nowadays, people enjoy more years in retirement and increases in life expectancy has centered the attention on quality rather than quantity, resulting in a growing use of measures of the expected healthy life in order to follow health trends and quantify health differences.

4.1 Healthy life expectancy

Healthy life expectancy (HLE), also known as disability-free life expectancy (DFLE), is an indicator that gives an estimate of the number of years lived in favorable states of health, which is to say without incapacities or disabilities. It mainly indicates how many years within life expectancy are lived in good health. As life expectancy has become increasingly longer in recent decades, measuring how healthy these additional years are has become critical. According to general data, life expectancy and healthy life expectancy have both improved over the years. However, the number of years spent in good health has not increased as much as the total expected years of life.

According to World Health Organization data, life expectancy has increased globally by 6,6 years between 2000 and 2019, from 66,8 years in 2000 to 73,4 years in 2019, while healthy life expectancy has increased by 5,4 years, from 58,3 in 2000 to 63,7 in 2019. This was due to declining mortality rather than reduced years lived with disability. In other words, the increase in healthy life expectancy has not kept pace with the increase in life expectancy.

A similar comparison takes place at retirement age in the EU (Table 3 and Figure 4), in which life expectancy has experienced an increase of almost 2 years between 2004 and 2019, and healthy life expectancy increased less than 1 year over the same period. This illustrates that living longer and living healthier have tendencies that seem to grow alike but not parallel as population enjoy every time more years of life than years of good health, which also means that the period of life before death lived unhealthy is expanding as well.

	2004	**2019**	**Absolute variation**
Life expectancy (years)	18,3	20,2	1,9
Healthy life expectancy (years)	9,4	10,3	0,9
Spent unhealthy (%)	48,6%	49,0%	

Table 3. *Life expectancy and healthy life expectancy at age 65, 2004 vs 2019, European Union (27 countries). Source: Own elaboration according to EUROSTAT data, 2022*

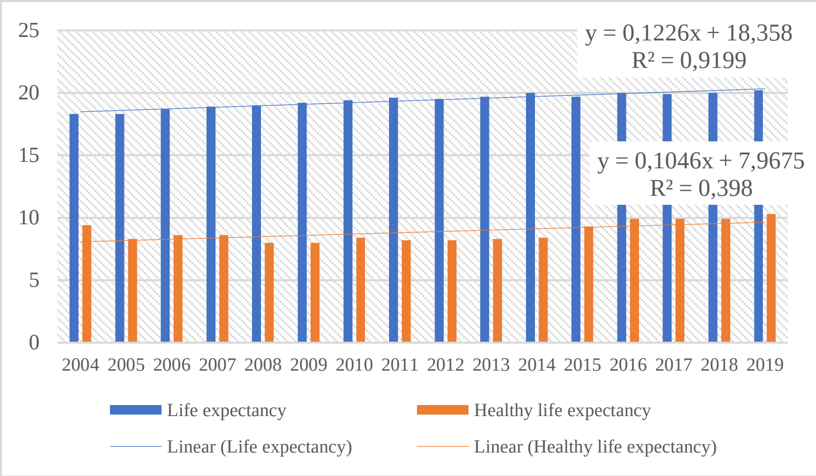


***Figure 4**. Life expectancy and healthy life expectancy at age 65, 2004-2019, European Union (27 countries). Source: Own elaboration according to EUROSTAT data, 2022*

The same information can be extracted from each country of the EU by gender (Table 4). The difference between life expectancy and healthy life expectancy provides the number of years with any disability or incapacity that prevent an individual from living in healthy conditions. The most recent data was chosen to represent how much of life expectancy at age 65 is spent unhealthy for both men and women in different EU countries. As life expectancy is longer for women than for men in all cases, results in 2019 show that healthy life expectancy is also longer for women at most times. Only in 10 countries men enjoy more healthy years than women after retirement (Spain, Italy, Portugal, Greece, Slovenia, Cyprus, Netherlands, Romania, Switzerland, and Iceland). However, data on life expectancy and unhealthy lived years do not have differences between genders. Longer periods for women being unhealthy is present in all cases as a consequence of a longer life expectancy.

It is important to track trends in life expectancy and healthy life expectancy to ensure policy reforms aimed at reducing or delaying the time spent in a state of disability or dependence. In a global context of population ageing, the need to ensure that the extra years of life are lived in good health is of vital importance to ensure adequate health, social care, and pension provision (Welsh et al., 2020).

In the meantime, in some other regions of the world, healthy life expectancy is predominant among older people. World Health Organization (WHO) provides information about the countries with the highest total healthy life expectancy at age 60 in the world in 2019, which are the followings: Japan (20,39 years), Singapore (19,95 years), Korea (19,81 years), France (19,7 years), Switzerland (19,52 years), Israel (19,33 years), Spain (19,2 years), and Iceland (19,04 years).

	Women			Men				
	Life expectancy	Healthy life years	Years with activity limitation	Life expectancy	Healthy life years	Years with activity limitation	% spent unhealthy - Women	% spent unhealthy - Men
France	23,9	11,6	12,3	19,8	10,4	9,4	51%	47%
Spain	23,9	11,3	12,6	19,8	12,4	7,4	53%	37%
Italy	22,9	10,2	12,7	19,7	10,6	9,1	55%	46%
Luxembourg	22,4	10,6	11,8	19,2	10,1	9,1	53%	47%
Malta	22,5	15,1	7,4	19,4	14,4	5,0	33%	26%
Portugal	22,3	6,9	15,4	18,5	7,9	10,6	69%	57%
Finland	22,3	9,6	12,7	18,8	9,3	9,5	57%	51%
Belgium	22,1	10,7	11,4	18,9	10,5	8,4	52%	44%
Greece	21,7	7,7	14,0	19,0	8,1	10,9	65%	57%
Slovenia	21,8	8,6	13,2	18,1	8,7	9,4	61%	52%
Ireland	22,1	14,1	8,0	19,4	13,1	6,3	36%	32%
Austria	21,7	7,7	14,0	18,7	7,7	11,0	65%	59%
Sweden	22,1	16,6	5,5	19,6	15,9	3,7	25%	19%
EU27	**21,8**	**10,4**	**11,4**	**18,4**	**10,2**	**8,2**	**52%**	**45%**
Cyprus	21,5	7,1	14,4	18,9	8,1	10,8	67%	57%
Germany	21,4	12,8	8,6	18,3	11,5	6,8	40%	37%
Netherlands	21,4	9,6	11,8	19,0	10,2	8,8	55%	46%
Denmark	21,0	11,8	9,2	18,4	10,7	7,7	44%	42%
Estonia	21,1	7,2	13,9	15,8	6,4	9,4	66%	59%
Poland	20,4	9,0	11,4	16,1	8,1	8,0	56%	50%
Czech Republic	20,1	8,2	11,9	16,4	8,0	8,4	59%	51%
Romania	18,6	6,5	12,1	14,9	6,7	8,2	65%	55%
Lithuania	20,0	6,4	13,6	14,8	6,0	8,8	68%	59%
Croatia	19,5	4,9	14,6	15,9	4,6	11,3	75%	71%
Slovakia	19,7	4,7	15,0	15,7	4,6	11,1	76%	71%
Latvia	19,4	4,8	14,6	14,4	4,5	9,9	75%	69%
Hungary	18,6	7,4	11,2	14,8	6,7	8,1	60%	55%
Bulgaria	18,1	10,4	7,7	14,2	9,2	5,0	43%	35%
Switzerland	23,0	10,5	12,5	20,3	11,2	9,1	54%	45%
Norway	21,9	15,8	6,1	19,6	15,8	3,8	28%	19%
Iceland	22,0	11,8[1]	10,2	20,0	13,2[1]	6,8	46%	34%
United Kingdom	21,1	10,6[1]	10,5	18,8	10,2[1]	8,6	50%	46%

Note: (1) Data of 2018 instead of 2019

Table 4. *Differences between healthy and unhealthy years in life expectancy at age 65, by gender, 2019. Source: Own elaboration according to EUROSTAT data, 2022*

4.2 Healthy life expectancy based on self-perceived health

Measuring good health as a status of no disability or limitation in daily life activity has been such a useful approach on differentiating between healthy and unhealthy years of life. However, there is an increased need to study further the health and functional status of elderly population and create a strong base for appropriate policies that ensure quality of life at old ages.

Self-perceived health is one of the most important health and well-being indicators to monitor population's health and quality of life. Understanding the health problems of older people is crucial to plan health care services and social support systems. Therefore, objective biomedical information about population's healthy conditions has led to wonder how older adults really perceive their general status. Self-perceived health deals with the subjective assessment that an individual makes about one's own physical and nonphysical health state. It serves as an independent predictor for morbidity and mortality and is often used as an indicator to compute healthy life expectancy (Croezen et al., 2016).

Existing population-based surveys have been implemented across several European countries providing critical information to monitor health and disease, describing health inequalities within and across countries, and informing policymakers. The three most important surveys in Europe which have their information publicly available are: EU Statistics on Income and Living Conditions (EU-SILC), the Survey of Health, Ageing and Retirement in Europe (SHARE) and the European Social Survey (ESS). With the objective to present a subjective measure of overall health and well-being, EU-SILC, SHARE and ESS included the same measure of self-perceived health based on the question: “How is your health in general?”.

Among the most important factors with which self-perceived health is associated, we can find: age, sex, education level, welfare level, degree of disability and civil status, pointing up as the main factors for bad self-perceived health a low level of education and the presence of behavioral vices caused by material welfare, like smoking. On the other hand, the most important factors associated with good self-perceived health are wealth and education among all the variables considered (Gagauz et al., 2017).

Despite the existing differences across European countries about the methods and the measurement of survey estimates, healthy life expectancy based on self-perceived health at age 65 in the EU has generally increased by 3,2 years between 2004 and 2019, from 12,9 years to 16,1 years (Figure 5). This also shows that despite the fact of having any type of incapacity or health issue, the average self-perception for an old adult in the EU about the general feeling of good health has increased significantly more than what life expectancy and general healthy life expectancy have done over the same period. Therefore, the gap between full life expectancy and years of self-perceived health of elderly population is slowly reducing, while life expectancy based on the lack of disabilities or any type of limitation that affects physical or mental health still differs considerably. A more accurate comparison for each European country is represented (see Annex 2).

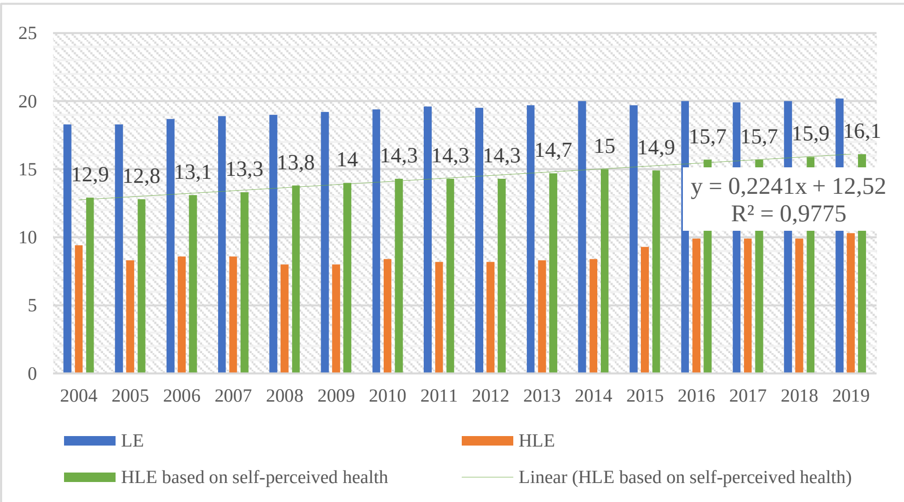


***Figure 5**. Life expectancy, healthy life expectancy and healthy life expectancy based on self-perceived health at age 65, 2004-2019, European Union (27 countries). Source: Own elaboration according to EUROSTAT data, 2022*

5. Methodology

Our objective is to adjust the retirement age estimation for the coming years using healthy life expectancy data instead of life expectancy's. We present in sections 5.1 and 5.2 the methodological approach used to forecast healthy life expectancy and to adjust the new data to the retirement age. Our intention here is to present only a summary that helps to better understand the obtained results.

5.1 Life expectancy

Following the actuarial statistical book "Estadística actuarial vida" by M. Ayuso et al. (2007), given an individual who has reached age x, we can relate their current age with their age of death, X. The difference between both ages is called residual life or future life (referring to the rest of their life). As the age of death X is a random variable, residual life will be as well, whose definition is as follows:

$$T(x) = X - x$$

Given the residual life for a certain age x, the mean value is a general indicator of the possibilities of survival for individuals with that age. Therefore, life expectancy of an individual with age x is defined as the expected value of the variable $T(x)$:

$$\bar{e}_x = E[T(x)] = \int_0^{w-x} t \cdot g_x(t)dt = \int_0^{w-x} t \cdot tp_x \cdot \mu(x+t)dt$$

where:

- w: actuarial infinite.

- t: moment of time.

- $g_x(t)$: density function of $T(x)$.

- tp_x: probability of survival for an individual of age x for a period of time t.

- $\mu(x+t)$: instantaneous coefficient of mortality at age $x+t$.

This expectancy can be written depending on the cohort:

$$\bar{e}_x = \int_0^{w-x} t \cdot \left(-\frac{l'(x+t)}{l(x)}\right)dt = -\frac{1}{l(x)}\int_0^{w-x} t \cdot l'(x+t)dt$$

And by solving the integral,

$$\bar{e}_x = -\frac{1}{l(x)}[t \cdot l(x+t)]_0^{w-x} + \int_0^{w-x} \frac{l(x+t)}{l(x)}\,dt = \int_0^{w-x} tp_x\,dt$$

given that $l(x+t)$ is null for $t = w - x$, the first part is cancelled.

5.2 The model

Let Y be the general equation of a simple lineal model, where n is the starting point that intercepts the y-axis (x=0) and m the slope or gradient of the line:

$$Y = m \cdot x + n$$

being the function of the slope:

$$m = \frac{change\ in\ y}{change\ in\ x}$$

Taking the observed data from past years, we have been able to set a linear trendline from the starting point *n* until the most recent data is analyzed. That is a simple model but according to Figure 4 and 5, it could synthesize very well the behavior observed in the last fifteen years. Once obtained it, the general equation of a straight line is used to forecast the values for the next years using the same *m* and *n* as the trendline of the observed data. Like this, we are capable to prognosticate future estimates of healthy life expectancy at retirement based on past observations.

5.3 Automatic adjustment mechanisms

By using recent data of life expectancy at age 65 and do a forecast one decade ahead, we could see how many years of difference exist between both moments of the period. Increases in life expectancy have been, in most countries, a major cause of several changes in the age to retire. As the Finnish Centre for Pensions[3] has recently estimated future modifications of retirement ages in the EU members, we established for this paper a cause-and-effect relationship between the variation in life expectancy previously obtained and the variation in the retirement age for the same projected period.

Taking this variation relationship and applying it but using healthy life expectancy data at age 65 instead of life expectancy, we could link future changes of the retirement age to health development.

Let *difRA2* be the additional number of years of the retirement age if based on healthy life expectancy:

$$difRA2 = \frac{difRA1 * difHLE}{difLE}$$

where:

- *difRA1*: additional number of years of the retirement age if based on life expectancy.

- *difHLE*: variation in years of healthy life expectancy.

- *difLE*: variation in years of life expectancy.

The same procedure can be done using healthy life expectancy based on self-perceived health at the age of 65.

A similar method has been used to estimate the dependency ratio when retirement age is based on health life expectancy. Unlike before, here we are estimating using single values and not variations between two different moments of time.

Let *difDR2* be the dependency ratio when retirement ages are based on health developments:

$$DR2 = \frac{DR1 * RA1}{RA2}$$

[3] Central body of the statutory earnings-related pensions.

where:

- *DR1*: dependency ratio when retirement ages are based on life expectancy.

- *RA1*: retirement age based on life expectancy.

- *RA2*: retirement age based on health life expectancy.

6. Results

In this section we present the results obtained by using the methodology previously exposed. Health expectancy measures are analyzed and forecasted for both men and women and their effects on the estimation of the retirement age based on healthy life expectancy along with how those effects impact on dependency ratio are summarized here.

6.1 Differences in health trends

Although there exists a general tendency to reach old ages because of increases in life expectancy, populations of the EU do not seem to age uniformly. In addition, whether most of these extra years of life are spent in good health is still unclear. Health expectancies are of vital importance due to future implications for medical and health care requirements, so the theoretical goal for all countries is obtaining gains in life expectancy combined with large gains in the number of healthy years. However, different national data show that some populations are still far from this.

Trends in life and health expectancies have been summarized in a way that a list of classified countries according to the gradient of their trends is clearly visible (Table 5 and Table 6). As represented previously for LE, HLE and HLE based on self-perceived health at age 65 in the EU, we have adjusted the model for each country and ordered the slopes of each tendency (Beta) from largest to smallest. The starting point from which each progression starts is also shown (Alpha).

Countries with the most positive gains in longevity/health measures have been positioned among the first places, while those with a more stalled progress have been placed lasts. This way, major differences in longevity developments between European countries are observed, as improvements in health after retirement are compared as well.

As represented in Table 5 and 6, increases in life expectancy are observed in all countries between 2004 and 2019 for both men and women, being Estonia the country with the highest growing tendency for both sexes while men from Bulgaria and women from Iceland have the smallest growths in terms of longevity.

On the other hand, we can notice that for both men and women, most of the European countries have had improvements in the number of healthy years after retirement, but some of them show a decrease in that aspect. The expected number of remaining years of life at age 65 without diseases or incapacities have been reduced for some elderly populations in the continent. For men, there are a total of 9 countries that show no improvements in healthy life expectancy at age 65 (United Kingdom, Slovenia, Netherlands, Latvia, Bulgaria, Greece, Denmark, Switzerland, and Croatia), while for women there are the same countries mentioned besides Italy and Luxembourg. For both sexes, Switzerland (CHE) and Croatia (HRV) have the smallest projections in terms of objective health.

Despite the fact that some populations experience decreases in healthy life expectancy at retirement, when it is based on self-perceived health improvements across the years are clearly positive for all cases. Most of old people live with slight injuries or minimum health issues that prevent them from living in perfect conditions but not from perceiving a general well-being.

Life expectancy at age 65				Healthy life expectancy at age 65				Healthy life expectancy based on self-perceived health at age 65			
Position	Country	Beta	Alpha	Position	Country	Beta	Alpha	Position	Country	Beta	Alpha
1	EST	0,2126	12,743	**1**	DEU[1]	0,3982	5,2076	**1**	CYP[1]	0,33	11,447
2	IRL	0,206	16,043	**2**	SWE	0,3489	10,499	**2**	ESP	0,3149	11,993
3	LUX	0,1888	16,333	**3**	IRL	0,2753	8,3975	**3**	SLV[1]	0,3107	9,5743
4	SLV[1]	0,1875	15,46	**4**	NOR	0,2538	12,268	**4**	FIN	0,2832	12,205
5	DNK	0,1737	15,805	**5**	FIN	0,1902	6,7026	**5**	POL[1]	0,2761	7,2448
6	SVK[1]	0,1721	13,15	**6**	EST	0,1396	3,82	**6**	SVK[1]	0,2711	6,4314
7	ESP	0,1672	17,198	**7**	ESP	0,1306	9,115	**7**	PRT	0,2604	8,48
8	NOR	0,1672	16,898	**8**	ISL	0,13	13	**8**	HUN[1]	0,2493	6,9924
9	NDL[1]	0,1654	16,624	**9**	PRT	0,1297	6,31	**9**	ITA	0,2387	12,103
10	ITA	0,1621	17,148	**10**	HUN[1]	0,1282	4,981	**10**	EST	0,2384	7,4925
11	PRT	0,1513	16,183	**11**	FRA	0,1172	8,3725	**11**	FRA	0,2128	13,223
12	LVA[1]	0,1482	12,281	**12**	BEL	0,0924	9,515	**12**	CZE[1]	0,2118	9,719
13	BEL	0,1456	16,538	**13**	POL[1]	0,0729	6,9438	**13**	IRL	0,2099	14,648
14	CYP[1]	0,1443	17,026	**14**	CZE[1]	0,0661	7,4314	**14**	LTU[1]	0,2068	6,699
15	FIN	0,1425	16,508	**15**	AUT	0,0481	7,485	**15**	BGR[2]	0,1974	8,3055
16	FRA	0,1412	17,775	**16**	LUX	0,0428	9,73	**16**	LUX	0,1935	13,255
17	SWE	0,1375	17,313	**17**	CYP[1]	0,0404	8,7171	**17**	LVA[1]	0,1932	6,6543
18	CHE[3]	0,1341	18,515	**18**	SVK[1]	0,0271	3,7295	**18**	NOR	0,1893	14,523
19	UK[1]	0,1307	17,214	**19**	ITA	0,0174	8,69	**19**	DNK	0,1828	13,815
20	POL[1]	0,1289	14,289	**20**	LTU[1]	0,0007	5,7543	**20**	NDL[1]	0,1811	15,038
21	GRC	0,1269	17,128	**21**	UK[1]	-0,0242	10,653	**21**	HRV[4]	0,18	7,7
22	CZE[1]	0,1246	14,623	**22**	SLV[1]	-0,0296	8,1305	**22**	ISL	0,1764	15,615
23	ISL	0,1238	17,935	**23**	NDL[1]	-0,0321	10,477	**23**	SWE	0,1588	15,588
24	AUT	0,1153	16,958	**24**	LVA[1]	-0,0511	4,9352	**24**	AUT	0,1482	13,103
25	HRV[4]	0,1097	14,747	**25**	BGR[2]	-0,1229	10,114	**25**	BEL	0,1338	13,95
26	LTU[1]	0,1068	13,086	**26**	GRC	-0,1531	9,92	**26**	DEU[1]	0,1179	14,037
27	HUN[1]	0,0929	13,477	**27**	DNK	-0,1659	13,173	**27**	GRC	0,1171	12,58
28	DEU[1]	0,0796	17,116	**28**	CHE[3]	-0,178	12,677	**28**	CHE[3]	0,1115	17,612
29	BGR[2]	0,0684	13,395	**29**	HRV[4]	-0,3061	7,4533	**29**	UK[1]	0,0934	15,164

Note: (1) Data from 2005; (2) Data from 2006; (3) Data from 2007; (4) Data from 2010

Table 5*. Life expectancy, healthy life expectancy and healthy life expectancy based on self-perceived health trends, 2004-2019, Men. Source: Own elaboration according to EUROSTAT data, 2022*

Life expectancy at age 65				Healthy life expectancy at age 65				Healthy life expectancy based on self-perceived health at age 65			
Position	Country	Beta	Alpha	Position	Country	Beta	Alpha	Position	Country	Beta	Alpha
1	EST	0,2216	17,848	1	DEU[1]	0,495	4,8	1	CYP[1]	0,5043	10,179
2	SVK[1]	0,1743	17,046	2	SWE	0,3381	11,497	2	ESP	0,3891	12,868
3	CYP[1]	0,1736	19,318	3	IRL	0,294	9,2075	3	POL[1]	0,3871	7,5829
4	LVA[1]	0,1679	17,004	4	NOR	0,2338	12,788	4	SVK[1]	0,3775	6,2933
5	ESP	0,1644	21,353	5	EST	0,1822	3,8325	5	SLV[1]	0,3686	10,831
6	SLV[1]	0,1614	19,722	6	FIN	0,1466	7,435	6	BGR[2]	0,3574	8,2769
7	PRT	0,1607	19,84	7	PRT	0,1432	5,02	7	PRT	0,3522	7,175
8	LUX	0,1476	20,233	8	ESP	0,1351	8,5825	8	FIN	0,3274	14,768
9	DNK	0,1469	18,795	9	BEL	0,1324	9,425	9	HUN[1]	0,32	7,4267
10	CZE[1]	0,145	18,02	10	HUN[1]	0,1161	5,2581	10	LVA[1]	0,3021	7,4295
11	IRL	0,1413	19,543	11	FRA	0,1154	9,35	11	CZE[1]	0,2943	10,486
12	LTU[1]	0,1361	17,898	12	CYP[1]	0,1111	6,7448	12	EST	0,291	9,195
13	POL[1]	0,1346	18,61	13	CZE[1]	0,0771	7,8162	13	HRV[4]	0,2867	7,6133
14	BGR[2]	0,1286	16,414	14	SVK[1]	0,0375	3,4667	14	LTU[1]	0,2771	6,7562
15	GRC	0,1194	20,035	15	POL[1]	0,0368	7,979	15	FRA	0,2682	15,72
16	BEL	0,1187	20,298	16	LTU[1]	0,0368	5,7057	16	ITA	0,2437	13,173
17	ITA	0,1112	21,193	17	ISL	0,0293	13,612	17	DNK	0,1894	15,753
18	FRA	0,1109	22,358	18	AUT	0,0171	7,68	18	DEU[1]	0,1889	15,129
19	HRV[4]	0,1061	18,347	19	ITA	-0,0081	8,525	19	ISL	0,175	16,747
20	UK[1]	0,0893	20,026	20	LVA[1]	-0,0454	5,2162	20	AUT	0,1622	14,803
21	FIN	0,0871	20,848	21	LUX	-0,0696	10,823	21	LUX	0,1563	15,19
22	AUT	0,0865	20,515	22	UK[1]	-0,0714	11,671	22	NOR	0,1541	16,715
23	SWE	0,0763	20,595	23	SLV[1]	-0,1264	9,2581	23	IRL	0,1518	17,773
24	NOR	0,0754	20,628	24	NDL[1]	-0,1282	11,146	24	GRC	0,1288	13,318
25	HUN[1]	0,0746	17,603	25	DNK	-0,1456	13,988	25	BEL	0,1193	15,943
26	NDL[1]	0,0682	20,421	26	BGR[2]	-0,1868	11,73	26	SWE	0,1146	18,22
27	DEU[1]	0,0679	20,397	27	GRC	-0,199	9,9225	27	CHE[3]	0,0852	20,473
28	CHE[3]	0,0654	22,104	28	CHE[3]	-0,2659	13,123	28	NDL[1]	0,0811	18,165
29	ISL	0,0632	20,775	29	HRV[4]	-0,2994	7,3867	29	UK[1]	0,0574	17,505

Note: (1) Data from 2005; (2) Data from 2006; (3) Data from 2007; (4) Data from 2010

Table 6*. Life expectancy, healthy life expectancy and healthy life expectancy based on self-perceived health trends, 2004-2019, Women. Source: Own elaboration according to EUROSTAT data, 2022*

6.2 Projections

By analyzing data of recent decades, we have been able to build a linear trendline from observations registered between 2004 and 2019, which is the period in which the most recent information is available. This regression model shows the linear trajectory that life expectancy and both health expectancies at age 65 have followed until now. In order to forecast their values by 2030, we used the same general equations of these trendlines and projected them forward as many years as needed (Figure 6).

Generally, most countries experienced increases in terms of longevity and also in both general and self-perceived health and, therefore, their projections by 2030 followed the same positive trend (e.g., Spain, France, Norway, Germany, or Portugal). However, in a few regions, elderly population have been showing over the years slight declines in terms of healthy life expectancy at retirement (e.g., United Kingdom, Denmark, Netherlands, Greece, or Switzerland). On the contrary, observations on self-perceived health at same ages have showed strong rises everywhere until the point where in some countries the gap between life expectancy and healthy life expectancy based on the subjective perception of the individual is rapidly shortening (e.g., Spain, Finland, Cyprus, or Hungary). All expected projections for each European country are represented along with those shown in Figure 6 (see Annex 3).

Forecasts made in this thesis are only a simple way to prognosticate future adjustments of the retirement age based on healthy life expectancy registered information from the past. More advanced research in the context of morbidity is required if we want to calculate life expectancies according to survival probabilities by age (mainly in the context of multiple state models). In any case, more exhaustive data is required at the individual level.

6.3 Adjusted retirement ages

As described in section 5.3, we have created a cause-and-effect relationship between the difference of years from the last known data to the data we predicted one decade after on life expectancy at 65 and future changes in the retirement age. The same association has been applied taking healthy life expectancy data at age 65 as a reference, with the objective to automatically adjust the retirement age taking into account only the years lived with good health (Table 7 and 8).

The results show that most countries expect to extend the working life by increasing the retirement age by 2030 due to continual improvements in life expectancy at advanced ages. For now, only few countries will maintain the same age in which people can stop working without adjusting it to the fact that old people live longer (e.g., Austria, Finland, Cyprus, Greece, and Italy). In addition, some national pension schemes already announced that retirement age will be completely linked to life expectancy movements in the near future (e.g., Denmark, Netherlands, United Kingdom, Estonia, Sweden, Finland, Cyprus, Greece, Italy, and Portugal).

While life expectancy is by nature longer for women than for men, in more than half of OECD countries the standard retirement age has been the same for both genders (OECD 2019). In the few countries where there is still a gender difference, most are currently in the process to remove it and equal both ages in the future. On this day, retirement age for women in Austria is fixed at 60 years while for men is at 65, a gap that will no longer exist by 2030. The same intentions to reach equality by the end of the decade are pursued

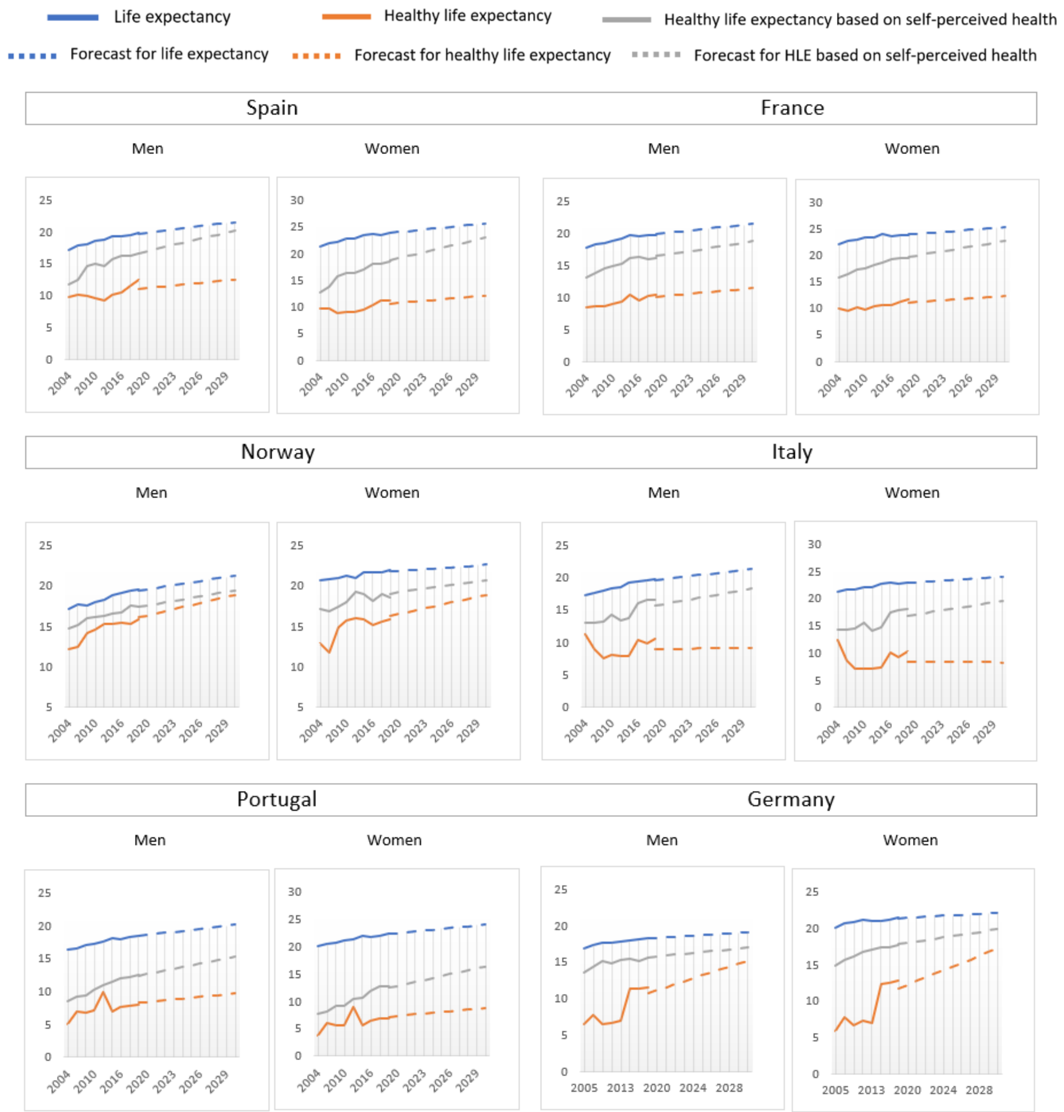


Figure 6. *Adjusted and projected life expectancy, healthy life expectancy and healthy life expectancy based on self-perceived health, 2020-2030, by gender. Source: Own elaboration according to EUROSTAT data, 2022*

by Hungary, Lithuania, Croatia, among other members of the OECD.

At the same time, healthy life expectancy experienced in most cases an increase between the current data and our predictions. Only few countries showed a constant decrease to this day which let us assume that the number of healthy life years will continue diminishing for the next few years (e.g., Denmark, Netherlands, United Kingdom, Bulgaria, Latvia, Croatia, or Greece).

As a consequence of such declines, the adjustment mechanism to estimate the retirement age based on healthy life expectancy will automatically show a proportional reduction from the current age. In a situation where the period of unhealthy years of life among the elderly is expanding not only because of longevity improvements that allow them to live longer but also because the number of healthy lived years is diminishing with time, retirement age will be lower according to population's indicator of health.

At the same time, healthy life expectancy experienced in most cases an increase between the current data and our predictions. Only few countries showed a constant decrease to this day which let us assume that the number of healthy life years will continue

Men								
	Life expectancy at 65		Retirement age		Healthy life expectancy at 65		Retirement age	
	2020	2030	2020	2030	2020	2030	2020	2030
Denmark (DNK)	18,6	20,3	67	68*	10,5	8,9	67	**66**
Netherlands (NDL)	19,1	20,8	66,3	67*	10	9,7	66,3	**66**
Spain (ESP)	19,9	21,5	65	67	11,2	12,5	65	**67**
United Kingdom (UK)	19,2	20,5	66	67*	10,3	10	66	**66**
Austria (AUT)	18,8	20	65	65	8,3	8,7	65	**65**
Bulgaria (BGR)	14,4	15	66,6	67	8,4	7,2	66,6	**66**
Czech Republic (CZE)	16,5	17,7	63,7	65	8,4	9,1	63,7	**64**
Estonia (EST)	16,1	18,3	63,8	65*	6,1	7,4	63,8	**65**
France (FRA)	20	21,4	64,5	67	10,2	11,4	64,5	**67**
Hungary (HUN)	14,9	15,8	64,5	65	6,9	8,2	64,5	**65**
Ireland (IRL)	19,3	21,4	66	68	12,8	15,6	66	**69**
Latvia (LVA)	14,5	16	63,8	65	4,2	3,7	63,8	**63**
Lithuania (LTU)	14,7	15,8	64	65	5,8	5,8	64	**64**
Slovakia (SVK)	15,7	17,5	62,7	64	4,1	4,4	62,7	**63**
Sweden (SWE)	19,5	20,9	65	66*	16,1	19,6	65	**68**
Belgium (BEL)	18,9	20,3	65	67	11	11,9	65	**66**
Finland (FIN)	18,8	20,2	65	65*	9,7	11,6	65	**65**
Cyprus (CYP)	19,2	20,6	65	65*	9,3	9,7	65	**65**
Croatia (HRV)	15,8	16,9	65	67	4,4	1,3	65	**59**
Germany (DEU)	18,3	19,1	65,7	67	11,2	15,2	65,7	**72**
Greece (GRC)	19,2	20,4	67	67*	7,5	5,9	67	**67**
Italy (ITA)	19,7	21,4	67	67*	9	9,1	67	**67**
Portugal (PRT)	18,6	20,1	65,3	66*	8,4	9,7	65,3	**66**

Note: (*) means automatically linked to life expectancy
Source: Own elaboration according to EUROSTAT data, 2022

Table 7. *Retirement ages based on healthy life expectancy data, 2030, Men.*

diminishing for the next few years (e.g., Denmark, Netherlands, United Kingdom, Bulgaria, Latvia, Croatia, or Greece).

As a consequence of such declines, the adjustment mechanism to estimate the retirement age based on healthy life expectancy will automatically show a proportional reduction from the current age. In a situation where the period of unhealthy years of life among the elderly is expanding not only because of longevity improvements that allow them to live longer but also because the number of healthy lived years is diminishing with time, retirement age will be lower according to population's indicator of health.

As observed in both tables, when the period of healthy life years becomes much greater in 2030, the retirement age increases proportionally, sometimes even reaching ages over 70 (e.g., Germany). In some other cases, as the retirement age is not estimated to change because of improvements in life expectancy, results exposed here show no modifications either on future retirement ages independently of health development (e.g., Finland, Cyprus, Greece, and Italy). In Austria, only men have not experienced any variation in the retirement age.

Notice that this adjustment mechanism has been applied for both genders separately and that common sense in the policy making has not been searched. Although in most cases men receive the same or a greater retirement age based on healthy life expectancy than women, in a few other cases men are the ones who automatically receive a lower age as a result of greater improvements for women in healthy life years (e.g., Hungary, Ireland, Latvia, Sweden, Belgium, and Germany).

	Women							
	Life expectancy at 65		Retirement age		Healthy life expectancy at 65		Retirement age	
	2020	2030	2020	2030	2020	2030	2020	2030
Denmark (DNK)	21,1	22,6	67	68*	11,7	10,2	67	**66**
Netherlands (NDL)	21,4	22,1	66,3	67*	9,2	7,9	66,3	**65**
Spain (ESP)	24	25,6	65	67	10,7	12,1	65	**67**
United Kingdom (UK)	21,4	22,3	66	67*	10,6	9,9	66	**65**
Austria (AUT)	21,9	22,8	60	65	8	8,1	60	**61**
Bulgaria (BGR)	18,2	19,5	66,6	67	9,1	7,2	66,6	**66**
Czech Republic (CZE)	20,2	21,6	63,7	65	9	9,7	63,7	**64**
Estonia (EST)	21,4	23,6	63,8	65*	6,7	8,6	63,8	**65**
France (FRA)	24,1	25,2	64,5	67	11,2	12,4	64,5	**67**
Hungary (HUN)	18,7	19,5	62	65	7	8,2	62	**67**
Ireland (IRL)	21,8	23,2	66	68	13,9	16,9	66	**70**
Latvia (LVA)	19,5	21,2	63,8	65	4,5	4,1	63,8	**64**
Lithuania (LTU)	19,9	21,3	63	65	6,3	6,6	63	**63**
Slovakia (SVK)	19,7	21,4	62,7	64	4	4,4	62,7	**63**
Sweden (SWE)	21,8	22,6	65	66*	16,9	20,3	65	**69**
Belgium (BEL)	22,2	23,4	65	67	11,5	12,9	65	**67**
Finland (FIN)	22,2	23,1	65	65*	9,8	11,2	65	**65**
Cyprus (CYP)	21,9	23,7	65	65*	8,4	9,5	65	**65**
Croatia (HRV)	19,4	20,5	62	67	4,4	1,4	62	**48**
Germany (DEU)	21,4	22,1	65,7	67	12,2	17,2	65,7	**75**
Greece (GRC)	21,9	23,1	67	67*	6,7	4,7	67	**67**
Italy (ITA)	23	24,1	67	67*	8,4	8,3	67	**67**
Portugal (PRT)	22,4	24	65,3	66*	7,3	8,7	65,3	**66**

Note: (*) means automatically linked to life expectancy
Source: Own elaboration according to EUROSTAT data, 2022

Table 8. *Retirement ages based on healthy life expectancy data, 2030, Women*

6.4 Age dependency ratio

Establishing new pension policies that either anticipate or delay the standard exit age from the labor market has an impact on population's dependence. An important indicator that is affected by ageing of population and pension policy making is the dependency ratio, which is normally defined as the ratio between population who is generally economically inactive (people of 0 to 14 years and 65 years or over) and people in a working age or active population (15 to 64 years). Therefore, a brief analysis of how retirement ages based on healthy life expectancy at age 65 affects the dependency ratio has been made and the results obtained are summarized in this section.

Information obtained from official database has given us the observed and the expected total age dependency ratio in 2020 and 2030 of different European populations (Table 9). Observing the data, we can easily see that in 2020 most countries present an age dependency ratio surpassing the 50%, which tells us that the inactive population group is greater than the active population. Only two cases among the countries analyzed in this section has showed less than 50% in the demographic indicator (Cyprus and Slovakia). When turning into the fourth and last column, it is shown the age dependency ratio projections by 2030 and increases are clearly visible, even surpassing 60% in some cases.

The major expected increases are 10,9% more in Lithuania and 10,8% more in Germany, while the least expected changes are 0,3% in Ireland and 0,8% in Sweden.

	Retirement age		Age Dependency ratio (%)	
	2020	2030	2020	2030
Belgium (BEL)	65	67	56,3	61
Bulgaria (BGR)	66,6	67	56,4	60,8
Czech Republic (CZE)	63,7	65	56,2	59,5
Denmark (DNK)	67	68*	57	64
Germany (DEU)	65,7	67	55	65,8
Estonia (EST)	63,8	65*	57,4	60,2
Ireland (IRL)	66	68	53,1	53,4
Greece (GRC)	67	67*	57,6	62,1
Spain (ESP)	65	67	51,9	56,3
France (FRA)	64,5	67	62,2	67,3
Croatia (HRV)		67	54,8	61,8
Italy (ITA)	67	67*	56,6	62,3
Cyprus (CYP)	65	65*	47,9	54,3
Latvia (LVA)	63,8	65	57,6	65,7
Lithuania (LTU)		65	54	64,9
Hungary (HUN)		65	52,6	56
Netherlands (NDL)	66,3	67*	54,3	62,8
Austria (AUT)		65	50,2	59,4
Portugal (PRT)	65,3	66*	55,6	64,3
Slovakia (SVK)	62,7	64	47,9	55,9
Finland (FIN)	65	65*	61,4	63,9
Sweden (SWE)	65	66*	60,8	61,6

Notes: (*) means automatically linked to life expectancy. Empty spaces refer to those ages with gender differences

Table 9. *Observed and expected age dependency ratio (%) when retirement age is based on life expectancy, 2030. Source: Own elaboration according to EUROSTAT data, 2022*

These are the expected percentage increases in the age dependency ratio by the end of the decade mainly caused by improvements in life expectancy. However, having obtained new retirement ages based on healthy expectancy of population in the previous section, we summarized next our estimations of the age dependency ratio if we only take into account those ages based on healthy life years. For this, we differentiated the results by gender due to some differences in the retirement age between men and women that would make the analysis harder. Taking the general data from Table 9 and using the methodology described in section 5.2, we have been able to estimate new age dependency ratio projections by 2030 for both men and women (Table 10 and 11).

By the results obtained, in both men and women the age dependency ratios in 2020 are the same as exposed in Table 9, with exception of few empty spaces due to the previous lack of data due to gender differences. However, as most of these gender differences in the retirement age are expected to be removed by 2030, this allowed us to estimate future changes in the age dependency ratio without problem. In the methodology used for this section, we have taken into account the estimated age in which population pass from being active to economically inactive, as a delay of this age would automatically mean more people working and, thus, a smaller age dependency ratio. The opposite effect would take place if the retirement age turned out to be anticipated.

	Retirement age		Age Dependency ratio (%)	
	2020	2030	2020	2030
Belgium (BEL)	65	66	56,3	61,9
Bulgaria (BGR)	66,6	66	56,4	61,7
Czech Republic (CZE)	63,7	64	56,2	60,4
Denmark (DNK)	67	66	57	65,9
Germany (DEU)	65,7	72	55	61,2
Estonia (EST)	63,8	65	57,4	60,2
Ireland (IRL)	66	69	53,1	52,6
Greece (GRC)	67	67	57,6	62,1
Spain (ESP)	65	67	51,9	56,3
France (FRA)	64,5	67	62,2	67,3
Croatia (HRV)	65	59		70,2
Italy (ITA)	67	67	56,6	62,3
Cyprus (CYP)	65	65	47,9	54,3
Latvia (LVA)	63,8	63	57,6	67,8
Lithuania (LTU)	64	64		65,9
Hungary (HUN)	64,5	65		56,0
Netherlands (NDL)	66,3	66	54,3	63,8
Austria (AUT)	65	65		59,4
Portugal (PRT)	65,3	66	55,6	64,3
Slovakia (SVK)	62,7	63	47,9	56,8
Finland (FIN)	65	65	61,4	63,9
Sweden (SWE)	65	68	60,8	59,8

Note: Empty spaces refer to the previous lack of data in Table 9 used for this new estimation

Table 10. *Expected age dependency ratio (%) when retirement age is based on healthy life expectancy, 2030, Men. Source: Own elaboration according to EUROSTAT data, 2022*

For example, only four countries have had their retirement ages delayed due to population improvements in health that would allow people to work more years, are Germany, with a projection of the retirement age going from 67 years to 72 years for men and 67 to 75 for women and a dependency ratio going from 65,8% to 61,2% and 58,8% for men and women respectively; Ireland with a projection of the retirement age going from 68 years to 69 years for men and 70 for women and a dependency ratio going from 53,4% to 52,6% and 51,9% for men and women respectively; Sweden going from 66 years to 68 years for men and 69 for women and a dependency ratio going from 61,6% to 59,8% and 58,9% for men and women respectively; and in Hungary only women have had a decrease in the dependency ratio from 56% to 54,3% due to an increase in the projection of the retirement age only for women.

Another particular case worth of analysis is Croatia, which as we analyzed in previous sections is one of the countries with greater declines in healthy life expectancy in both sexes. Due to such declines, projections for the retirement age decrease from 67 years to 59 years for men and 48 for women if based on health expectancy. This leads to important changes in the dependency ratio as it goes from 61,8% to 70,2% for men and 86,3% for women, 8,4% and 24,5% more respectively.

	Retirement age		Age Dependency ratio	
	2020	2030	2020	2030
Belgium (BEL)	65	67	56,3	61,0
Bulgaria (BGR)	66,6	66	56,4	61,7
Czech Republic (CZE)	63,7	64	56,2	60,4
Denmark (DNK)	67	66	57	65,9
Germany (DEU)	65,7	75	55	58,8
Estonia (EST)	63,8	65	57,4	60,2
Ireland (IRL)	66	70	53,1	51,9
Greece (GRC)	67	67	57,6	62,1
Spain (ESP)	65	67	51,9	56,3
France (FRA)	64,5	67	62,2	67,3
Croatia (HRV)	62	48		86,3
Italy (ITA)	67	67	56,6	62,3
Cyprus (CYP)	65	65	47,9	54,3
Latvia (LVA)	63,8	64	57,6	66,7
Lithuania (LTU)	63	63		67,0
Hungary (HUN)	62	67		54,3
Netherlands (NDL)	66,3	65	54,3	64,7
Austria (AUT)	60	61		63,3
Portugal (PRT)	65,3	66	55,6	64,3
Slovakia (SVK)	62,7	63	47,9	56,8
Finland (FIN)	65	65	61,4	63,9
Sweden (SWE)	65	69	60,8	58,9

Note: Empty spaces refer to the previous lack of data in Table 9 used for this new estimation

Table 11. *Expected age dependency ratio (%) when retirement age is based on healthy life expectancy, 2030, Women. Source: Own elaboration according to EUROSTAT data, 2022*

7. Conclusions

In general, we can say that longevity of population is an aspect which describes most of the actual societies nowadays and certainly of the coming ones. Living longer not only changes population's age distribution but also brings itself several implications in many social areas.

In front of the uncertainty whether longer life expectancies come with improvements in the health status of older people, we can affirm at least that living longer does not automatically translate into more years spent in good health as the expected number of years lived healthy after retirement might decrease with time. However, a more direct relationship can be seen between life expectancy and self-perceived health as both trends turned out to be more similar.

The one-decade projections made for both life expectancy and healthy life expectancy suggest that, in some cases, the proportion of life in good health after retirement will remain broadly constant, implying that the additional years gained in life expectancy will be in poor health. On the contrary, healthy life years have been increasing in some regions more than the actual extra years of life, which suggests that here the period lived unhealthy will be slowly shortened.

Using the estimated data of healthy life expectancy to adjust future retirement ages instead of using life expectancy data has shown that expanding the working age period is not always rational in terms of health. Based on healthy life development, results suggest that declines in good health should come with leaving before the labor market by anticipating the retirement age. Otherwise, greater improvements in healthy life expectancy would theoretically lead to great increases in the retirement age expanding like this the working age period.

Age dependency ratio is also affected by these adjustments and is demonstrated that better health leads to more years in the labor market contributing to society that in the meantime reduces the group of dependent people in total population.

As we highlighted, given the rapid increase in the share of elderly people in total population, healthy ageing is an important factor in the socio-economic development of ageing societies. Therefore, more attention should be addressed to health care systems in order to shorten or delay periods of health issues or in a state of dependence among older adults.

Future lines of research are related to analyze policy making and future health care systems with the objective to expand the healthy life period of population as life expectancy keeps growing. It might be also interesting to introduce the results obtained in this study in all those automatic adjustment mechanisms related to life expectancy like, for example, the design of sustainability factors and both inter and intragenerational equity mechanisms. It will be also relevant to analyze its impact on the design of both reducing and bonus coefficients with respect to the advance or delay of the legal retirement age.

8. Bibliography

Ayuso, M., Bravo, J. M., and Holzmann, R. (2021a). Getting life expectancy estimates right for pension policy: Period versus cohort approach. *Journal of Pension Economics and Finance*, 20(2), 212—231. https://doi.org/10.1017/S1474747220000050

Ayuso, M., Bravo, J. M., Holzmann, R., and Palmer, E. (2021b). Automatic indexation of pension age to life expectancy: When policy design matters. Risks, 9(5), 96. https://doi.org/10.3390/risks9050096

Bravo, J. M., Ayuso, M., Holzmann, R., Palmer, E. (2021a). Intergenerational actuarial fairness when longevity increases: Amending the retirement age. *CESifo Working Papers*, 9408, ISSN 2364-1428 (electronic version).

Bravo, J. M., Ayuso, M., Holzmann, R., Palmer, E. (2021b). Addressing the life expectancy gap in pension policy. *Insurance: Mathematics and Economics*, 99, 200-221.

Bravo, J.M., Ayuso, M. (2021c). Linking pensions to life expectancy: Tackling conceptual uncertainty through Bayesian Model Averaging. *Mathematics*, 9, 24, 3307.

Chetty, Raj, Michael Stepner, Sarah Abraham, Shelby Lin, Benjamin Scuderi, Nicholas Turner, Augustin Bergeron, and David Cutler, (2016). The association between income and life expectancy in the United States, 2001–2014. *The Journal of the American Medical Association* 315: 1750–66.

Croezen, S., Burdorf, A., van Lenthe, F. J., (2016). Self-perceived health in older Europeans: Does the choice of survey matter?. *The European Journal of Public Health*, Vol. 26, No. 4, 686–692. doi:10.1093/eurpub/ckw017

Gagauz, O., Avram, C., Pahomii, I., (2017). Self-perceived health of the elderly: economic and sociodemographic inequalities. Economy and Sociology. CZU: 316.346.2-053.9. JEL: I 10, I 15, N 3, Pag. 45-53. https://ibn.idsi.md/ro/vizualizare_articol/53430

Jivraj, S., Goodman, A., Pongiglione, B., Ploubidis, G. B. (2020). Living longer but not necessarily healthier: The joint progress of health and mortality in the working-age population of England, Population Studies, Vol 74:3, pages 399-414.

Lloyd-Sherlock, P., (2000). Population ageing in developed and developing regions: implications for health policy. *Social Science & Medicine* Vol 51-6 (2000), pag. 887-895. https://doi.org/10.1016/S0277-9536(00)00068-X

Martin, J.P., Whitehouse, E., (2008). Reforming Retirement-Income Systems: Lessons from the Recent Experiences of OECD Countries. *OECD Social, Employment and Migration Working Paper 66*.

OECD (2011), Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries, OECD Publishing, Paris, https://doi.org/10.1787/pension_glance-2011-en.

OECD (2019), Pensions at a Glance 2019: OECD and G20 Indicators, OECD Publishing, Paris, https://doi.org/10.1787/b6d3dcfc-en.

OECD (2019a), Health at a Glance 2019: OECD Indicators, OECD Publishing, Paris, https://doi.org/10.1787/4dd50c09-en.

OECD (2021), Pensions at a Glance 2021: OECD and G20 Indicators, OECD Publishing, Paris, https://doi.org/10.1787/ca401ebd-en.

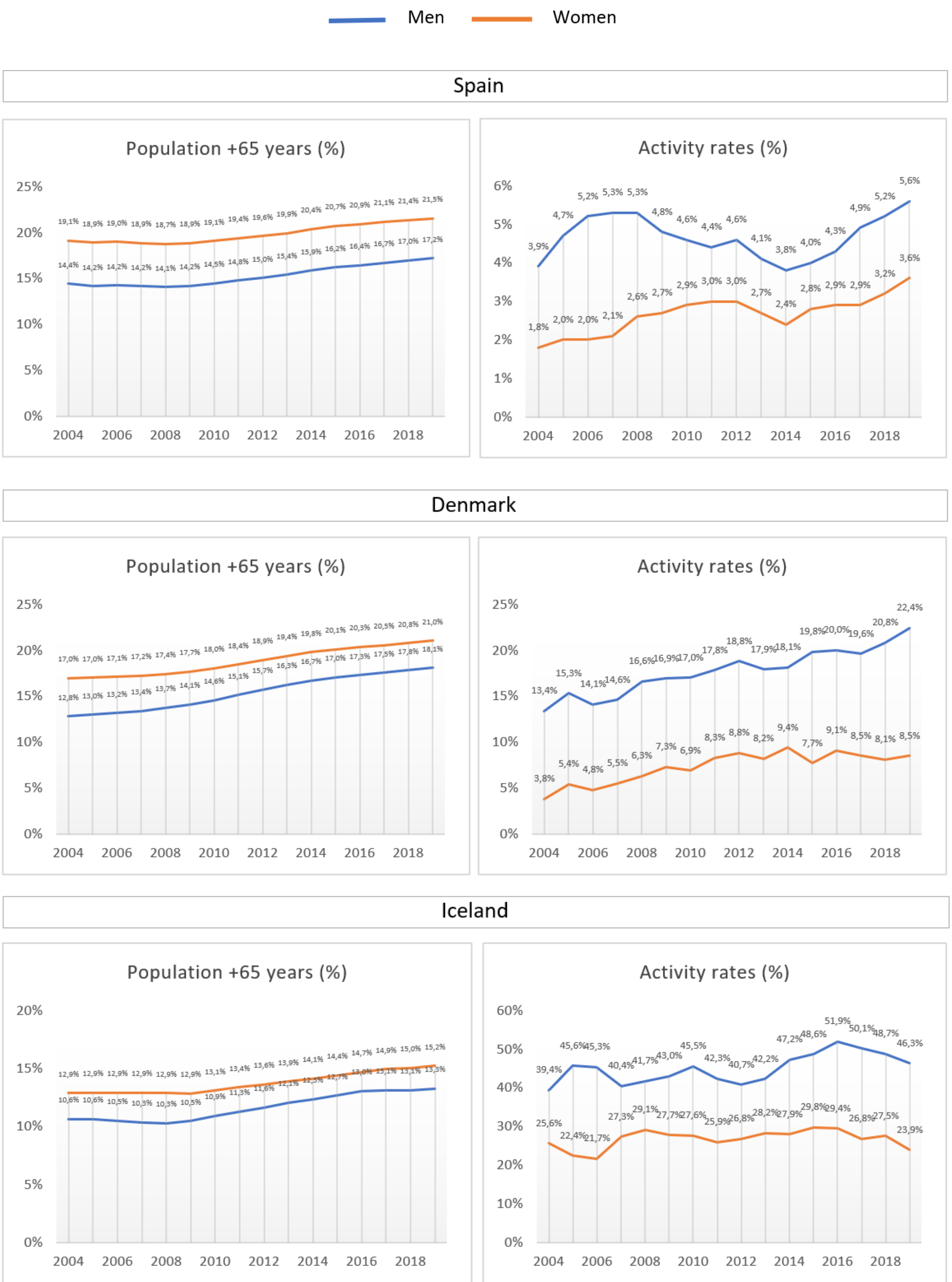
Staudinger, Ursula M., Finkelstein, R., Esteban, C., Sivaramakrishnan, K., (2016). A Global View on the Effects of Work on Health in Later Life. *Gerontologist*, 2016, Vol. 56, No. S2, S281–S292.

Welsh, C. E., Matthews, F. E., Jagger, C., (2020). Trends in life expectancy and healthy life years at birth and age 65 in the UK, 2008-2016, and other countries of the EU28: An observational cross-sectional study. The Lancet Regional Health - Europe 2 (2021) 100023. https://doi.org/10.1016/j.lanepe.2020.100023

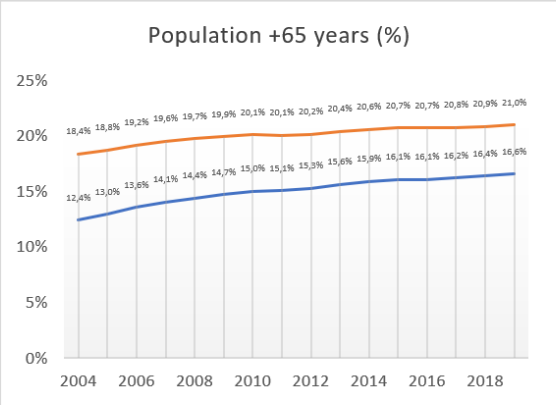
Zaninotto, P., Batty, G. D., Stenholm, S., Kawachi, I., Hyde, M., Goldberg, M., Westerlund, H., Vahtera, J., Head, J., (2020). Socioeconomic Inequalities in Disability-free Life Expectancy in Older People from England and the United States: A Cross-national Population-Based Study. *Journals of Gerontology: Medical Sciences*, 2020, Vol. 75, No. 5, 906–913.

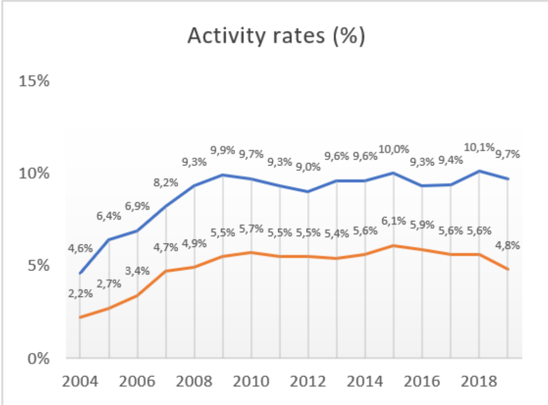
9. Annexes

1. Evolution of population aged 65 years or over share in total population and of the activity rate from 2004 to 2019 by gender:

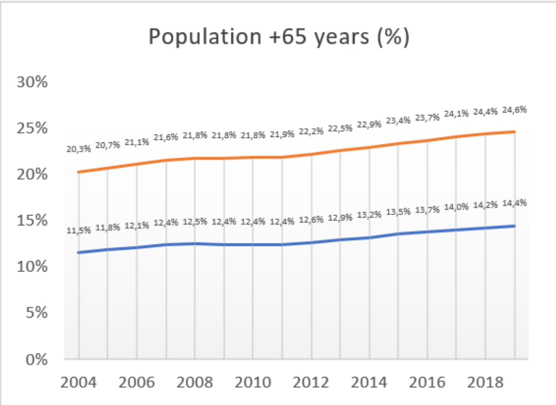


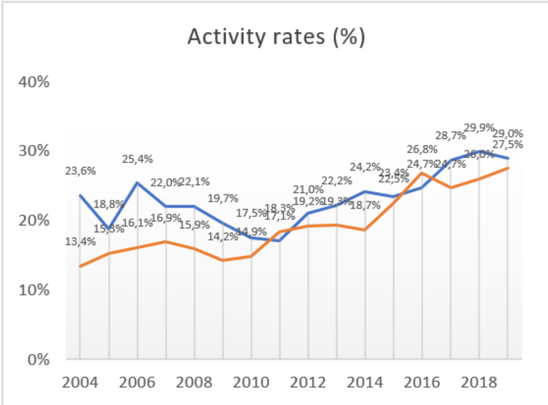
Austria



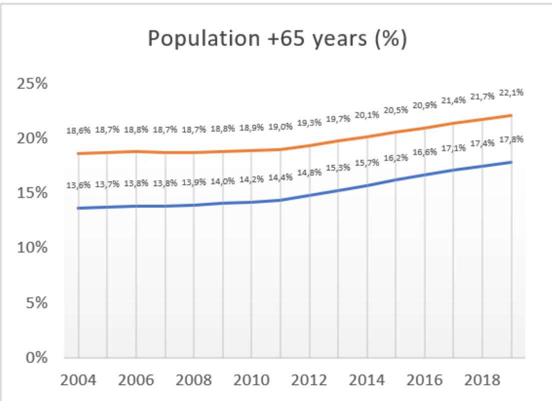


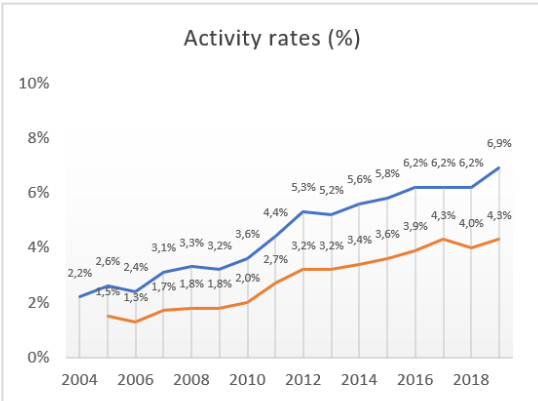
Estonia



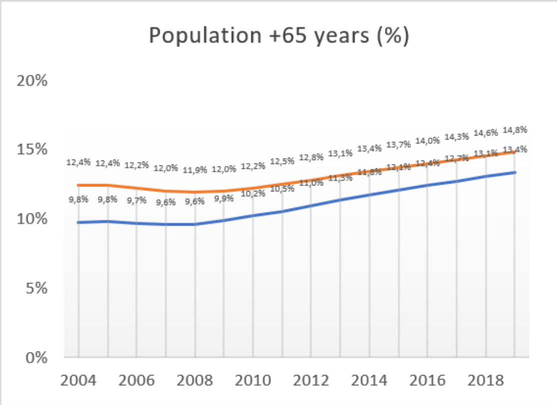


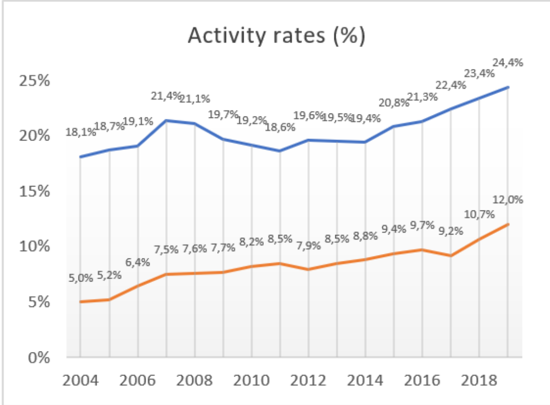
France



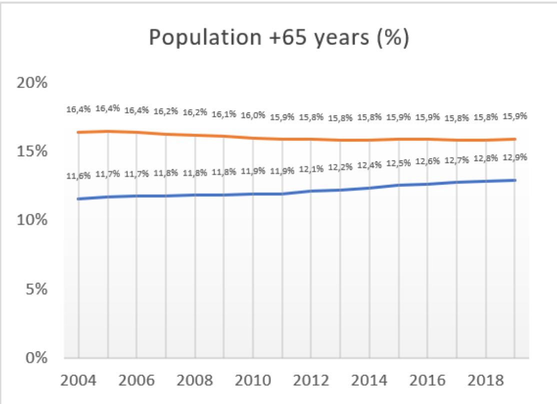


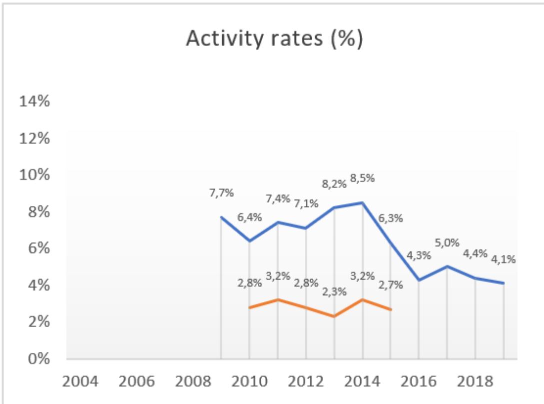
Ireland



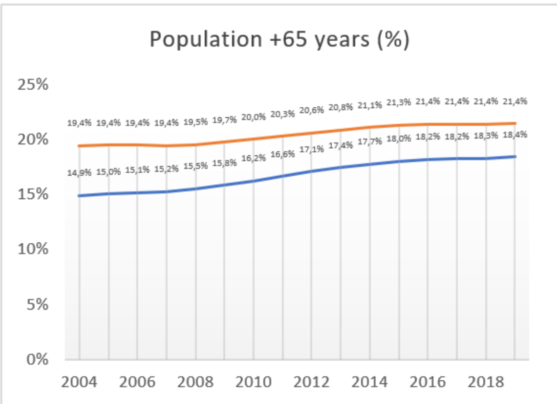


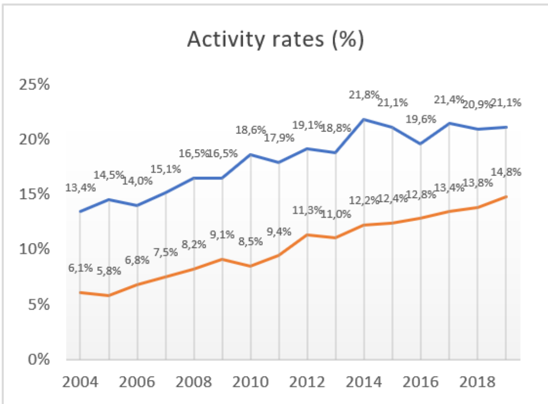
Luxembourg



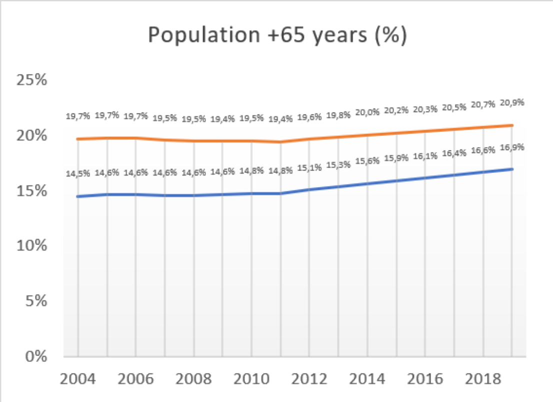


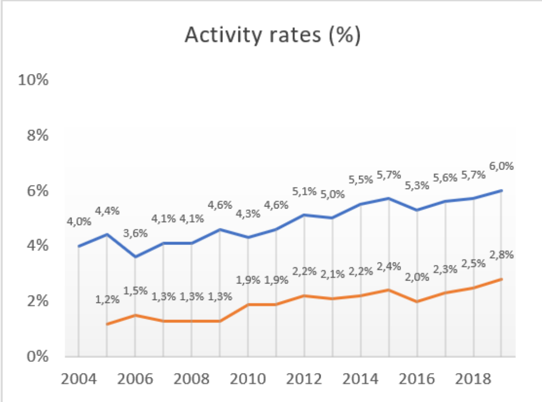
Sweden



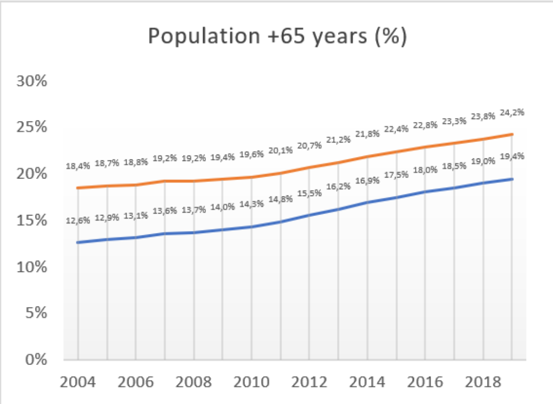


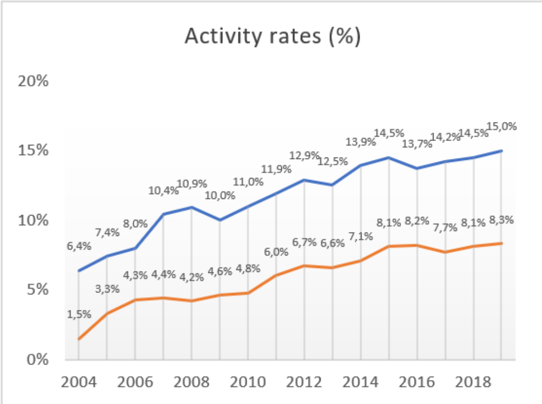
Belgium



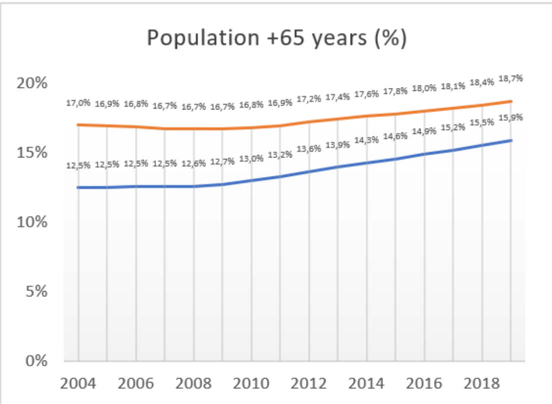


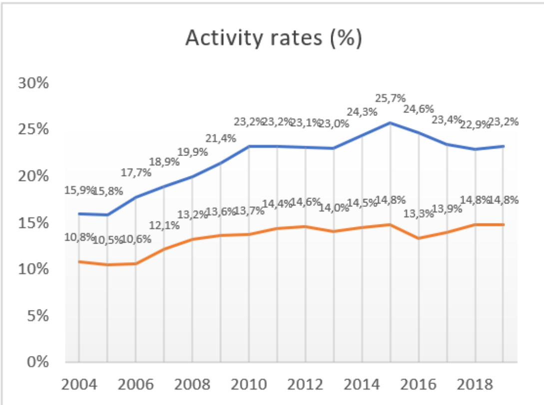
Finland



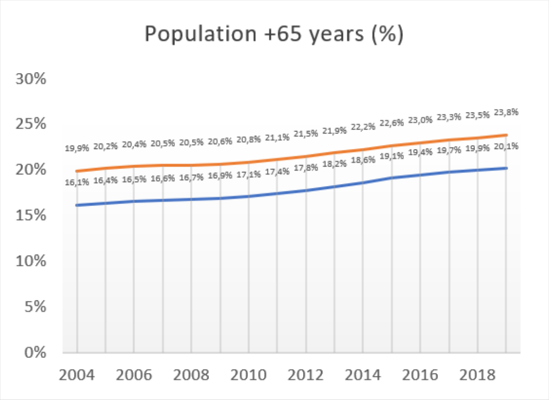


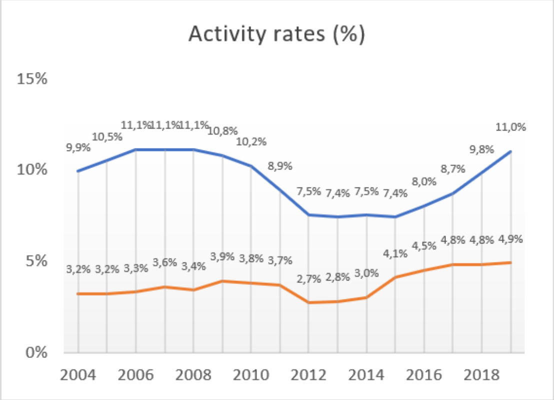
Norway



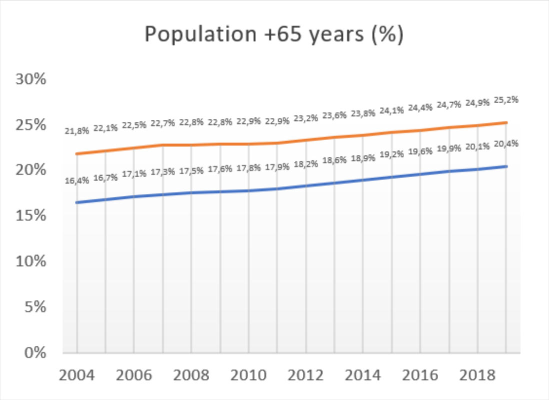


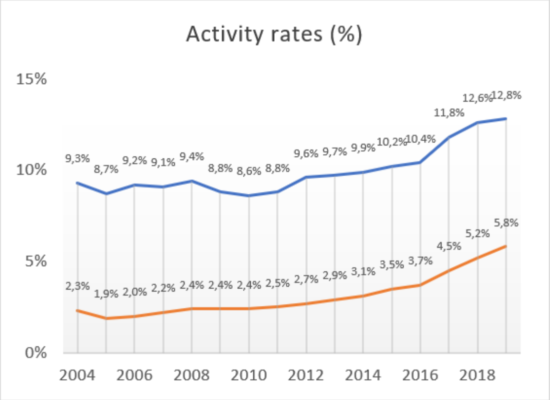
Greece



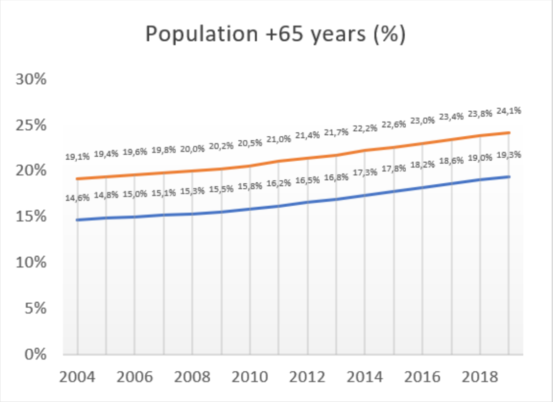


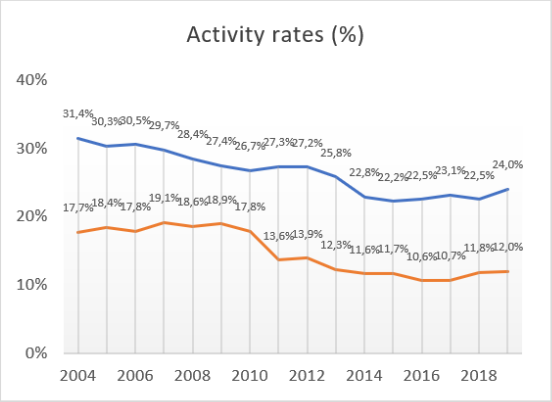
Italy



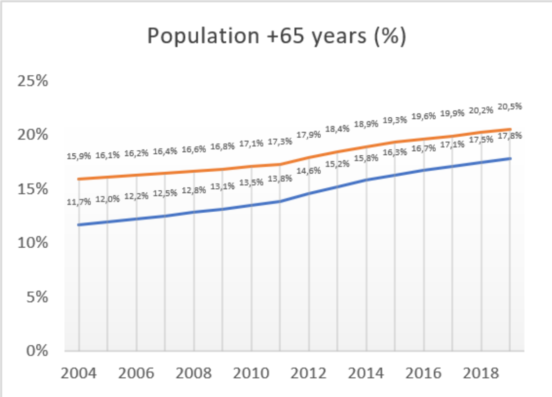


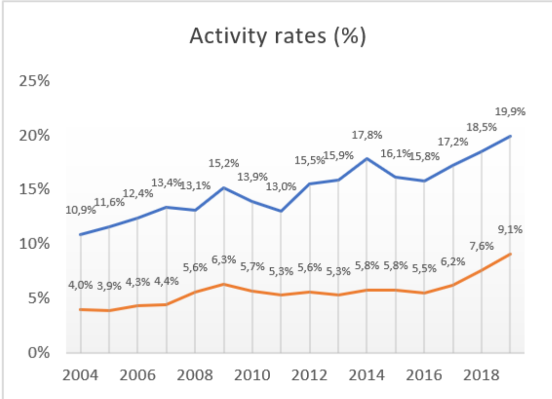
Portugal



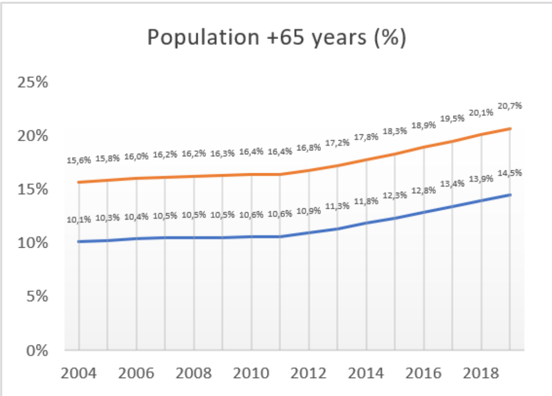


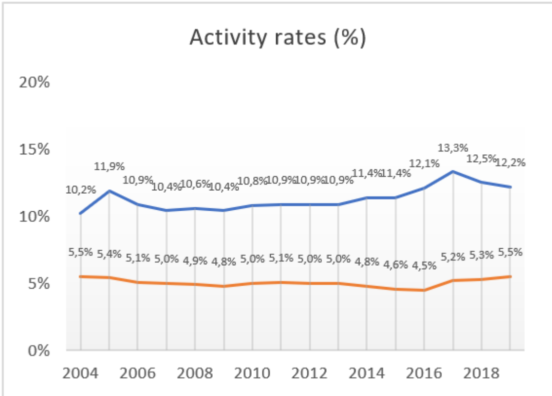
Netherlands



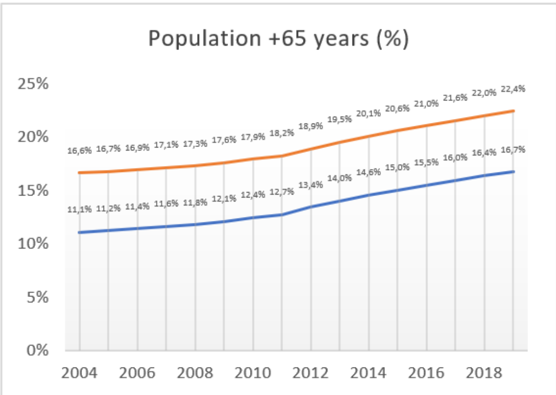


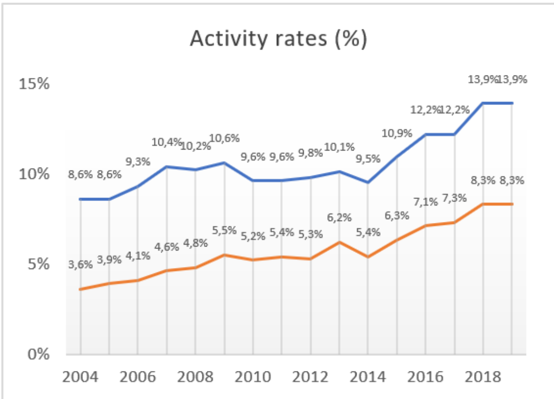
Poland



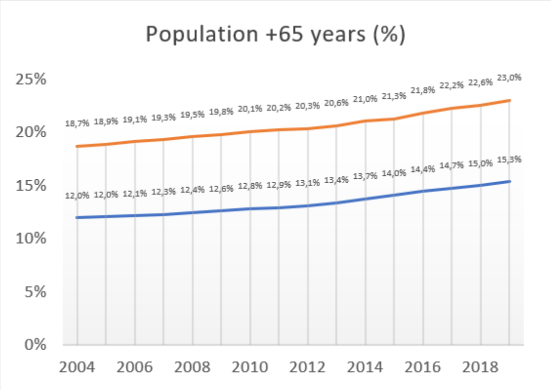


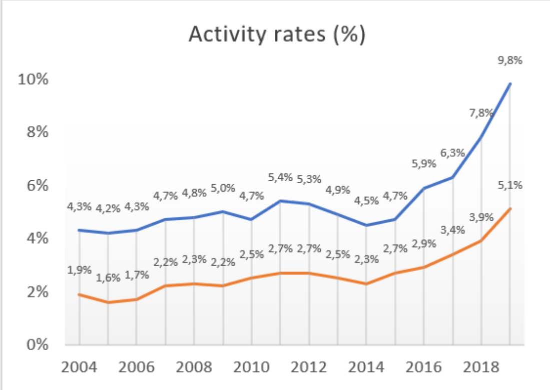
Czech Republic



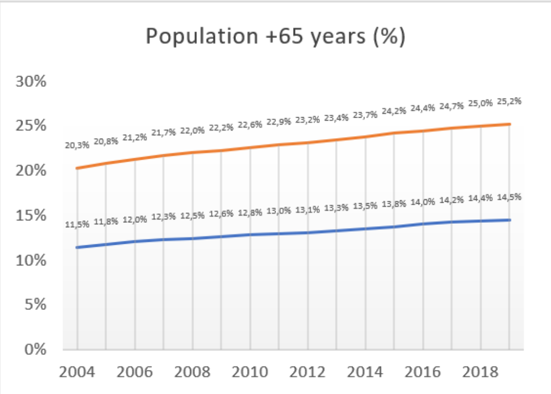


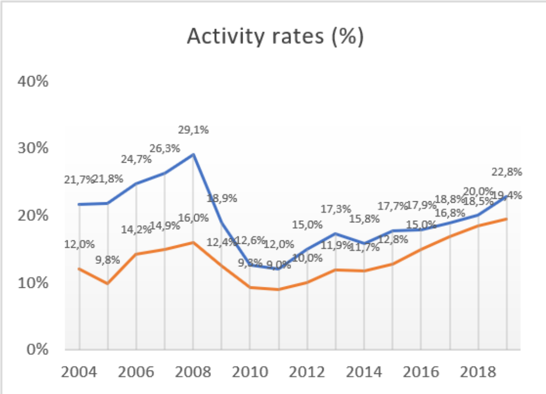
Hungary



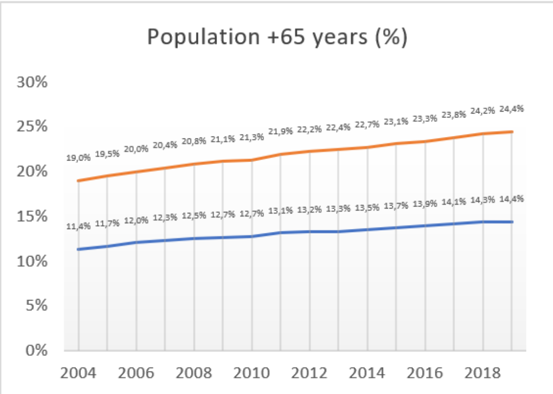


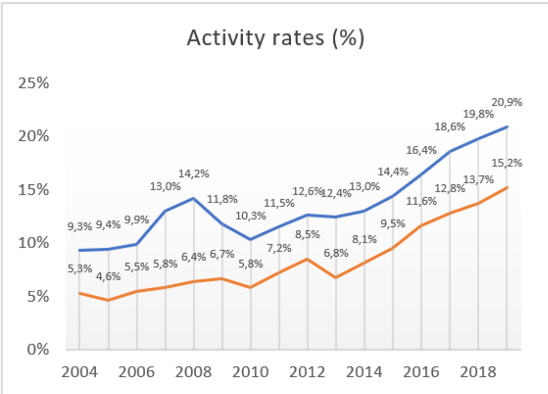
Latvia



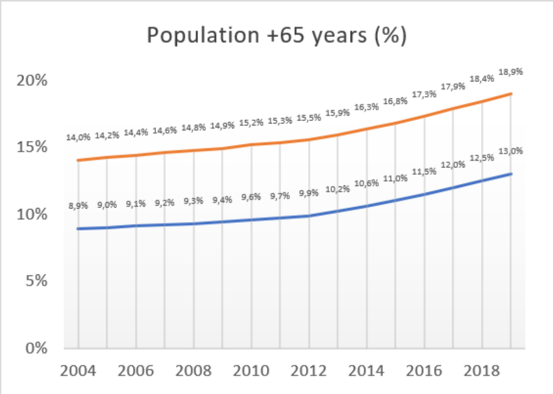


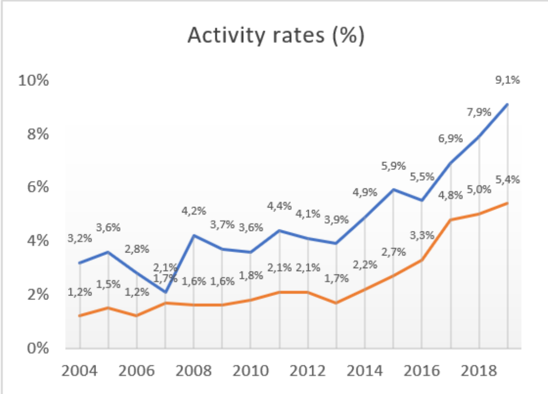
Lithuania



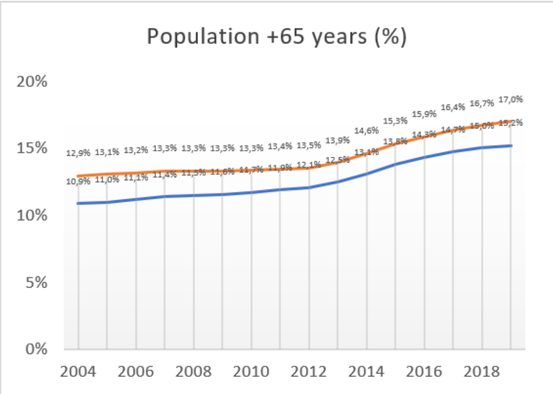


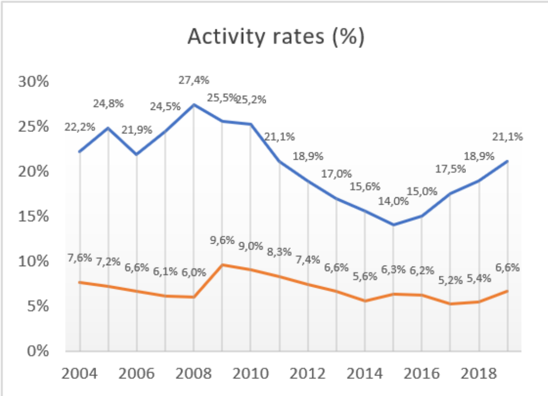
Slovakia



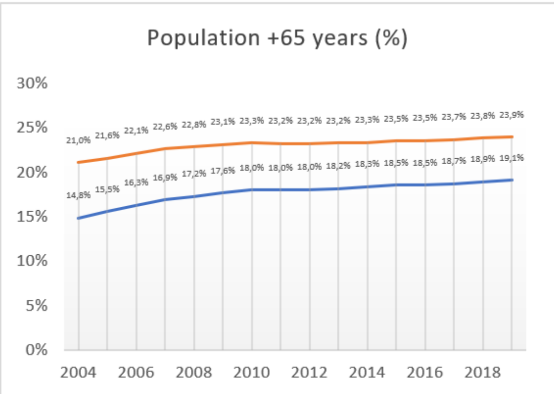


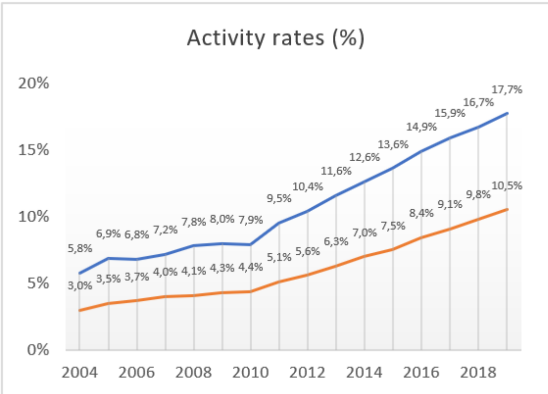
Cyprus



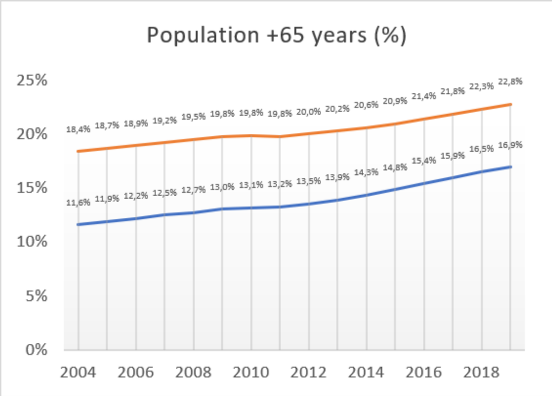


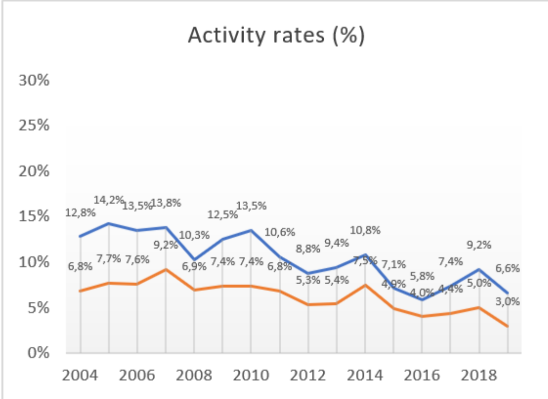
Germany



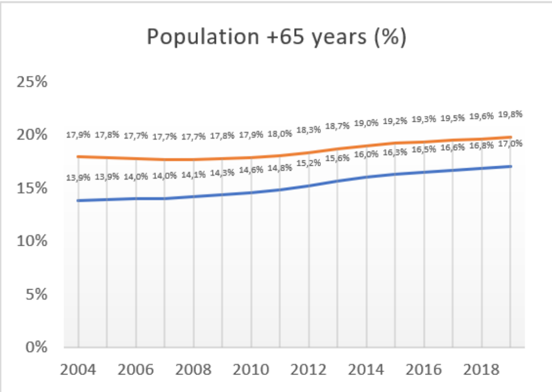


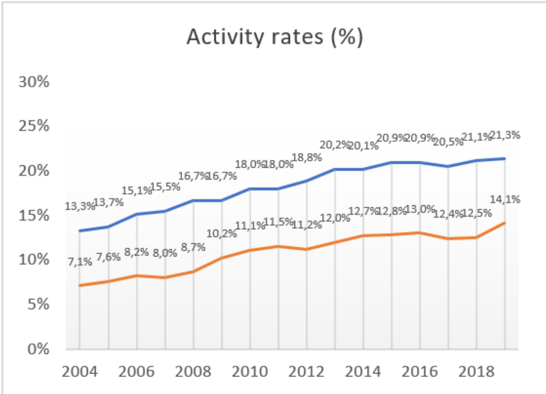
Slovenia



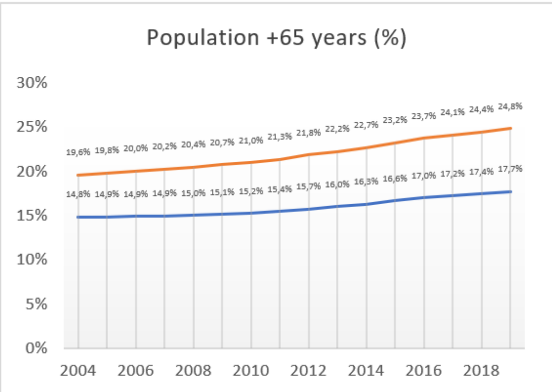


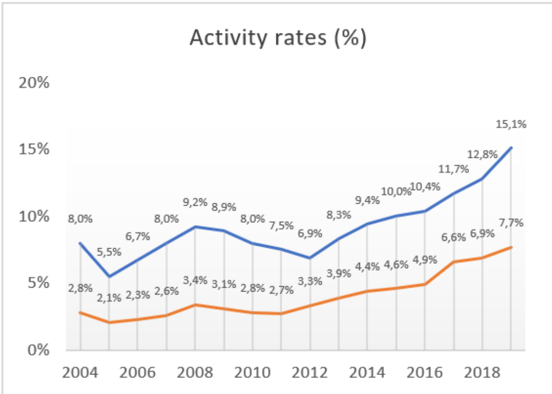
United Kingdom



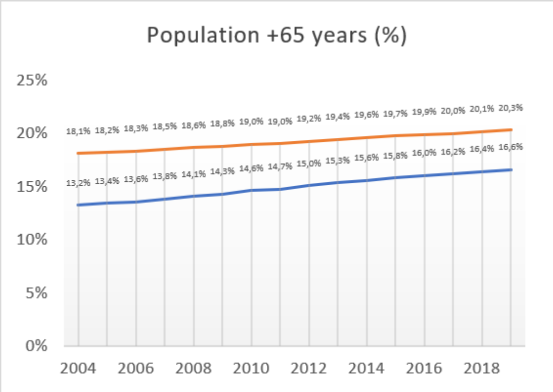


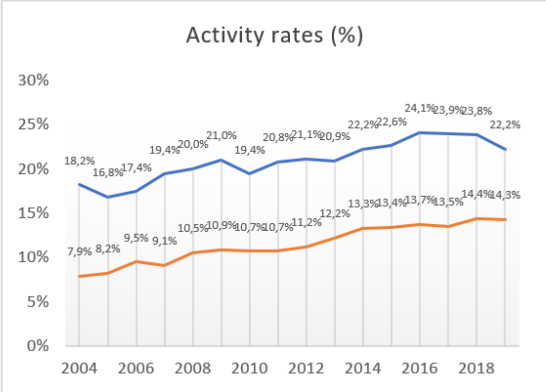
Bulgaria



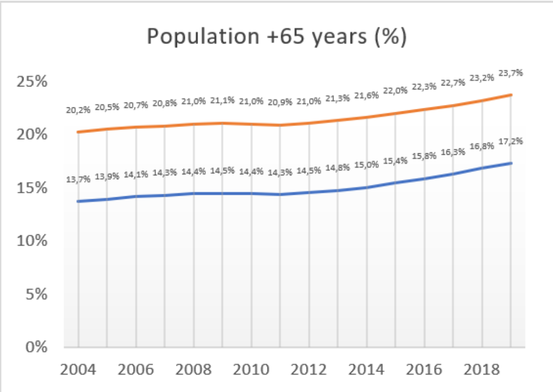


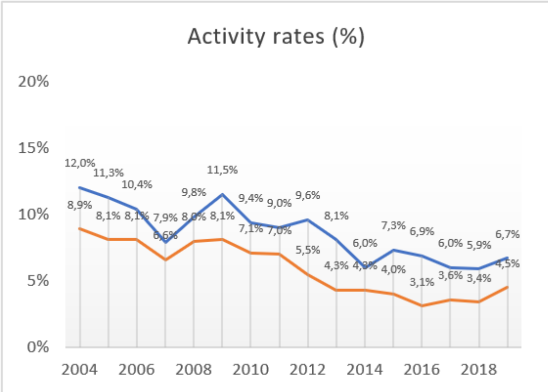
Switzerland



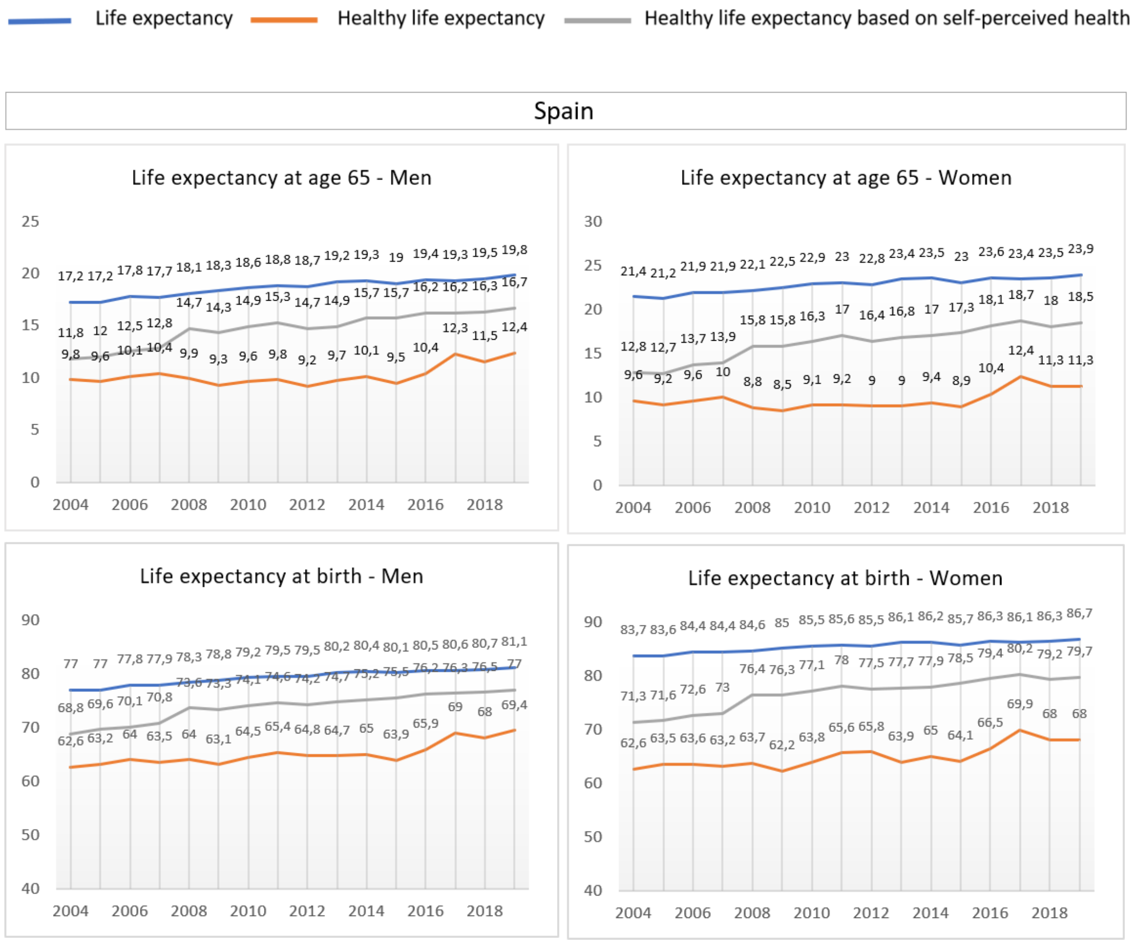


Croatia

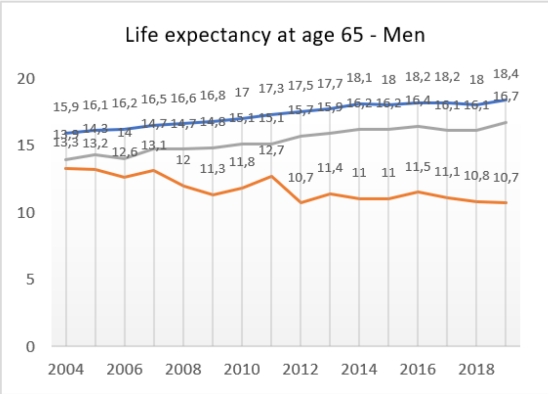


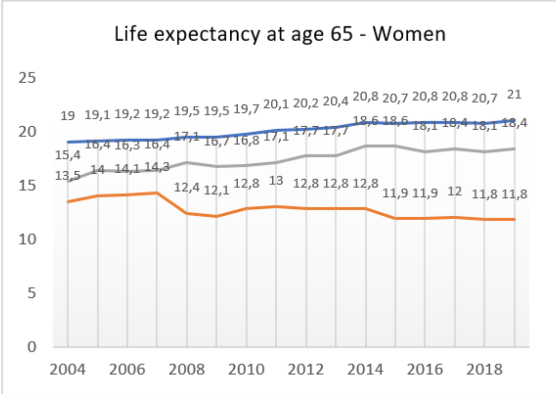


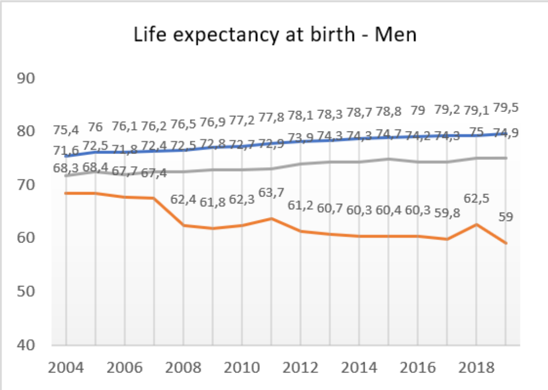
2. Life expectancy, healthy life expectancy and healthy life expectancy based on self-perceived health at birth and at age 65 from 2004 to 2019 by gender:

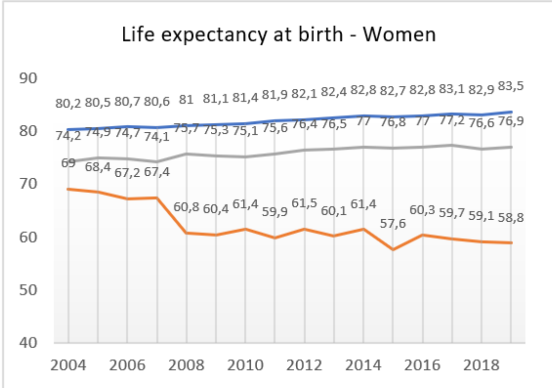


Denmark

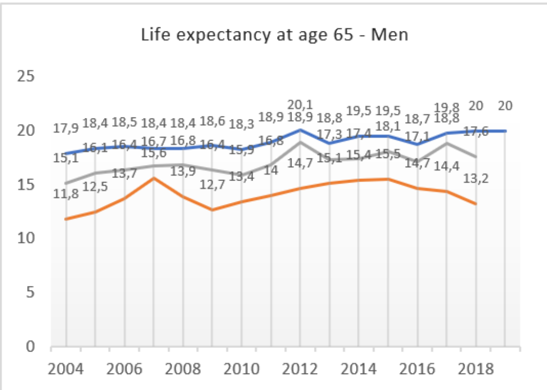


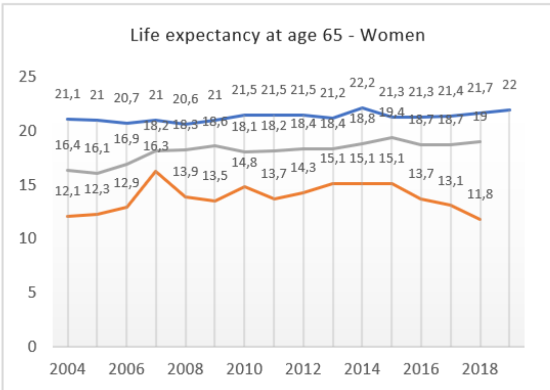


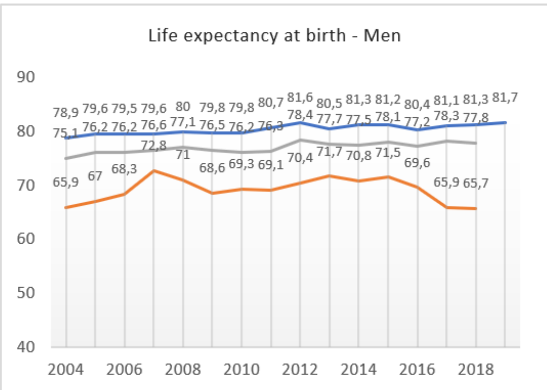


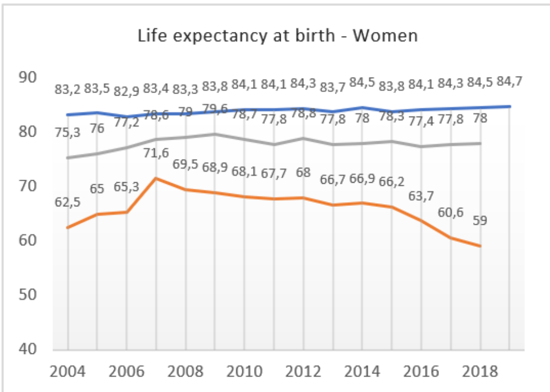


Iceland

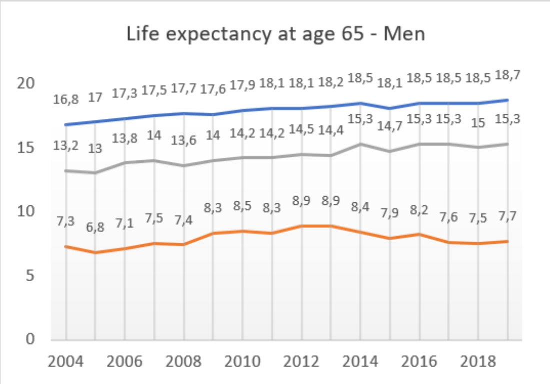


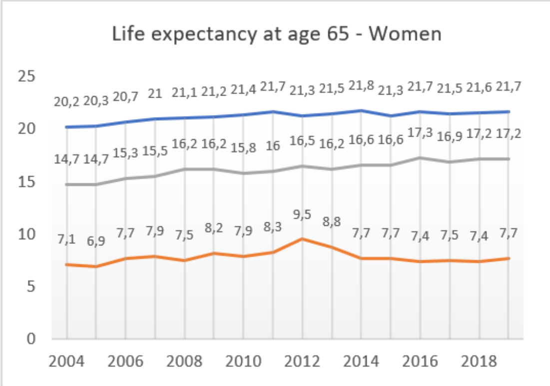


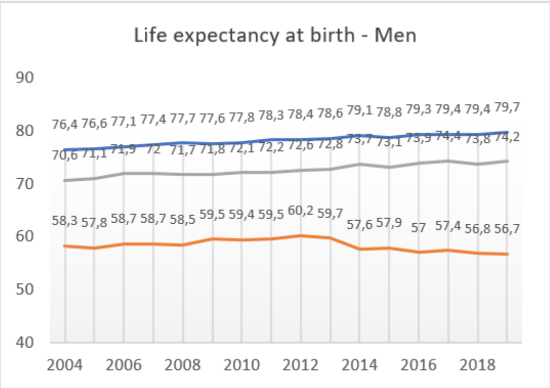


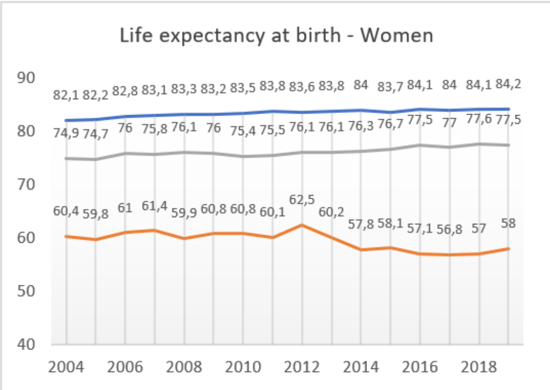


Austria

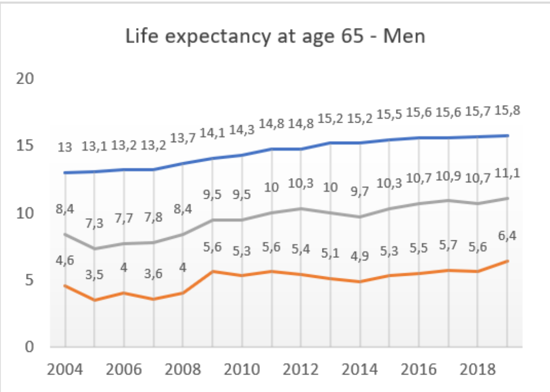


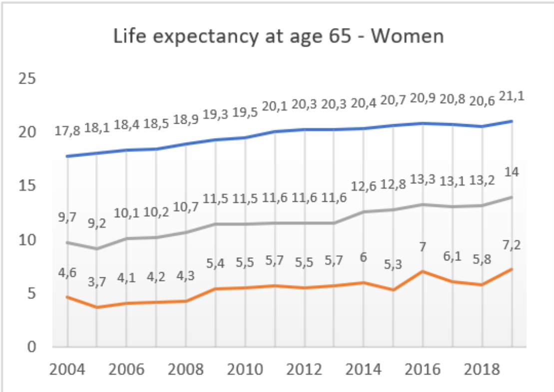


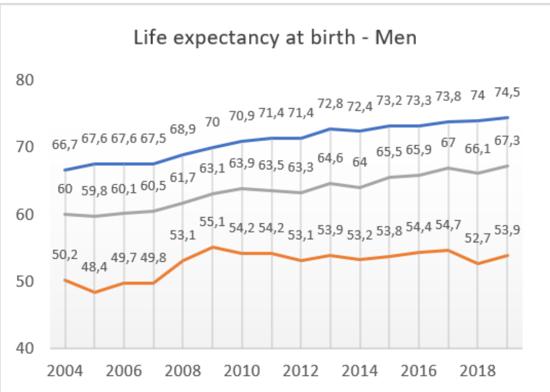


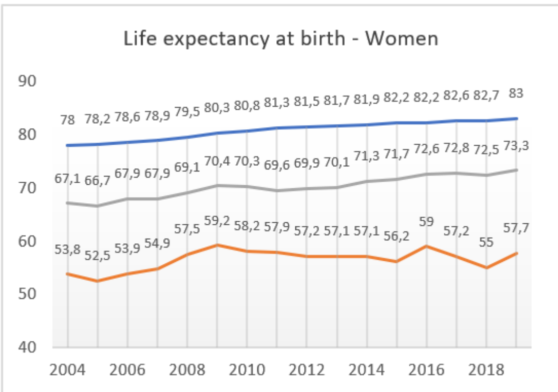


Estonia

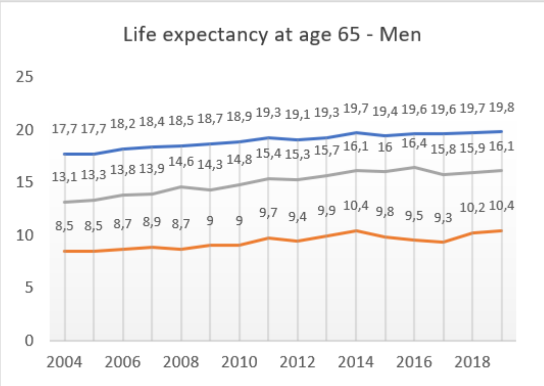


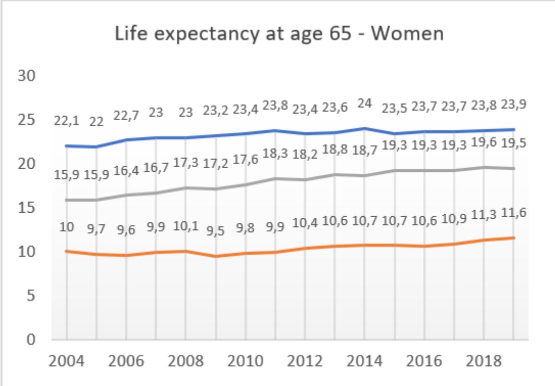


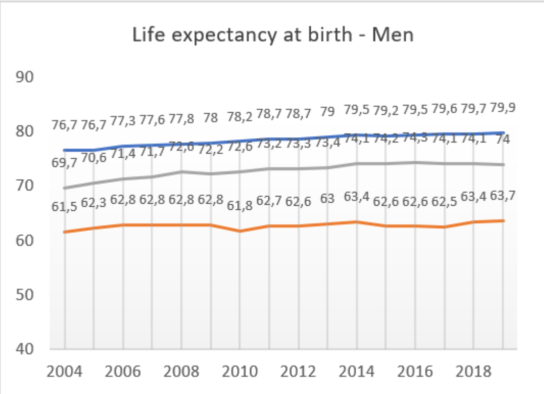


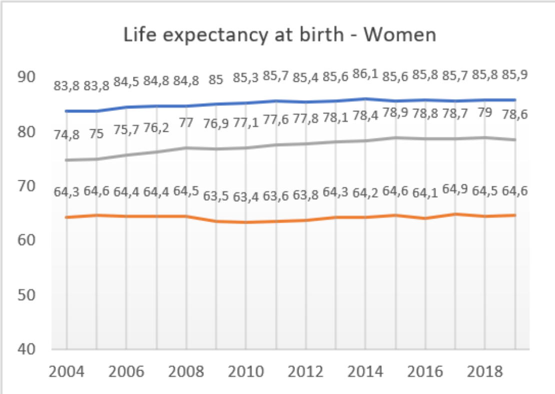


France

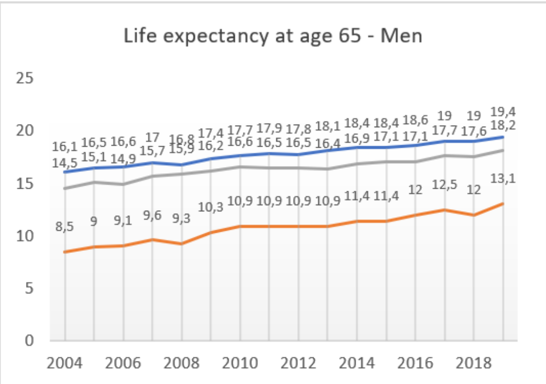


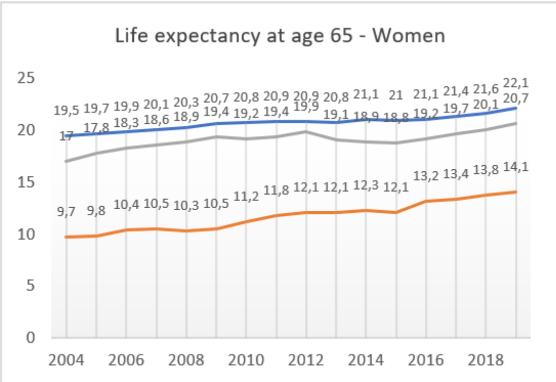


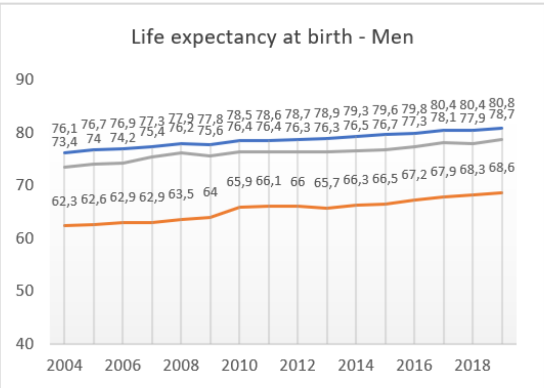


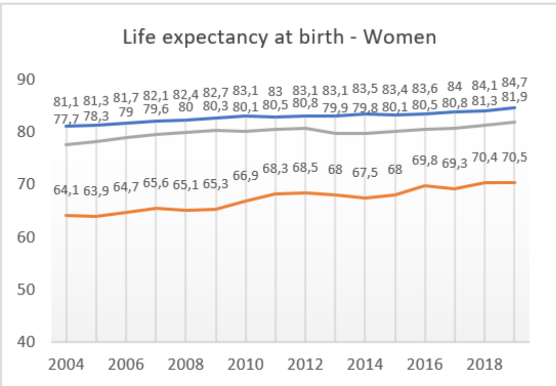


Ireland



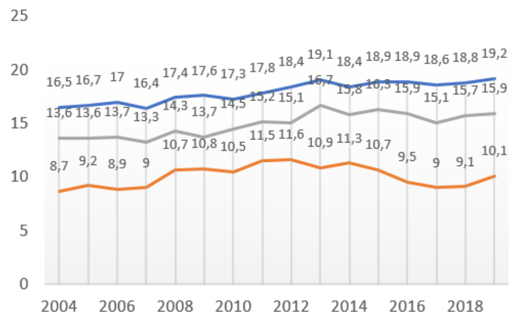




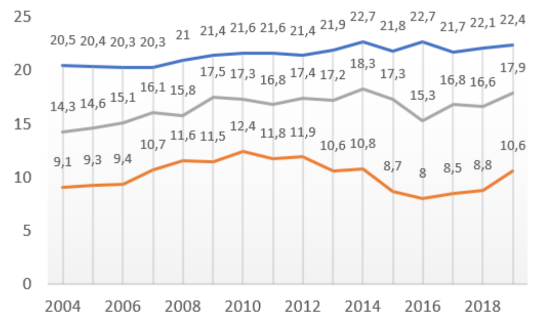


Luxembourg

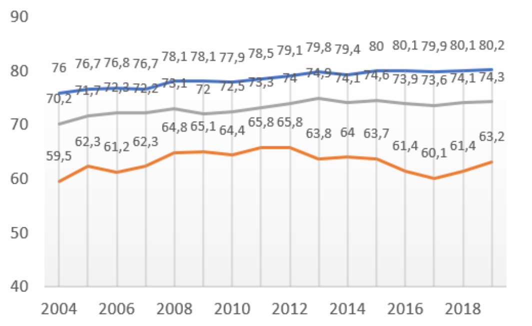
Life expectancy at age 65 - Men



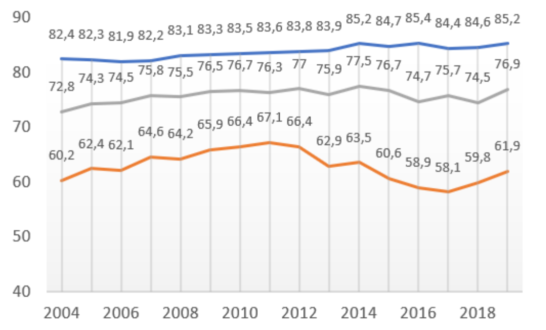
Life expectancy at age 65 - Women



Life expectancy at birth - Men

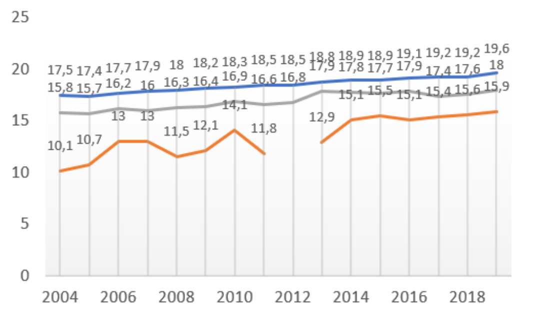


Life expectancy at birth - Women

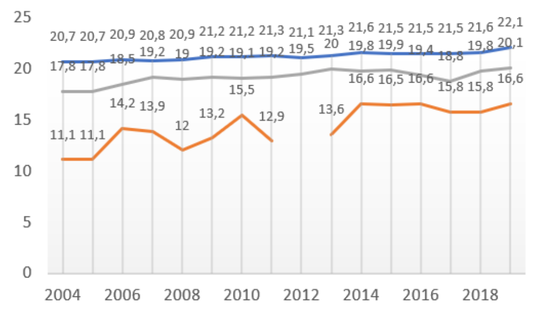


Sweden

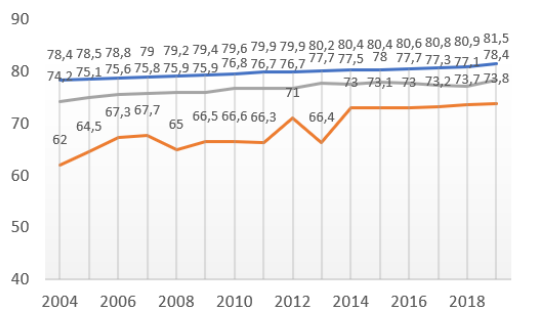
Life expectancy at age 65 - Men



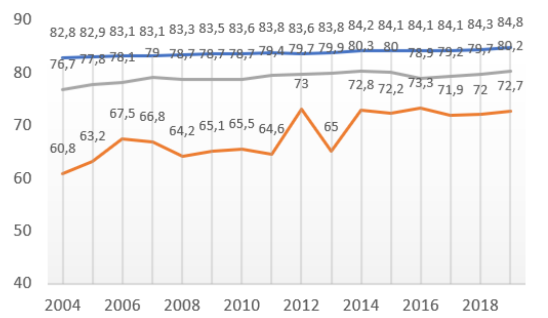
Life expectancy at age 65 - Women



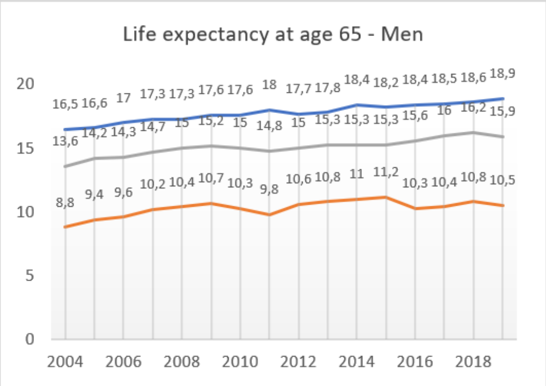
Life expectancy at birth - Men

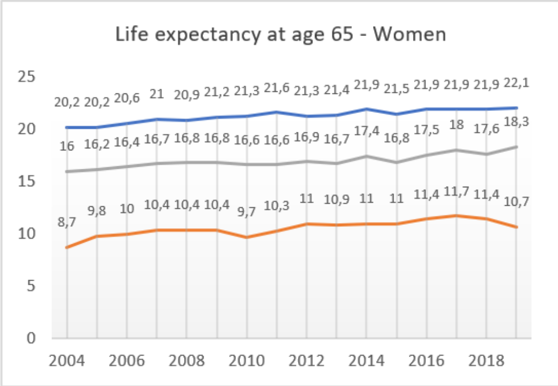


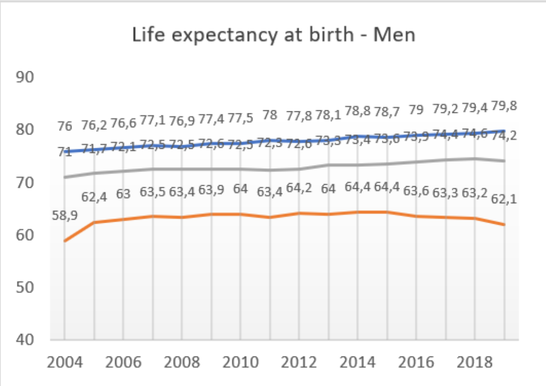
Life expectancy at birth - Women

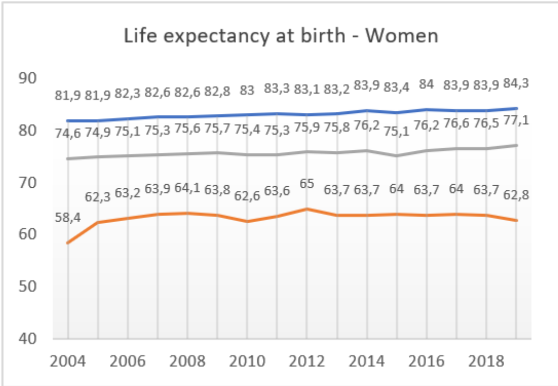


Belgium

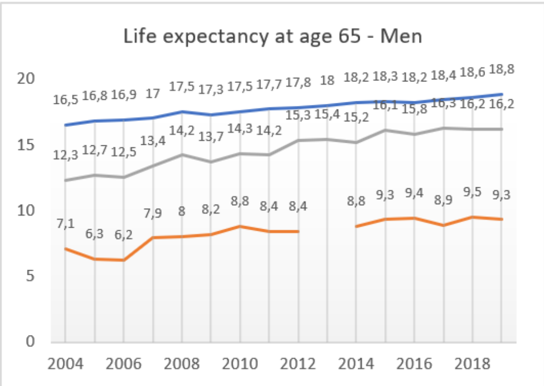


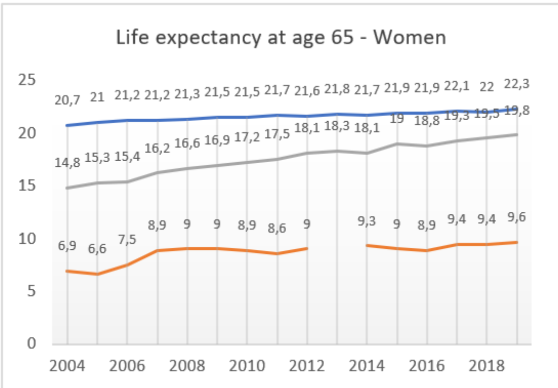


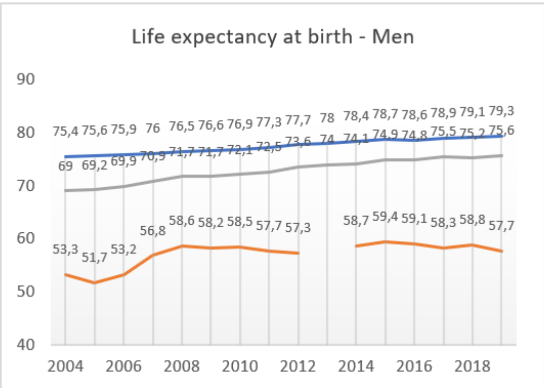


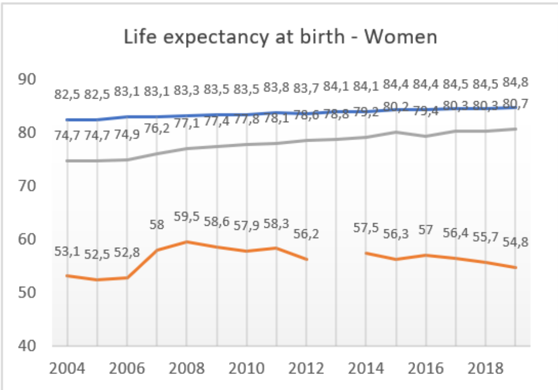


Finland

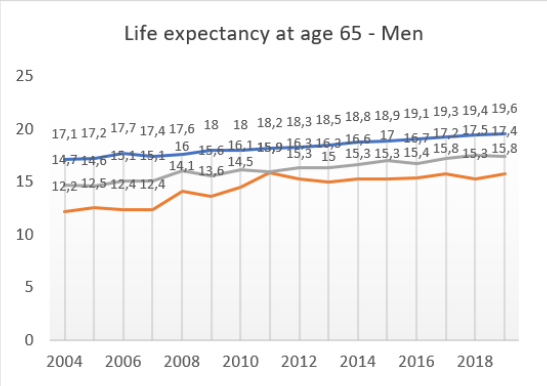




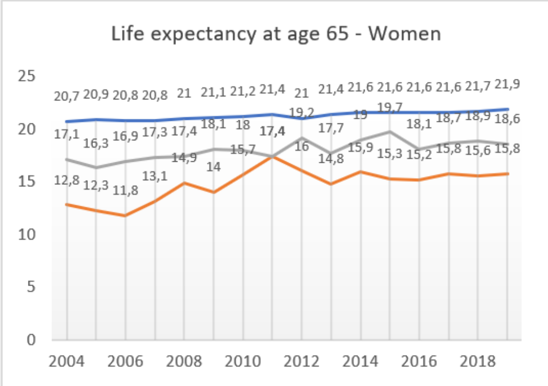




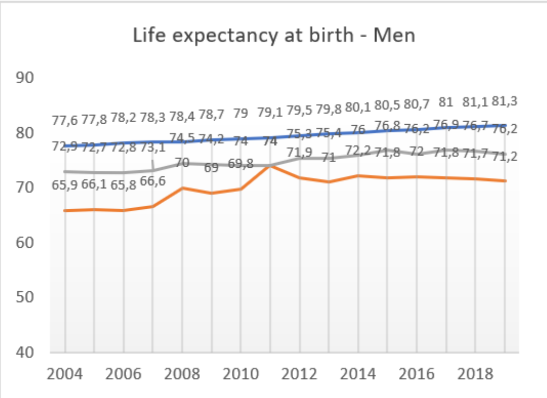
Norway



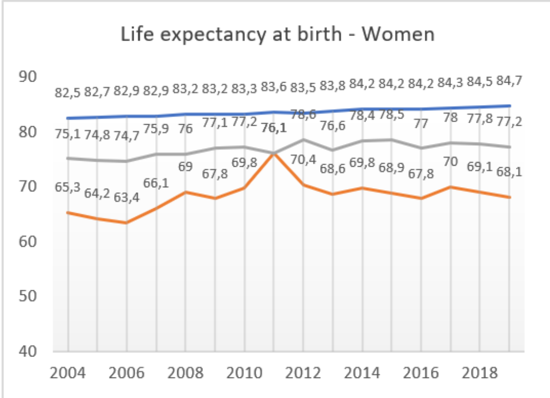
Life expectancy at age 65 - Men



Life expectancy at age 65 - Women

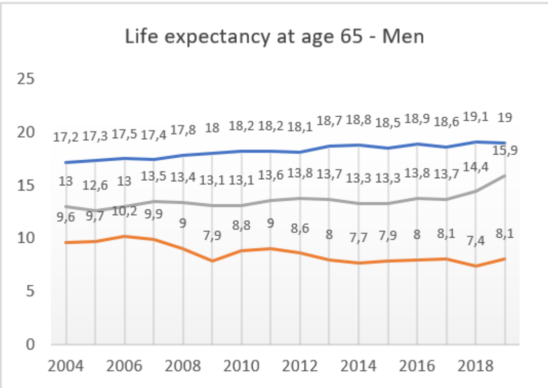


Life expectancy at birth - Men

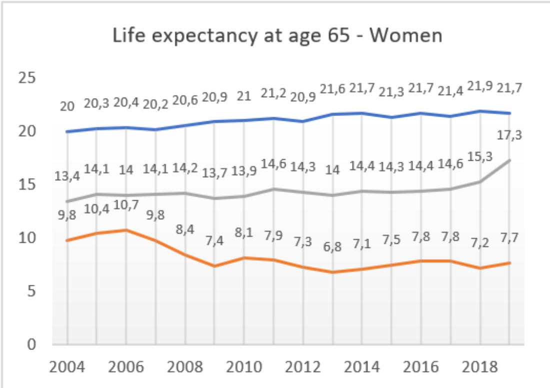


Life expectancy at birth - Women

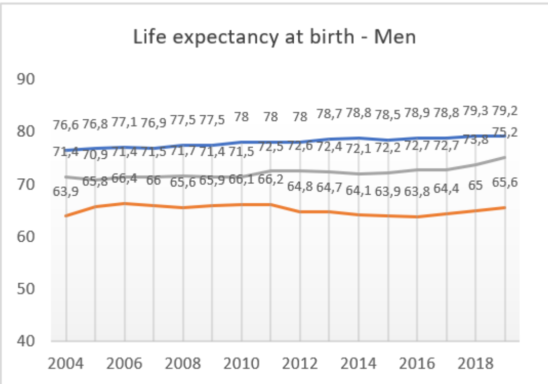
Greece



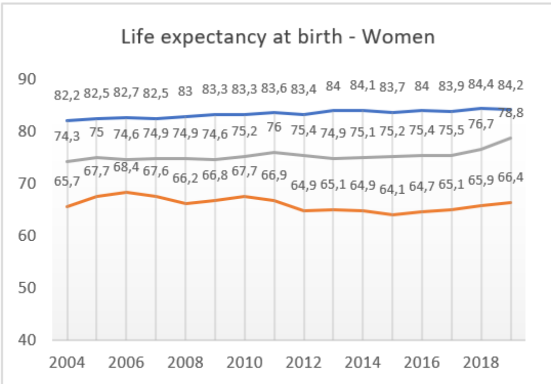
Life expectancy at age 65 - Men



Life expectancy at age 65 - Women

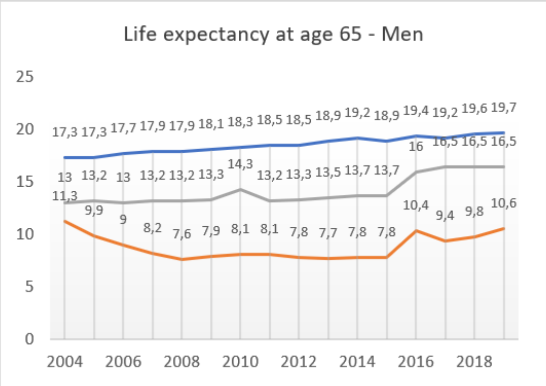


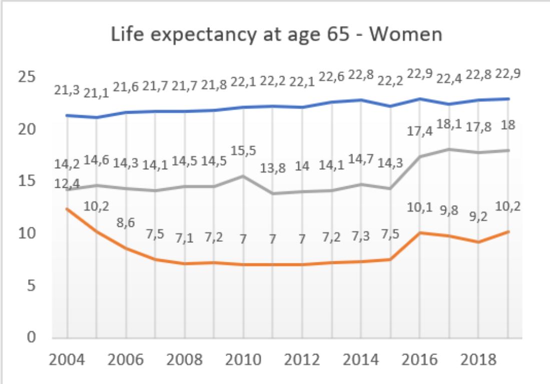
Life expectancy at birth - Men

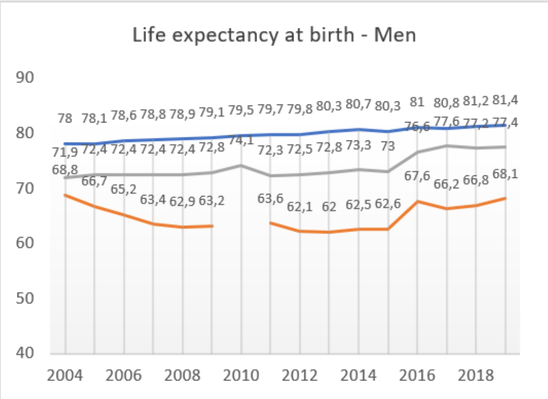


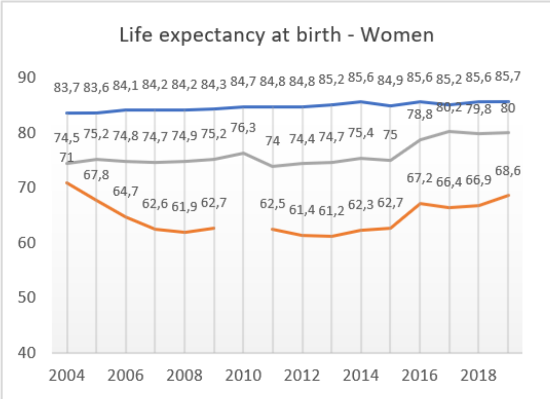
Life expectancy at birth - Women

Italy

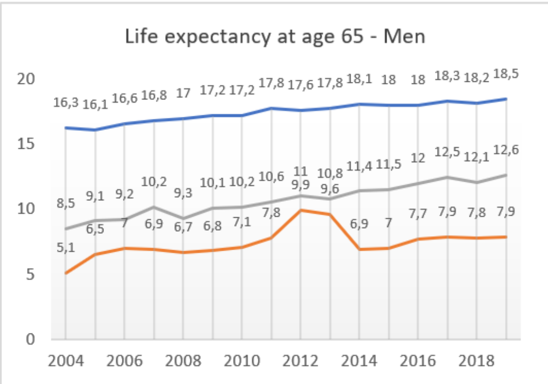


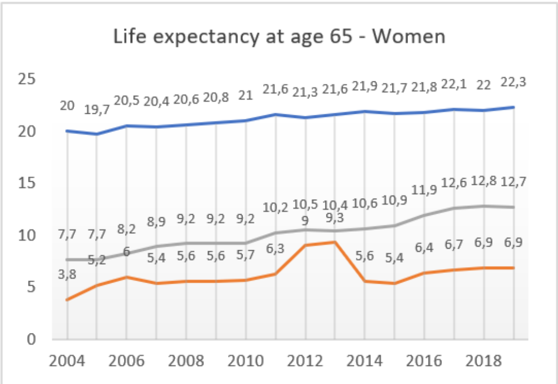


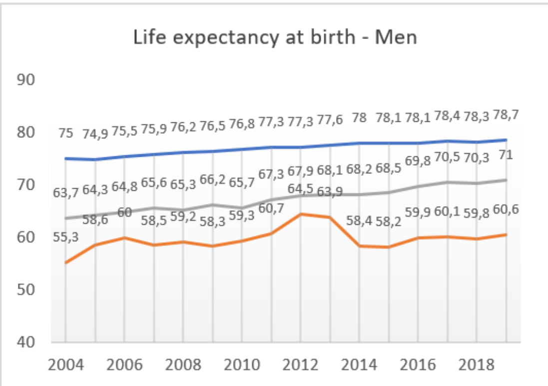


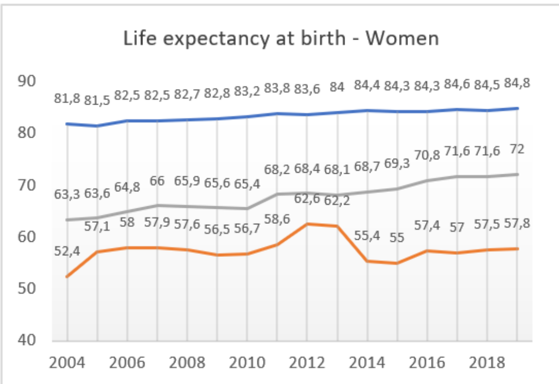


Portugal

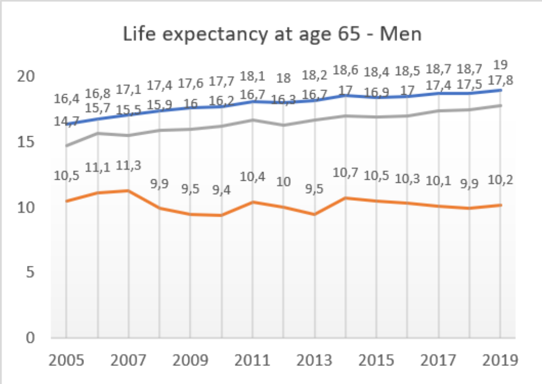


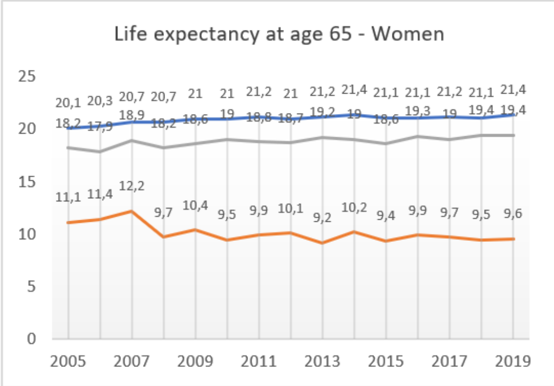


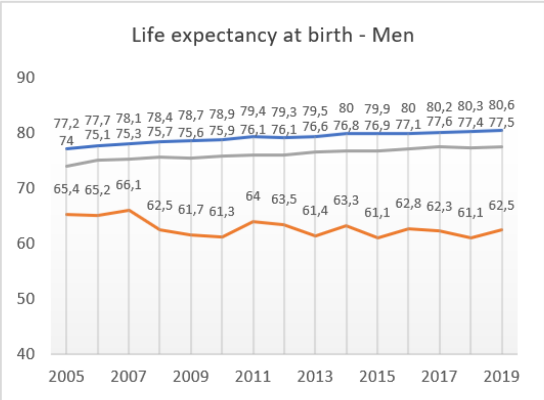


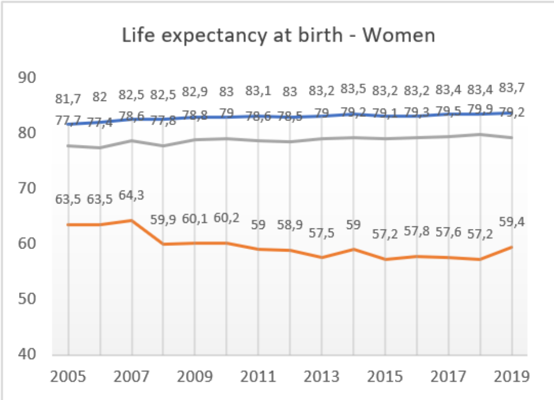


Netherlands

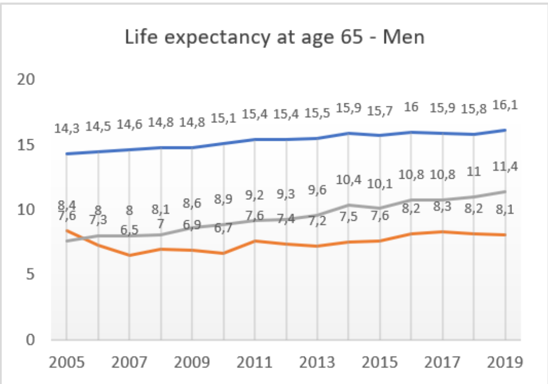


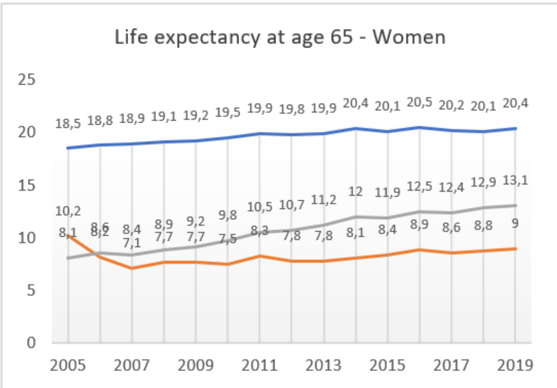


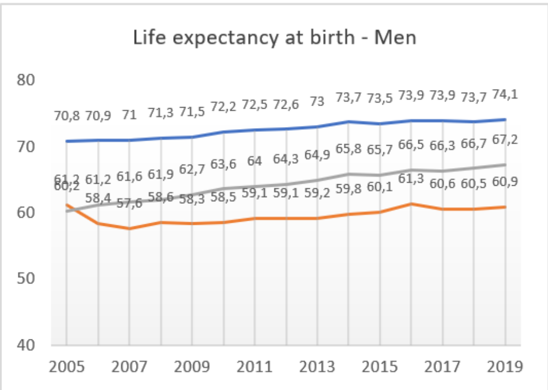


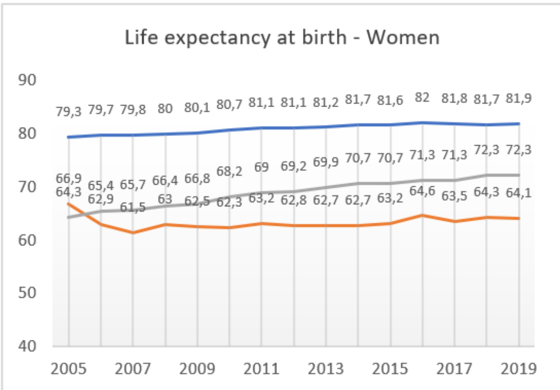


Poland

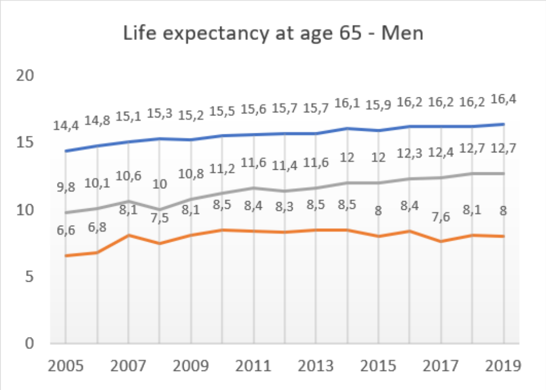


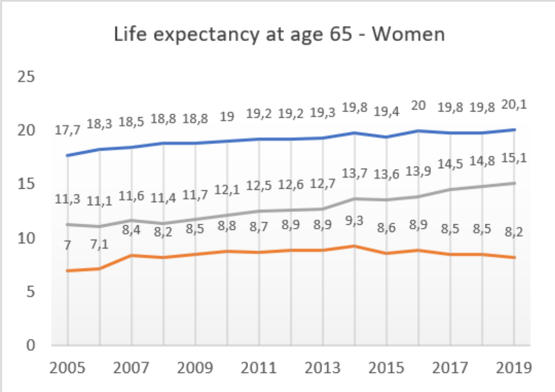


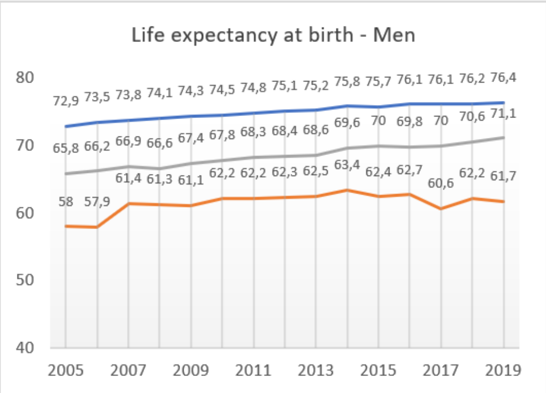


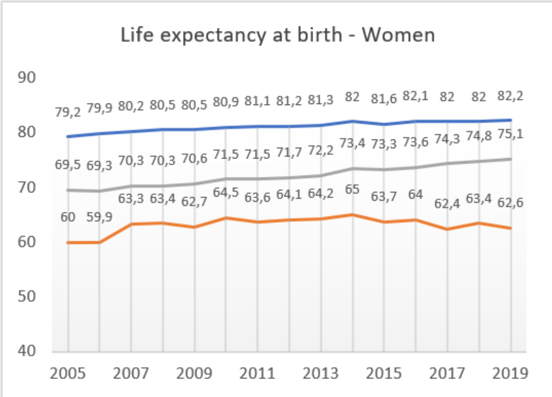


Czech Republic

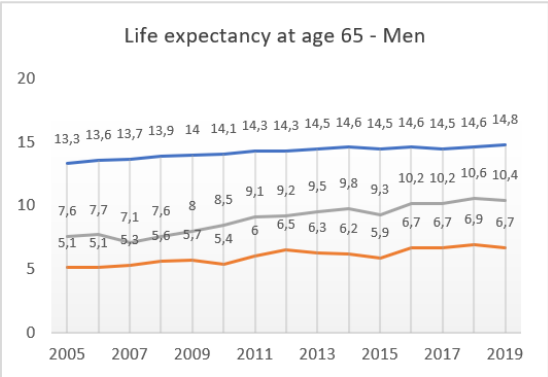


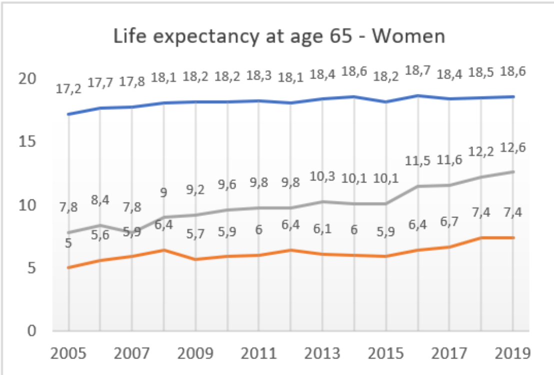


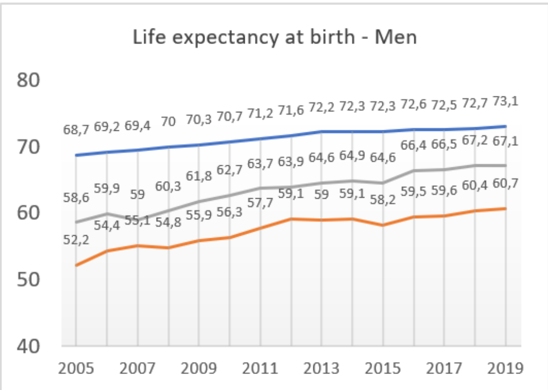


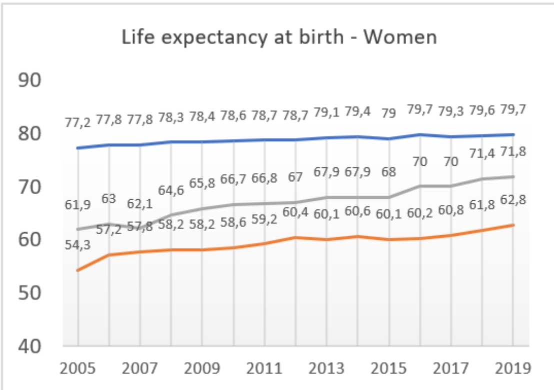


Hungary

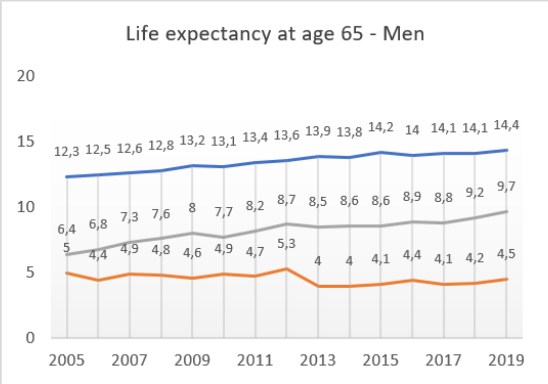


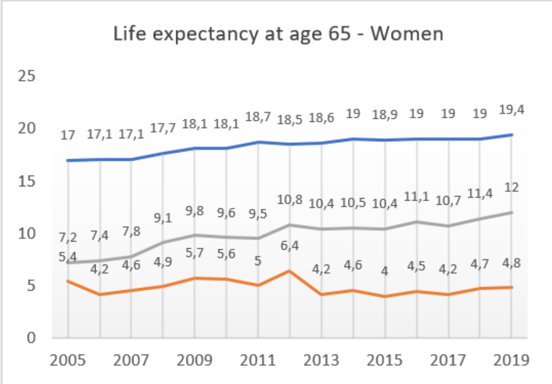


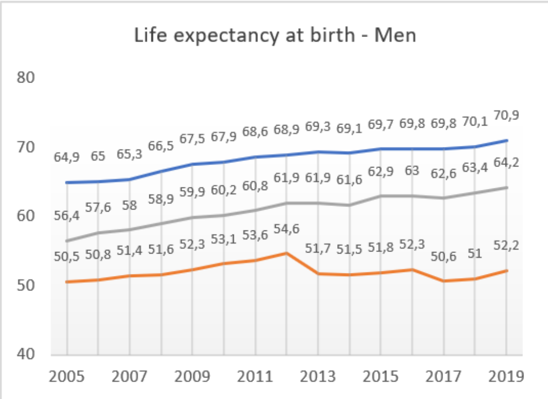


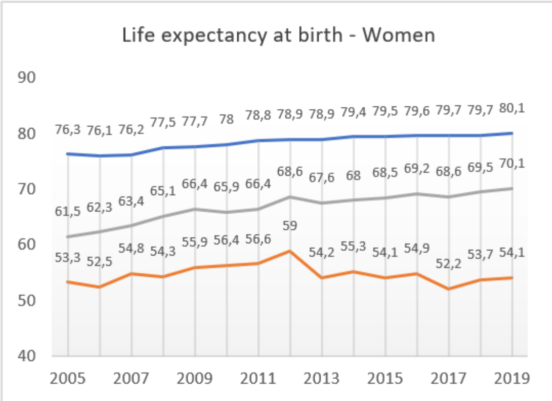


Latvia

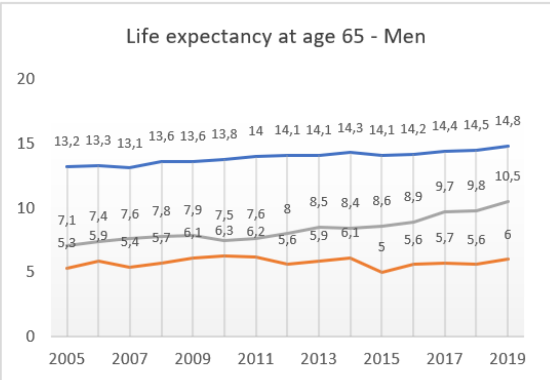


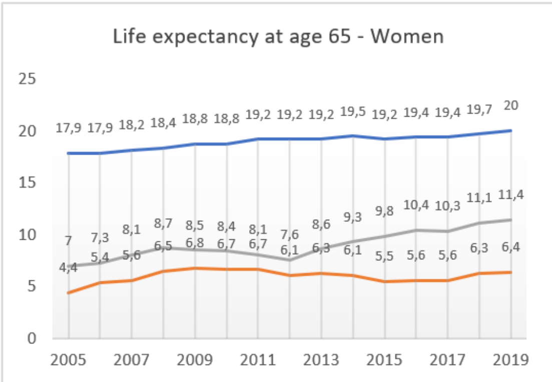


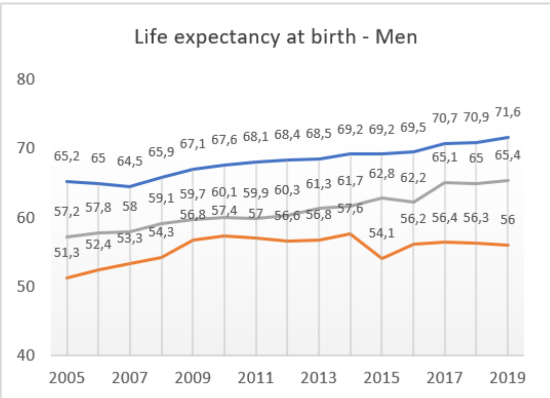


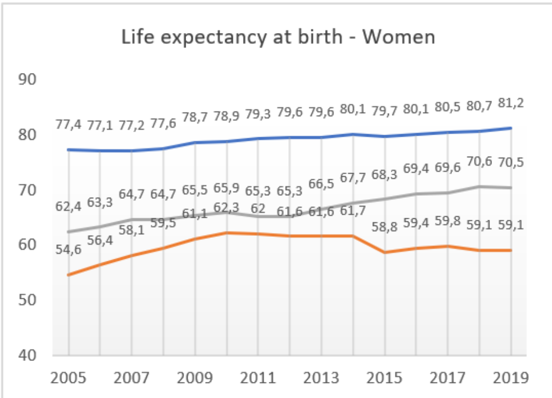


Lithuania

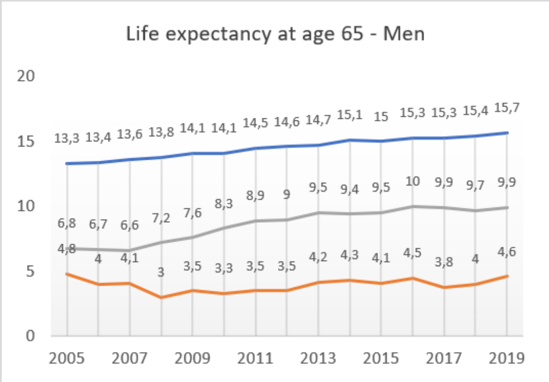


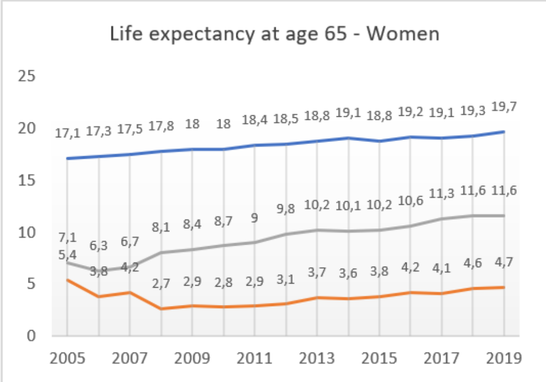


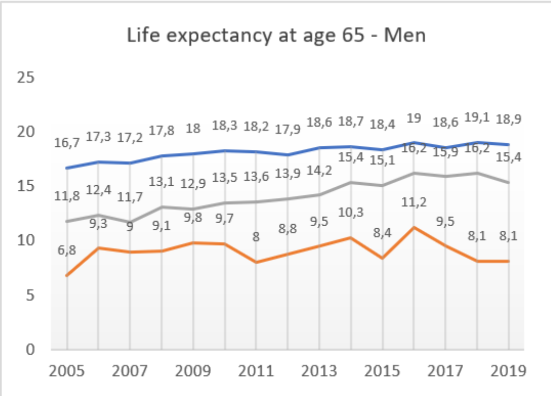


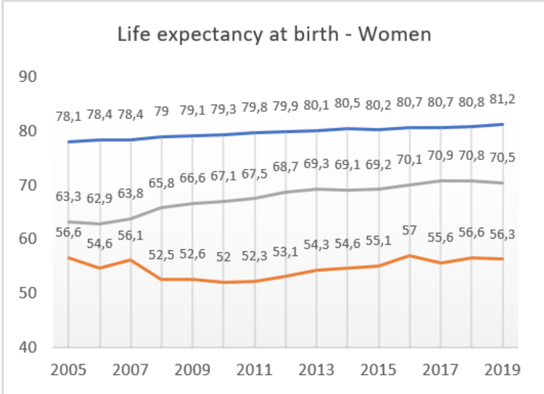


Slovakia

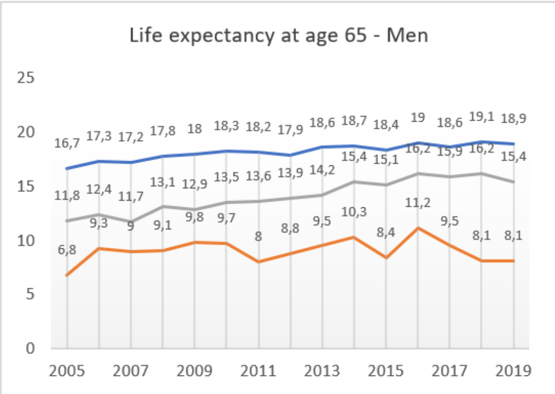


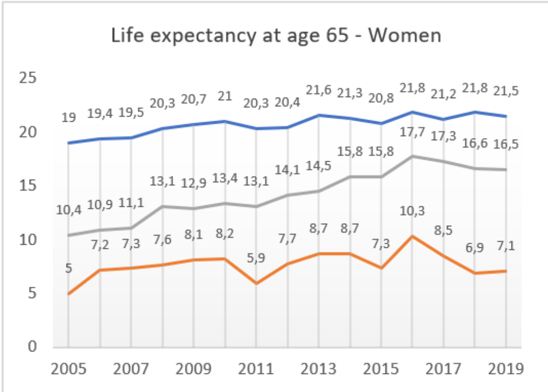


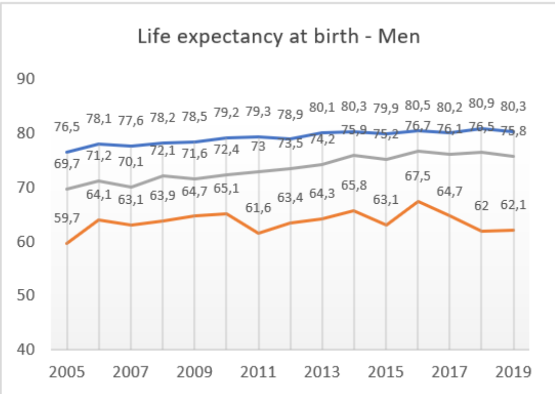


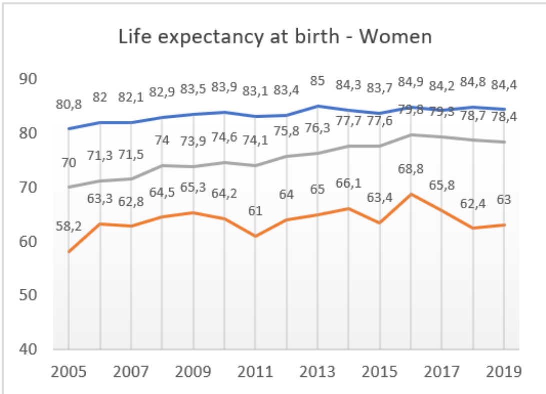


Cyprus

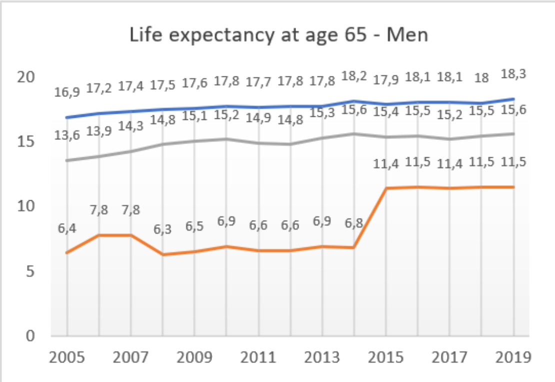


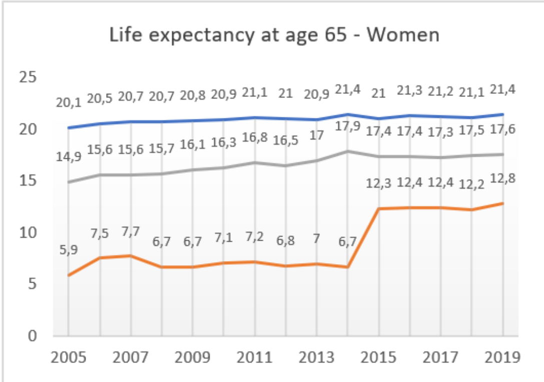


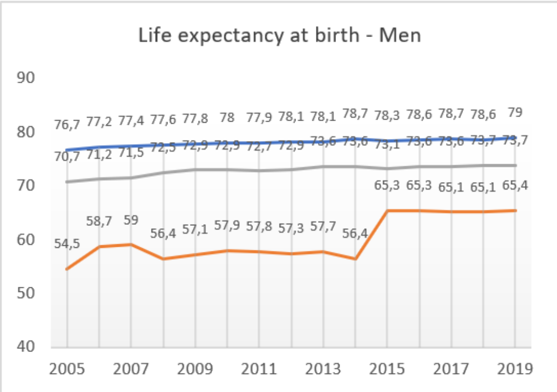


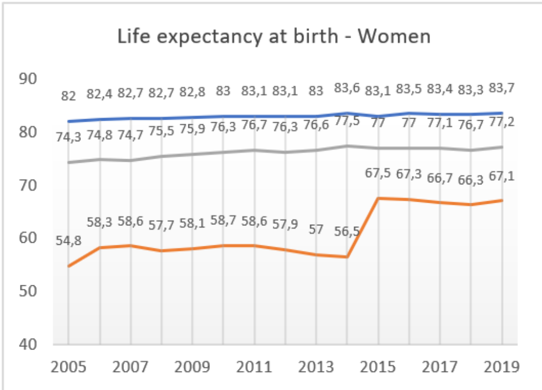


Germany

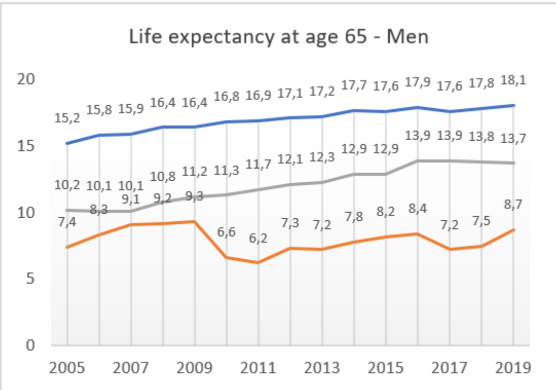


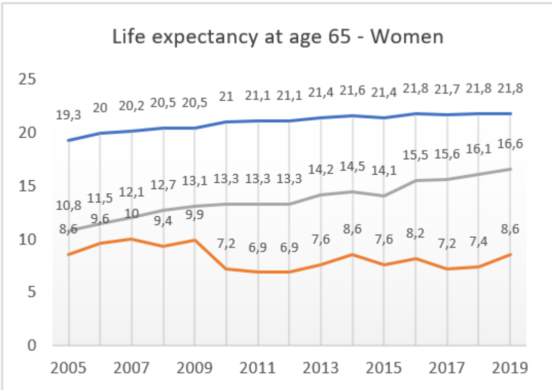


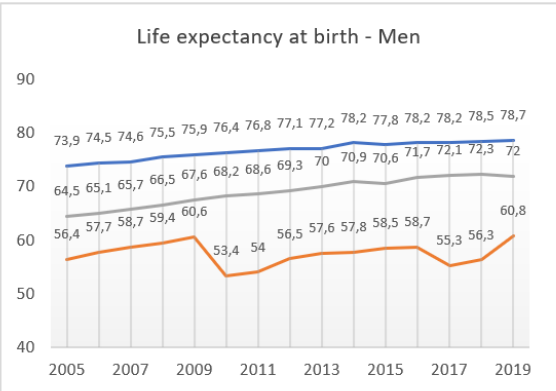


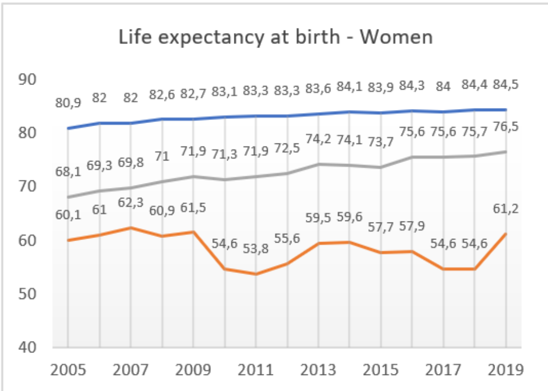


Slovenia

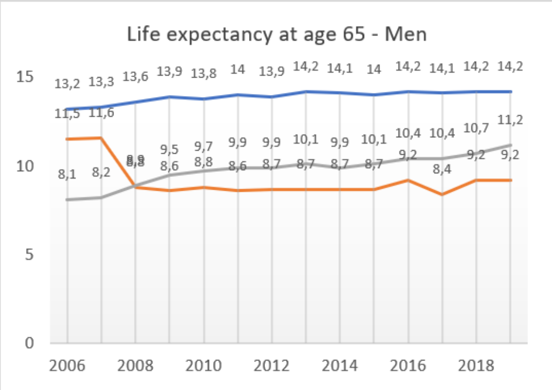


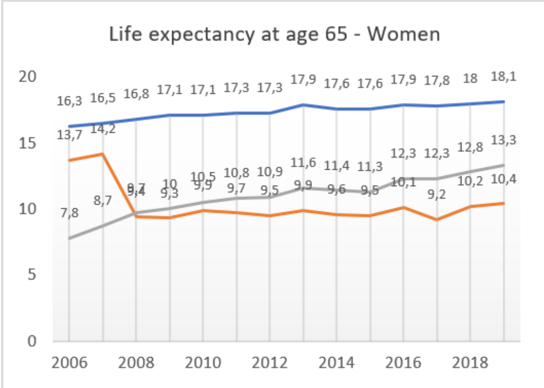


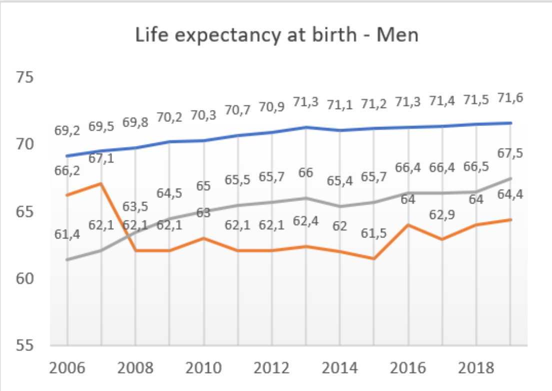


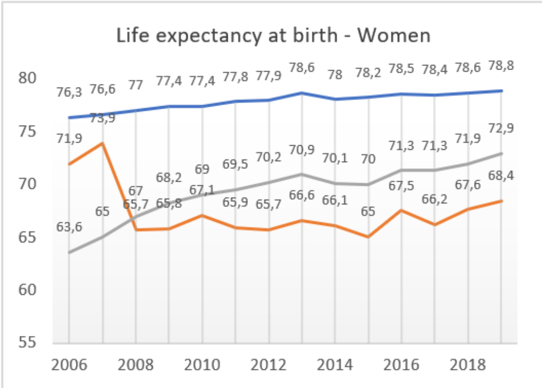


Bulgaria

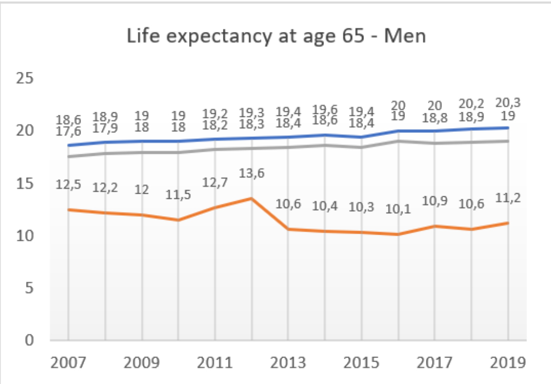


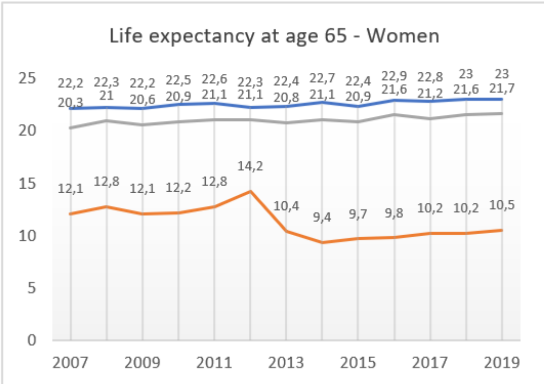


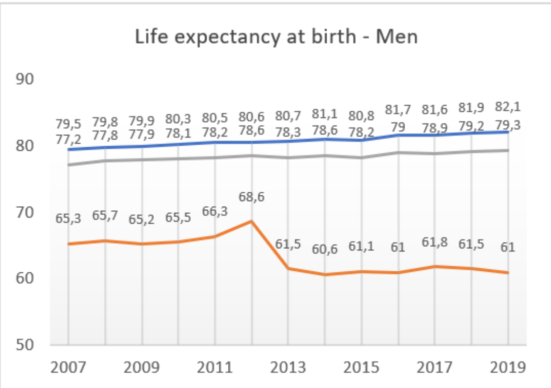


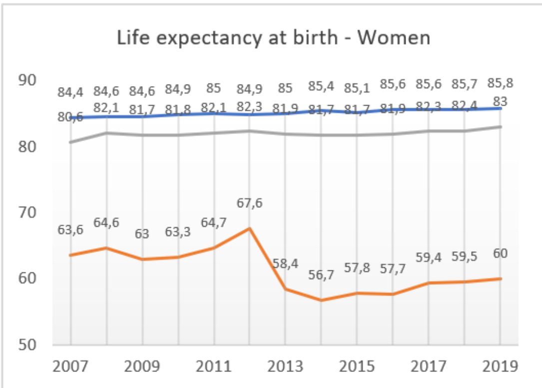


Switzerland

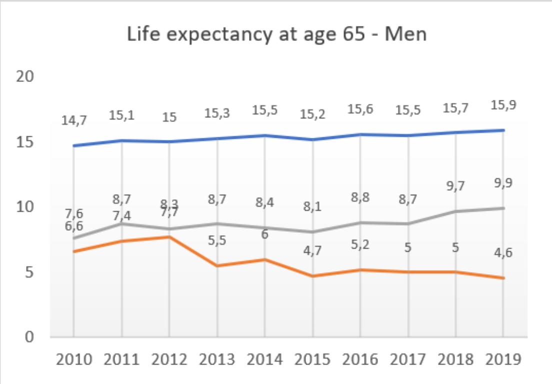


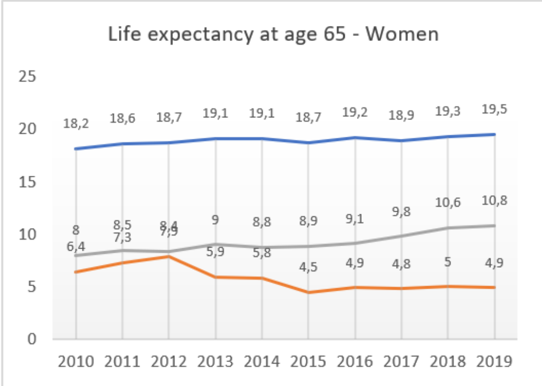


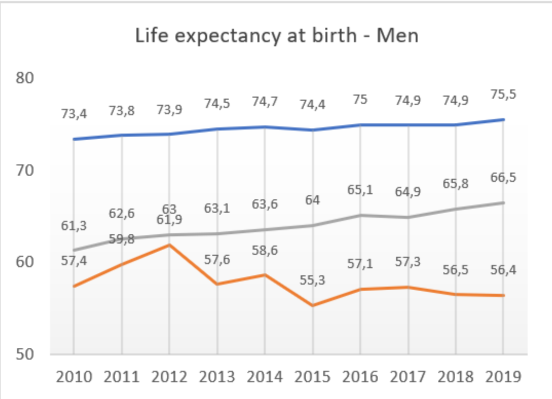


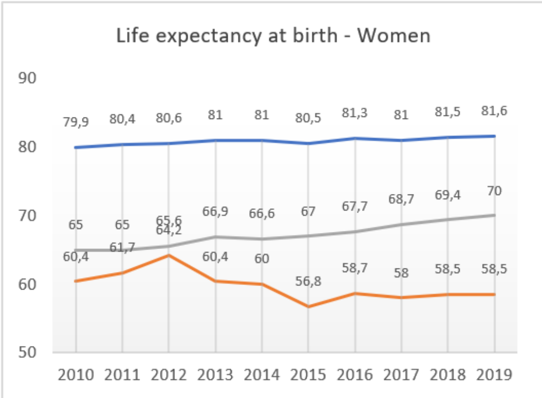


Croatia

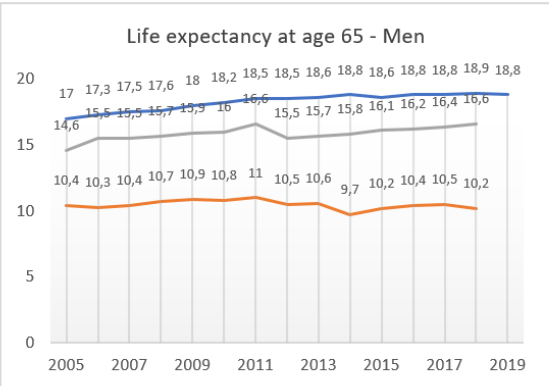


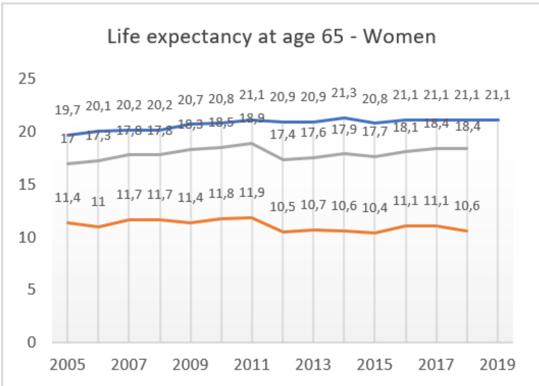




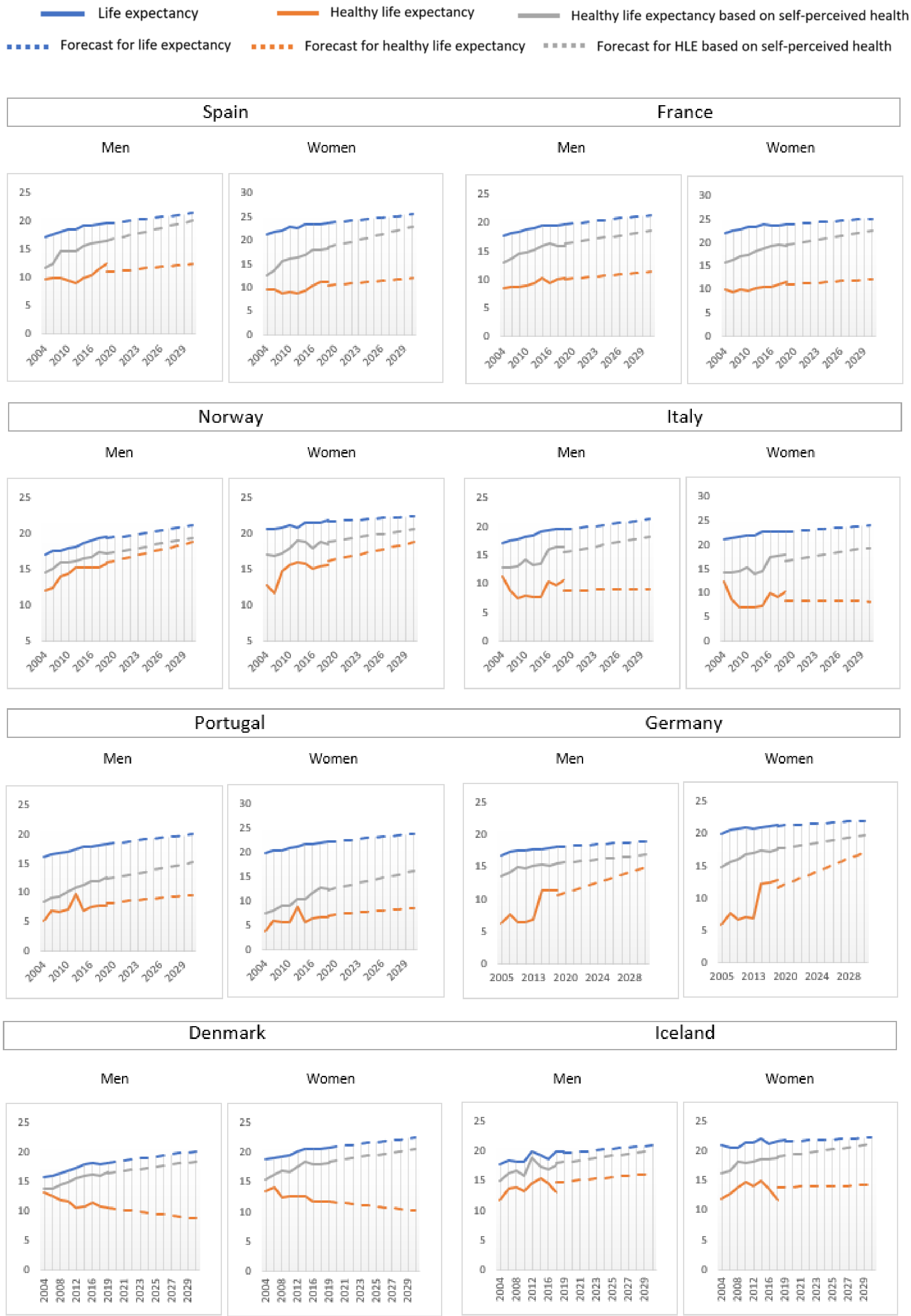


United Kingdom



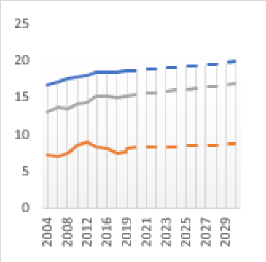


3. Observed and expected life expectancy, healthy life expectancy and healthy life expectancy based on self-perceived health at age 65 from 2004 to 2030 by gender:

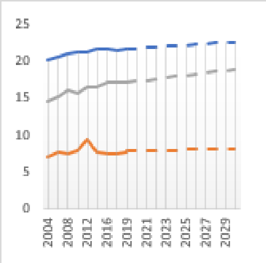


Austria

Men

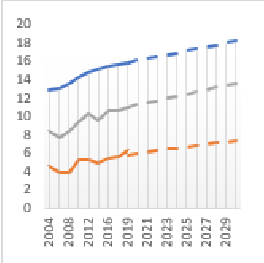


Women

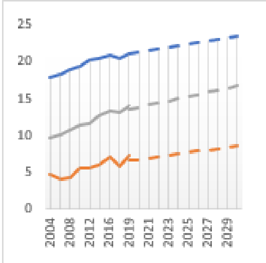


Estonia

Men

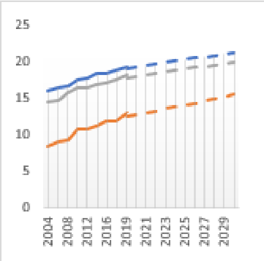


Women

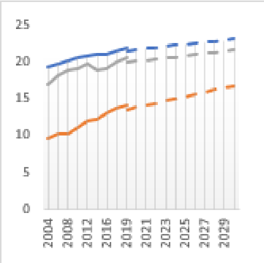


Ireland

Men

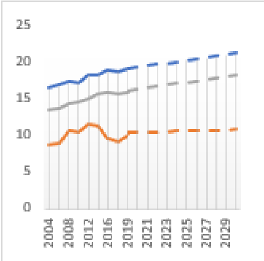


Women

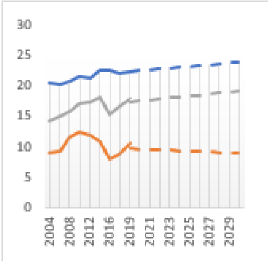


Luxembourg

Men

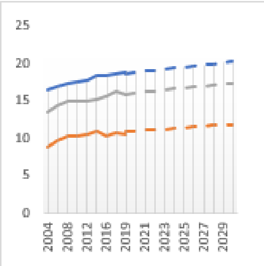


Women

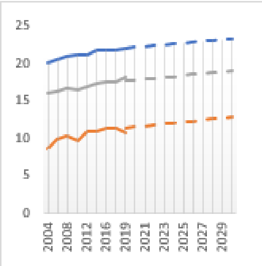


Belgium

Men

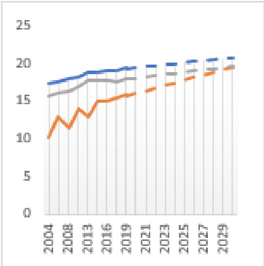


Women

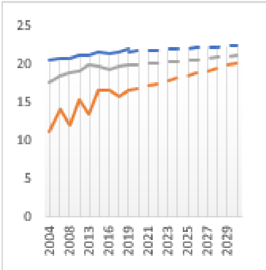


Sweden

Men

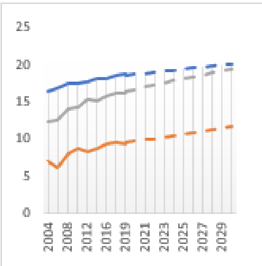


Women

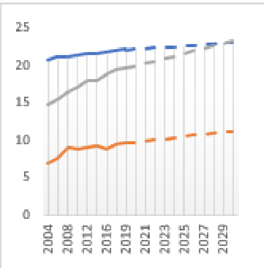


Finland

Men

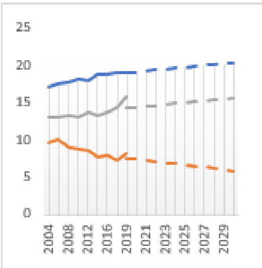


Women

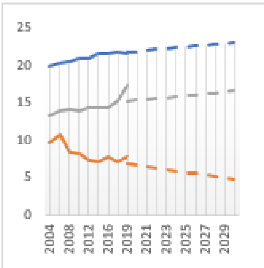


Greece

Men

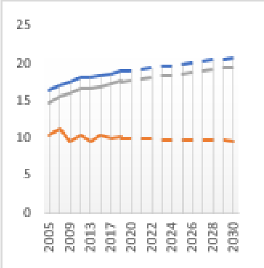


Women

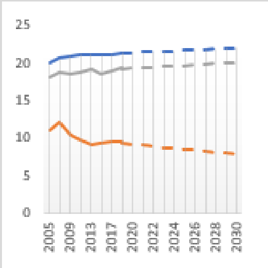


Netherlands

Men

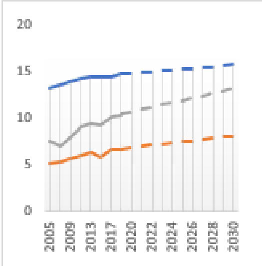


Women

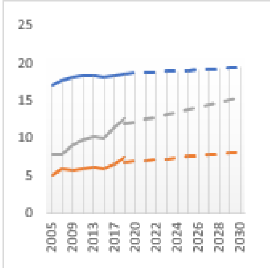


Hungary

Men

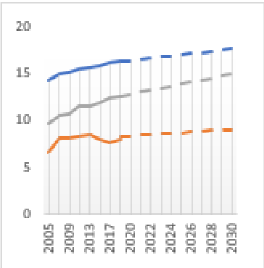


Women

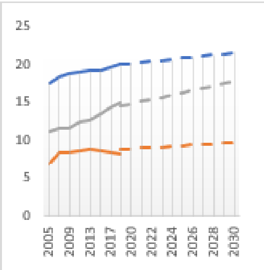


Czech Republic

Men

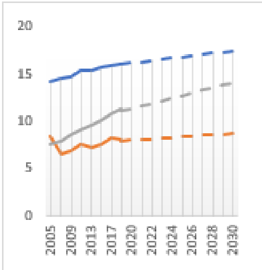


Women

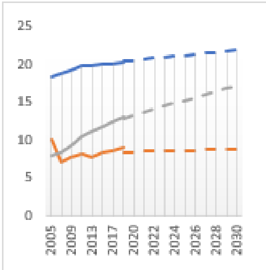


Poland

Men

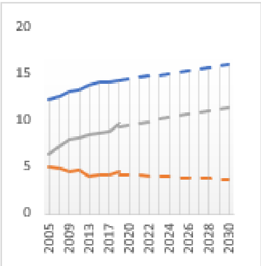


Women

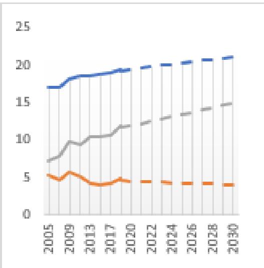


Latvia

Men

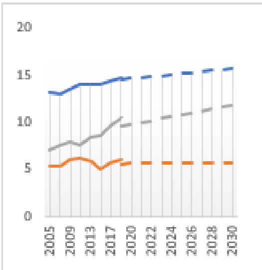


Women

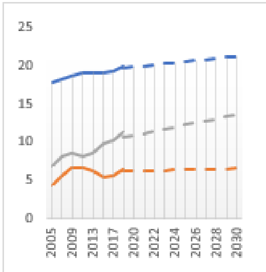


Lithuania

Men

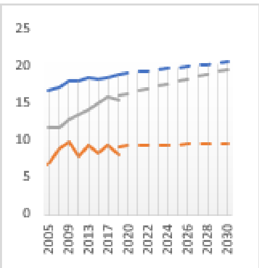


Women

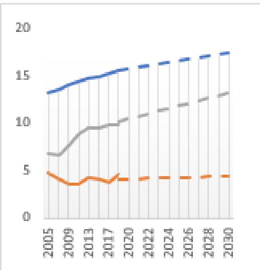


Cyprus

Men

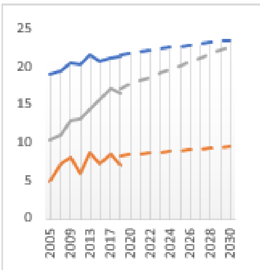


Women

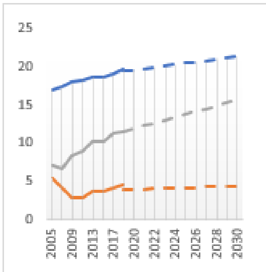


Slovakia

Men

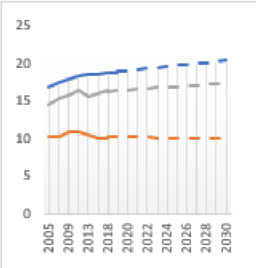


Women

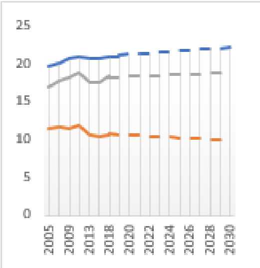


United Kingdom

Men

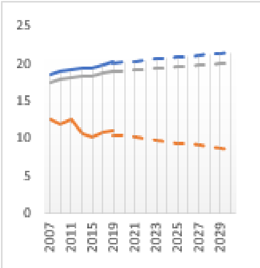


Women

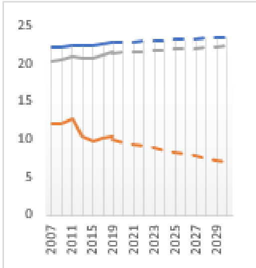


Switzerland

Men

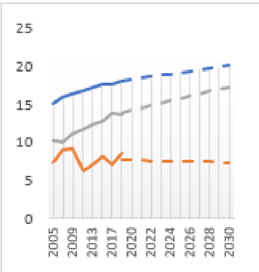


Women

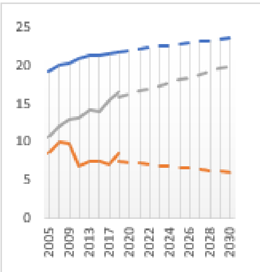


Slovenia

Men

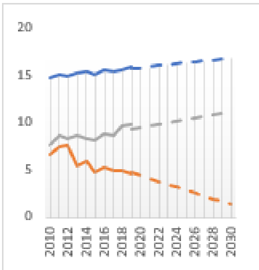


Women

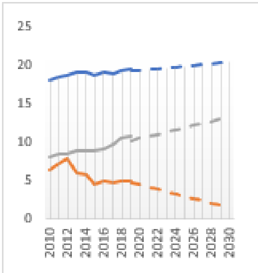


Croatia

Men

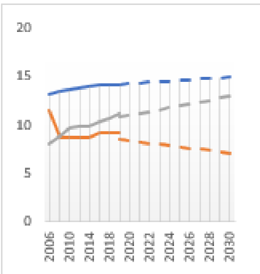


Women



Bulgaria

Men



Women