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Alternative Scenarios for Health, Life Expectancy and Social Expenditure

The Influence of Living Longer in Better Health on Health Care and Pension Expenditures and Government Finances in the EU

Frank Pellikaan and Ed Westerhout

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FRANK PELLIKAAN AND ED WESTERHOUT*

Abstract

This report investigates the effect of population ageing on public health- and long-term care expenditures, public pensions and government finances in EU countries in the projection period 2002-50. The authors specifically consider new insights about the development of demography and health on these projections. In this regard, the view has been expressed that people may live substantially longer in the future than estimated by current demographic projections and may spend part of these additional years in better health. Both developments have obvious implications for the correct projection of public expenditures and finances. To assess the effects of living longer in better health, four core scenarios are developed: a base case and scenarios for living longer, living in better health and living longer in better health.

The analysis also contains a number of new elements. First, it includes the costs incurred during the last years of life in the projections, which will be postponed by an increase in life expectancy. Hence, the calculations in the study correct for the overestimation of future health-care expenditure that arises when no account is made for mortality-related costs. Second, the cost of mortality is disaggregated into a health- and long-term care component, which differs by age. Third, tax revenues are incorporated into the projections for government finances. With this information, the analysis is able to project government finances in the future and assess whether government finances are sustainable under current social policy rules.

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Introduction

AGIR's work package (WP) 4 focuses on the effects of population ageing on public health-care expenditure, public pension expenditure and the sustainability of public finances. It pays particular attention to the role of new insights concerning the relation between living longer and in better health and health consumption, health-care expenditure and pension expenditure. The view that life expectancy may increase further than the standard demographic projections have suggested to date has been argued by Vaupel (1998), Vaupel and Lundström (1996) and Held (2002) among others. Likewise, many authors, including Cutler and Sheiner (2001), Jacobzone et al. (2000) and Thomas (1999), have considered the incidence of declining disability among the elderly and more generally the fact that the health of older persons is improving. If the health of the older population improves further in the future this may lead to a smaller rise in health and pension expenditures than thus far projected. We combine both features to investigate how the ageing process may impact the future development of health and pension expenditures if we take account of these factors.

WP4 builds a bridge between WPs 1, 2 and 3 on the one hand and WPs 5 and 6 on the other. WP4 aims at using the data collected in the first three work packages to make projections for public health and pension expenditures, using different assumptions with respect to demography, health and labour force participation. WPs 5 and 6 will draw upon these scenarios to come up with a discussion of policies that may cope with the population ageing problem.

This report can basically be divided into three parts and is structured as follows. First an overview is presented of other studies and results in this field. We make use of the insights of these studies and also clarify the ways in which the current study differs. Thereafter the structure of the model is explained, and the various data and assumptions underlying the model are presented in chapters 2 and 3 respectively.

In part I, chapter 4, the effect of population ageing on the development of health and pension expenditures in the base case scenario is projected, as well as its impact on the sustainability of government finances. We concentrate only on public expenditures and do not take account of any developments in private expenditures in these categories. These projections are, with the exception of some minor changes in several assumptions, in line with the latest projections of the European Policy Committee (EPC) (2001). We calculate projections for the individual EU countries (as far as data availability allows) and for the EU as a whole.

In part II of the report different scenarios are presented to show how the projections in the base case scenario change when demographic circumstances change and a health trend is incorporated into the model. In chapter 5 we investigate how demography and more specifically an increase in life expectancy influence our base case results. This scenario is labelled the 'living longer scenario'. In chapters 6 and 8 we subsequently incorporate expected health improvements in our scenario, first in the base case scenario and then in the living longer scenario. The scenarios are respectively dubbed the 'living in better health scenario' and the 'living longer in better health scenario'. Chapter 7 presents the results of a scenario that is the opposite of the living in better health scenario, namely the 'living in worse health scenario'. This may illustrate that it is far from easy to tell whether the future will indeed show improvements in the health status of the population. Following Jacobzone et al. (2000), the scenarios allow us to investigate the interplay between population ageing and health improvements on health-care expenditure, where we also focus on the impact of these processes on pension expenditures.

The various scenarios will impact government finances differently. For each scenario, we calculate the correction in primary surpluses (taxes or public spending) that is needed to keep government finances sustainable, the so-called 'sustainability gap', and how this compares to the sustainability gap found in the base case scenario.

In part III of this report we investigate the sensitivity of some crucial determinants underlying our projections, such as the assumptions about the amount of the interest rate, the rate of productivity growth and the development of the labour force participation rate. In chapter 9, we assess the relation between population ageing and its possible effect on the interest rate and the rate of productivity growth, and how the incorporation of a more direct relation between population ageing and these two variables influences our base case results. In chapter 10, we consider some other factors that are likely to influence health-care expenditures and especially focus on the role of medical technological progress in this regard. In this chapter we also investigate how changes in the yearly cost parameters influence health-care expenditures. Finally, in chapter 11 we assess how a possible change in the labour force participation rate affects the base case results and present both a best- and worst-case scenario. The summary and conclusions section highlights the findings presented in the report.

Chapter 1
An Overview of the Literature

The demographic structure of populations will change quite dramatically during the next decades. Indeed, many industrialised countries will see their populations becoming older. The main reasons are the fall in fertility rates, the gradual retirement of the baby-boom generation and the ongoing increase of life expectancies. These factors will have profound effects on the health-care sector, the long-term care sector and on pension schemes. Furthermore, labour market participation is expected to decline, which will have an impact on both tax revenues and social security expenditure. Through all these channels, population ageing may have a huge impact upon the sustainability of public finances.

This report critically examines several arguments that underlie this view. In particular, it focuses on the relevance of the mortality-cost argument (i.e. the fact that expenditure increases very quickly in the last years before mortality) for projections of health-care expenditure. It thereby distinguishes between health care and long-term care. It also explores the relevance of two additional arguments. The first is that life expectancy may increase in the coming decades much more than is recognised by official projections. The second is that the health of the population may improve in the coming decades, as it seems to have improved during the last decennia. To the extent that these arguments are true, they imply that health-care expenditure may rise at a much faster or slower pace in the future than expected thus far.

Public finances may be affected not only through health-care expenditure, but also through other channels. Indeed, life expectancy will significantly impact pension expenditure. Improvements in health status will affect labour market participation rates and thus taxation and expenditure on social security. This paper carefully calculates the effects on public finances through all these channels of the idea that in the future people may live longer and in better health.

1.1 Standard extrapolation method

The method that can be used to calculate the effect of population ageing – called the ‘age-group projection’ method by Getzen (1992) – is fairly standard. It calculates the effect of changes in the age structure of the population under the assumption that in the future the expenditure by age profile will remain unchanged. The procedure is as follows. First, current health-care expenditure per age cohort is decomposed into the expenditure per capita and the size of that age cohort. Second, health-care expenditure at some future date is calculated by multiplying the projected fractions of the population in different age cohorts at that date with historical expenditure per capita in these age cohorts, i.e. the expenditure per capita in these age cohorts that were calculated in the first step of the procedure. The population ageing effect follows from comparing the projected future expenditure with current expenditure.

Many studies have used the standard projection method to project the future rise in medical spending as a result of population ageing (Dang et al., 2001; Economic Policy Committee [EPC], 2001; Jacobzone et al., 2000). Dang et al. conclude that expenditure on health and long-term care for a group of OECD countries may increase from a level of 6% of GDP in 2000 to 9.3% in 2050. This would amount to a population ageing effect of about 55%. The EPC (2001) study focused on the EU area and calculated that the expenditure on health and long-term care may increase from 6.6% of GDP in 2000 to 8.8% in 2050, which implies an increase of 33%. Jacobzone et al. focused on the implications of population ageing for the expenditure on long-term care. In particular, this study examined the hypothesis that the needs of elderly societies for long-term care services may decline, which would result in a smaller increase in expenditure.

Although the age-group projection method is widely applied, it has its weaknesses. In particular, it makes the crucial assumption that health-care expenditure by age profile will remain the same in the future. This assumption may be wrong for a number of reasons. A first reason relates to women giving birth. If population ageing is the result of declining fertility rates, one may expect age profiles to be reduced for those ages at which women give birth (Ahn et al., 2004a). A second argument pertains to the gender imbalance, i.e. the fact that women outlive men on average. Reductions in this gender imbalance – brought about by increases in male life expectancies that outweigh increases in female life expectancies – may expand the possibilities of care-giving at home, thereby diminishing the demand for formal long-term care (Lakdawalla and Philipson, 1999).

The age profile of medical spending may also shift because of economic growth, medical technological progress and health-care sector price inflation. Cutler and Meara (1999) show that the age profile of health-care expenditure by Medicare beneficiaries in the US has grown and argue that this does not reflect changes in their health status. Instead, they find that the disability status of the eldest elderly (85+) is falling more rapidly than that of the youngest elderly (65-85).

What is most relevant in this report is that the age profile may also change in the case of an improvement in the health status of the population or an increase in life expectancy. Indeed, the scenario of living in better health reflects an improvement in the health status of the population, which may imply a downward shift of medical spending by age profile. This shift may be parallel or more specific if the health improvement occurs for particular ages. Next, the scenario of living longer reflects an increase in life expectancy, which may change the age profile of medical spending such that it increases less at middle ages and increases more steeply at higher ages.

1.2 The 'mortality-cost' argument

A major argument against the age-group projection method relates to health spending in the last years of life. There is widespread empirical evidence that medical spending in the last years of life relates to time to mortality (Lubitz and Riley, 1993; Zweifel et al. 1999; Cutler and Meara, 1999). Older persons consume more health care because they are closer to their mortality, not because they are older. It is obvious that this mortality-cost argument may change the predicted effects of population ageing: if population ageing is driven by the increase of life expectancies, one may expect age profiles to go down for those ages at which mortality rates decline.

Zweifel et al. (1999) have stated that health-care expenditure is completely independent of age, not only for individuals in the last years of their lives, but also for those of younger ages. If this is true, health-care expenditure per capita may decline because of population ageing. Most studies find that health-care expenditure per capita increases as mortality approaches, implying that health-care expenditure per capita decreases the longer the time to mortality. Think of ageing as an increase of the average time to mortality since it implies an increase in life expectancy. The effect of ageing would then be to reduce health-care expenditure per capita (Westerhout, 2004). In this implication, the time-to-mortality argument looks very strong. The same holds true for its assumptions, but these are partly unrealistic.

Much more plausible is a weaker form of the time-to-mortality argument, asserting that time to mortality is the major driver of health-care expenditure for persons in the last years of their lives, but that for others the most important explanatory variable is age. The effect of ageing upon health-care expenditure in this weak form of the time-to-mortality approach is ambiguous. Nevertheless, what we do know is that it is less strong than under the standard projection method.

Roos et al. (1987) were probably the first to make projections using this weak version of the time-to-mortality approach. They split the population into those who died within the projection period and those who survived, made separate cost projections for the two population groups and then combined the two into one aggregate projection. Roos et al. calculated that the rate of increase of hospital usage in the 1976-2000 period would have amounted to 64% rather than 73%, which would have applied if the projection had been made using the standard approach. The study by Van Ewijk et al. (2000) study (henceforth called the AIN study) calculated that health-care expenditure growth in the period 1998-2050 would decrease from 53 to 45% if the weak version of the time-to-mortality approach were substituted for the standard approach. The EPC (2001) study compared the standard scenario with a scenario that corrects for mortality costs for three countries, namely Italy, the Netherlands and Sweden. In all three cases, the expenditure projections for 2050 were considerably lower under the mortality-cost corrected method. Serup-Hansen et al. (2002) found that including the mortality-cost argument would lower the projected increase of Danish health-care costs in the period 1995-2020 from 18.5 to 15.1%.

In the following chapter we elaborate more explicitly on the method we use to project future health-care expenditures, taking account of the findings in the previously mentioned studies.

Chapter 2
Structure of the Model and Applied Methodology

We use a relatively simple model to calculate developments in health, pension expenditure and government finances through time. We basically use the same approach that was used by the CPB in the AIN study and by the Ageing Working Group (AWG) among others. The latter group prepared projections for health and pension expenditure until 2050 for the Economic Policy Committee (EPC). Our study basically builds on the insights that were obtained in these studies. It improves upon these projections by taking account of factors such as the relation between health and retirement, the effect of health changes on health-care expenditure and a better split in the composition of health costs by including the cost of mortality. Below we briefly discuss the respective parts of the model.

2.1 Demographics

To simulate demographic changes, total population is decomposed into its three respective arguments: first, net migration, which is immigration minus emigration; second, mortality; and third, fertility. Population in a given year *t* for a certain age *(j)* category can, aside for those that are aged 0,[1] be calculated as the sum of the population in the previous year plus any net migration, $NMIGR$ and mortality, σ that occurred during the year itself. Or

$$POP_{(j+1,t,s)} = POP_{(j,t-1,s)} + NMIGR_{(j+1,t,s)} - \sigma_{(j+1,t,s)} \times POP_{(j,t-1,s)}, \text{ with } 0 \leq j \leq 99 \quad (1)$$

with s representing gender. After reaching age 99 all persons are assumed to die. By changing the mortality rates for specific age categories we are then able to obtain a new demographic scenario, which can either represent an increase in life expectancy, i.e. a reduction in mortality rates, or a decrease in life expectancy, i.e. an increase in mortality rates.

2.2 Health-care expenditures

As outlined in the previous chapter, projections for health-care expenditure in earlier studies were usually based on the standard extrapolation method. By decomposing current health-care expenditures into different age groups one could obtain an average health-care profile by age category. By multiplying this average cost profile by the respective sizes of the population in these age groups total health-care expenditures could be calculated. To calculate health-care expenditures at a future date, the projected fractions of populations by age at that time would be multiplied with the average cost profile by age category. A comparison of projected future expenditure and current expenditure would then give the population ageing effect.

Our method differs in several respects and uses the insights of both the AIN and EPC studies. First, we have average health-care profiles by age category, but include the costs of mortality or the costs incurred during the lasts year of life in our calculations as in the AIN study. For this purpose we distinguish between total health-care costs, composed of health care and long-term care (as in the EPC study), of survivors and non-survivors. Here we define survivors as those persons who live during the whole year and non-survivors as those persons who die during the year. The number of survivors by age category can be calculated as the fraction of people who live during the whole year $(1-\sigma_{(j,t)})$, i.e. 1 minus the age-specific mortality rate that varies by time, multiplied by the size of the population in that age category at that specific time. Likewise

[1] The population at age 0 is equal to the respective number of births in that year.

the number of non-survivors can be calculated as the fraction of those persons who die during the year in a specific age category $\sigma_{(j,t)}$ (the age-specific mortality rate) multiplied by the size of the population in the specific age category at that time. Second, we decompose the cost of death *D* into a health-care and long-term care component that differs by age. This follows the reasoning that the split of the cost of mortality into health care and long-term care is different for someone who is for example aged 35 compared with a person who is aged 65.

Table 2.1 shows the division we adhere to in our projections for D,[2] which is based on findings by the Dutch WRR (1997).[3] The cost of mortality is defined here as the total health-care costs during the last four years of life. The division into health- and long-term care components can easily be made by grouping the various types of expenditures in the mentioned categories. The observed pattern of the cost of mortality by age and the respective health-care component also corresponds with the general findings of Roos et al. (1987) and Spillman and Lubitz (2000).

Table 2.1. Division of costs of mortality by age category over health- and long-term care components (%)

Age	Health care (ε_j)	Long-term care $(1-\varepsilon_j)$
0-54	100	0
55-64	93	7
65-69	91	9
70-74	88	12
75-79	79	21
80-84	67	33
85-89	57	43
90+	44	56

Source: WRR (1997).

At young ages (0-54) the cost of mortality is thus in its total made up of health-care costs, while at higher ages a larger part of the cost of mortality is made up of long-term care costs.

The health-care profile of a cohort of a certain age T_j can thus be constructed as follows:

$$T_{(j,t,k)} = (1-\sigma_{(j,t)}) \times U_{(j,t,k)} + \sigma_{(j,t)} \times D_{(j,t,k)}$$

$$\text{with: } U_{(j,t,k)} = U_{(j,0,k)} \times (1+g)^t \;,\; D_{(j,t,k)} = D_{(j,0,k)} \times (1+g)^t \text{ and } k \in (H,L) \qquad (2)$$

$$D_{(j,0,H)} = \varepsilon_j \times D_{(j,0)} \,,\quad D_{(j,0,L)} = (1-\varepsilon_j) \times D_{(j,0)}$$

where U is the average health-care profile for survivors, H and L represent the health-care and long-term components and g is the constant yearly labour productivity growth. It is thus the sum of the respective cost of survivors and non-survivors multiplied by their respective weights, i.e. the survival and mortality fractions.

[2] In chapter 4 we elaborate on the method we use in constructing the cost of death *D* by age category.

[3] As the WRR did not investigate the structure of the cost of mortality for persons younger than age 55, we made an assumption about this structure for those aged 0-54. Owing to the relatively small share of long-term care in the costs of mortality for those aged 55-64, we therefore assumed this to be zero for persons aged even younger.

To calibrate the model we use information from the EPC study on $T_{j,k}$. Using this information we can calculate adjusted health-care cost profiles for survivors[4] by subtracting the costs of mortality at a specific age category from the respective health-care component from which the cost of mortality is made up. The adjusted health-care profile for survivors is thus calibrated as follows:

$$U_{(j,0,H)} = \frac{(T_{H_j} - \sigma_{(j,t)} \times D_{H_j})}{(1-\sigma_{(j,t)})} \quad U_{(j,0,L)} = \frac{(T_{L_j} - \sigma_{(j,t)} \times D_{L_j})}{(1-\sigma_{(j,t)})} \tag{3}$$

If we multiply the health-care profiles for survivors and the health-care profile of non-survivors by age category with the respective size of the population in these age categories we ultimately obtain total health-care costs by specific age category. If we sum this up over all ages total health-care costs are obtained, which can be expressed as:

$$HCEXP_{(t)} = \sum_j T_{(j,t,H)} \times POP_{(j,t)} \quad LTCEXP_{(t)} = \sum_j T_{(j,t,L)} \times POP_{(j,t)} \tag{4}$$

$$THCEXP_{(t)} = HCEXP_{(t)} + LTCEXP_{(t)}$$

Total health-care expenditures in time thus vary because of both mortality changes and the associated population changes.

2.3 Pension expenditures

Pension expenditures are calculated in a straightforward manner. In the base year the aggregate amount of public replacement revenues[5] for persons aged 55 and above is divided over all individuals, men and women, who are eligible for these arrangements. From this we obtain average pension expenditure or benefit per person or those eligible. The average pension benefit will be held constant through time and only increases with yearly indexation β, which may differ across EU countries. The development of pension expenditures by age category until 2050 can then be calculated by multiplying the average pension benefit per person PB by the number of persons who are eligible for a pension in each respective year, E, or:

$$PEXP_{(j,t,s)} = PB_{(t)} \times E_{(j,t,s)}$$

$$\text{with } PB_{(t)} = PB_{(0)} \times (1+\beta g)^t \quad E_{(j,t,s)} = POP_{(j,t,s)} \times (1-LFP_{(j,t,s)}) \tag{5}$$

$$\text{for } 55 \le j \le 64 \text{ and } E_{(j,t,s)} = POP_{(j,t,s)} \text{ for } j \ge 65$$

Total pension expenditures can then be obtained by summing up expenditures over age and gender categories or:

$$TPEXP_{(t)} = \sum_j \sum_s PEXP_{(j,t,s)} \tag{6}$$

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[4] The initial health-care profiles for health and long-term care comprise total health-care costs and make no division between the cost of survivors and non-survivors. Since we construct separate profiles for survivors and non-survivors, the costs of the latter have to be subtracted from the initial health-care profiles to obtain an adjusted health-care profile for survivors.

[5] These expenditures include outlays on disability benefits, unemployment benefits, early retirement benefits and public pensions. Expenditures on public pensions comprise the largest part of these expenditures.

The number of persons eligible for pension benefits changes every year owing to both labour market developments, $LFP_{(j,t)}$, which differ by sex s and changing demographic circumstances captured by $POP_{(j,t)}$. An increase in the labour force participation of women aged 55 and over for example will lead to a decline in the number of women who make use of social security services and will lead to a decline in the number of persons who are eligible. Changes in demography can either lead to an increase or decrease in the number of persons in specific age categories with different impacts on the number of persons who are eligible for benefits. In calculating pension expenditures no account is taken of any policy changes that could influence the eligibility or rules of pension systems. We thus assume a policy-neutral environment.

2.4 Relation between a change in health status and labour force participation

The change in labour force participation resulting from a change in health is given by the following equation:

$$\Delta LFP_{health(j,t,s)} = \frac{ER_{(j,s)} + DI_{(j,s)}}{OUTFLOW_{(j,s)}} \times \frac{OUTFLOW_{(j,s)}}{LFP_{(j,t,s)}} \times \theta_{(j,t,s)} \times \varepsilon_{oh}$$

$$= \mu \times \theta \times \varepsilon_{oh}$$

$$with \quad \theta_{(j,t,s)} = \frac{HEALTH_{(j,t,s)} - HEALTH_{(j,t-1,s)}}{HEALTH} \qquad (7)$$

$$\overset{\wedge}{LFP} = LFP \times [1 + \mu \times \varepsilon_{oh}]$$

$$\text{with } 20 \le j \le 64$$

with ER, DI and $OUTFLOW$ respectively presenting early retirement, disability inflow and the yearly outflow from the labour market. The first two terms on the right-hand side of the equation reflect the number of persons who exit the labour force each year by respective age and gender and whose decision to do so may be altered if their health improves, for convenience of notation we shall term this μ. It thus presents the potential number of persons who might be influenced by any health change. As can be gauged from the first term, we implicitly make the assumption here that only those who make use of early retirement or disability schemes are likely to change their exit decision if their health improves, i.e. individuals who make use of unemployment schemes will not be affected by any health changes.[6] The third term on the right hand side of the equation represents the average health change that occurs in the respective year by respective age and gender as given by θ. The fourth term represents the elasticity ε_{oh} guiding the relation between the number of individuals who exit the labour force and health, which is the same for all age categories and for both genders. The respective change in labour force participation resulting from a change in health can then be used to correct for the number of persons who are eligible for pension expenditures at ages 55 to 64. Pension expenditures can then be written as:

$$PEXP_{(j,t,s)} = PB_{(t)} \times E_{(j,t,s)} \times (1 - \mu_{(j,t,s)} \times \theta_{(j,t,s)} \times \varepsilon_{oh}), \text{ for } 55 \le j \le 64 \qquad (8)$$

[6] In some countries, however, persons with health problems also use unemployment schemes as an alternative exit route, which is for example the case in the Netherlands. We will nevertheless assume that the majority of persons with health problems use the disability schemes and therefore disregard any influence of health changes on unemployment exits.

That is, an improvement in health will lead to more labour force participation captured by the term between brackets and reduce the number of persons receiving pension benefits E .

2.5 Relation between health changes and health-care expenditures

The relation between health changes and health-care expenditure can be calculated in a similar manner as the relation between health and labour force participation. It can be expressed as:

$$\hat{THCEXP}_{(t,k)} = THCEXP_{(t,k)} \times [1 - \varepsilon_{hh} \times \theta_{(j,t,s)}] \quad (9)$$

The first term is equal to total health-care expenditures as calculated before. This term is however multiplied by a factor to take account of any health improvements occurring in the respective year. This latter term is equal to one minus the product of the respective health change in the respective year θ with the respective elasticity ε_{hh} representing the relation between health and health-care expenditures. This elasticity differs between broad age groups. In the scenarios where no health improvements take place θ is 0 and health-care expenditures are calculated as before.

2.6 Government finances

To calculate the impact of population ageing on government finances we have to make assumptions on how government revenues and expenditures are likely to develop in the future. Starting first with the revenue side, total government revenues $TOTREV$ are divided into three categories, i.e. direct tax revenues $DTREV$, indirect tax revenues $ITREV$ and other revenues $OTREV$ (including such items as corporate taxes, profits on land sale, seignorage and so on). Direct tax revenues and other revenues are assumed to grow at the same rate as GDP, as these revenue categories are closely related to changes in economic growth. Indirect tax revenues, however, are more related to the level of consumption, which is better reflected by changes in population. The indirect taxes are therefore related to population changes. We thus have:

$$DTREV_t = DTREV_{(0)} \times (1+g)^t ,$$

$$ITREV_t = ITREV_{(t-1)} \times (1+p+g) \quad (10)$$

$$OTHREV_t = OTREV_{(0)} \times (1+g)^t$$

$$\text{and } TOTREV_t = DTREV_t + ITREV_t + OTHREV_t$$

with g and p respectively representing economic growth and population growth.

On the expenditure side, total expenditures $TOTEXP$ are divided into seven different expenditure categories. These are health-care expenditures $THCEXP$, pension expenditures $TPEXP$, expenditures on disability benefits $DBEXP$, expenditures on other social security benefits, $SSEXP$ (a mixture of unemployment, sickness and other social transfers, etc.), other expenditures $OTHEXP$ (including expenditures on infrastructure, defence and so on), education expenditures $EDEXP$ and finally expenditures on interest payments I . Health-care expenditures develop according to the equation described in chapter 3 (under the heading of relation between health and health-care expenditures section) where θ has the value of 0 if no health improvement takes place. Pension expenditures develop as described in chapter 3 (under this heading). Expenditures on disability benefits rise in line with economic growth and are also related to labour force participation changes. Other social security benefits and other expenditures rise in line with economic growth. Education expenditures rise in line with economic growth and are also related to changes in the number of young persons, i.e. those aged 5-24. Interest payments are calculated by multiplying the nominal interest rate with the debt level. We thus have:

$$THCEXP_{(t,k)} = \sum_j \left[T_{(j,t,k)} \times POP_{(j,t)}\right] \times \left[1 - \varepsilon_{hh} \times \theta_{(j,t,k,s)}\right]$$

$$TPEXP_{(t)} = \sum_j \sum_s PEXP_{(j,t,s)} \times (1 - \mu_{(j,t,s)} \times \theta_{(j,t,s)} \times \varepsilon_{oh}), \text{ for } 55 \le j \le 64$$

$$TPEXP_{(t)} = \sum_j \sum_s PEXP_{(j,t,s)}, \text{ for } 65 \le j$$

$$DBEXP_t = DBEXP_{(t-1)} \times (1+g) \times \frac{LFP_t}{LFP_{(t-1)}}$$

$$SSEXP_t = SSEXP_{(t-1)} \times (1+g), \qquad (11)$$

$$OTHEXP_t = OTHEXP_{(t-1)} \times (1+g)$$

$$EDEXP_t = EDEXP_{(t-1)} \times (1+g) \times \frac{POP_{t_{5-24}}}{POP_{(t-1)_{5-24}}}$$

$$I_t = r_t \times B_{(t-1)}$$

$$TOTEXP_t = THCEXP_t + TPEXP_t + DBEXP_t + SSEXP_t + OTHEXP_t + EDEXP_t + I_t$$

From the development in government revenues and expenditures the development in the government deficit DEF, the primary deficit pt and the debt B can be deducted in the usual manner:

$$DEF_t = TOTEXP_t - TOTREV_t$$

$$pt_t = DEF_t - I_t \qquad (12)$$

$$B_t = B_{(t-1)} + DEF_t$$

As we are interested in the impact of population ageing on government finances and specifically on the sustainability of government finances under current social policy rules, we construct a measure that expresses this sustainability – the so-called 'sustainability gap'.[7] This sustainability gap measures the difference between the tax level in the starting year of the projection and the tax level in that year that is needed to cover future public expenditure if government policy remains unchanged. A positive sustainability gap indicates the need to raise taxes to absorb an increase in debt levels during and at the end of the projection period. The opposite holds for a negative sustainability gap.

[7] This measure was also used in the EPC (2001) study *Budgetary Challenges Posed by Ageing Populations*. For a detailed exposition on the way this variable is constructed see annex 6 in that report.

The sustainability gap for government finances of European Union countries under the prevailing social policies can therefore be calculated in the following manner:

$$t_{g0} = (r_t - g) \times \left[B_0 + \sum_{t=1}^{46} pt_t \times \frac{1}{(1+r_t)^t} + pt_{46} \times \frac{1}{(1+r_t)^{46}} \times \frac{1}{(r-g)} \right] \tag{13}$$

where t_{g0} is the sustainability gap at time 0, r is the nominal interest rate, g the rate of nominal growth, B_0 is the original debt position and pt_t is the primary deficit at period t. The second term in the bracket represents the present value of the primary deficit until 2050, where the beginning of our projection period is set at 2004. The third term presents the present value of the period from 2050, to say infinity, to take account of the development in the primary deficit after 2050. From 2050 we assume that demographic and economic developments have stabilised and the economy and population grow at constant rates. This justifies the use of a constant interest rate and rate of productivity growth to calculate the present value of the primary deficits in the period after 2050.

Chapter 3
Demography and Data

In this chapter we first briefly consider the demographic developments in Europe in the period until 2050 and then explore the data and methodology that is used in our projections in more detail.

3.1 Demographic developments in the EU

In this section we describe some of the demographic developments awaiting the EU in the next 50 years. First the ageing of the population, caused both by an increase in life expectancy and the retirement of the baby boom generation, will lead to a substantial increase in the number of elderly persons in the population of the EU. Second, the fertility rate is expected to decline, leading to fewer births and this will put pressure on the growth capacities of economies in the future as the labour supply will decline. Third, the above-described developments will lead to a decline in the working-age population, which reduces the capacity to pay for the increase in expenditures associated with ageing, specifically those of health care and pensions. This is because most of these expenditures are financed on a pay-as-you-go (PAYG) basis in EU countries and thus have to be financed by the working-age population at that time. Below we briefly consider each of these developments.

Old-age dependency ratio

Figure 3.1 shows the development of the old-age dependency ratio in the EU, where it is defined as the ratio of elderly persons (65 and over) to the working-age population (20-64).[1] For all countries of the EU this ratio will increase substantially, but the differences across countries are marked. The countries that will see the largest rise in the number of elderly persons are Spain, Italy, Greece and Austria, which will see their old-age dependency ratio increase by 39%, 38%, 31% and 30% respectively. On the other hand the old-age dependency ratio in countries such as Sweden, the Netherlands, Denmark and Luxembourg compares favourably with the average trend seen in the other EU countries, with respective increases of 16%, 17%, 18% and 18%. In all countries it is the case that the old-age dependency ratio for men increases more sharply than for women, owing to the expected larger increase in life expectancy for men compared with women in the period up to 2050.

Youth dependency ratio

The development of the youth dependency ratio can be seen in Figure 3.2, where this ratio is defined as the ratio of young persons (aged 0-19) to the working-age population (aged 20-64). In most EU countries this ratio declines although usually by small margins. The decline is strongest in Ireland and Austria, with respective decreases of 12% and 5%.

[1] The old-age dependency ratio is also often expressed as the ratio of the population aged 65 and over to the population aged 15 and 64. The OECD (2004) has recently introduced an alternative definition for the working-age population to take account of the fact that many people aged 65 and over are still working and should therefore not be counted as dependent. The old-age dependency ratio should thus be defined as the ratio of inactive individuals aged 65 and over to the total labour force aged 15 and over. The new definition would lead to higher old-age dependency ratios, as it is measured over a larger total labour force.

Figure 3.1 The development of the old-age dependency ratio in the EU

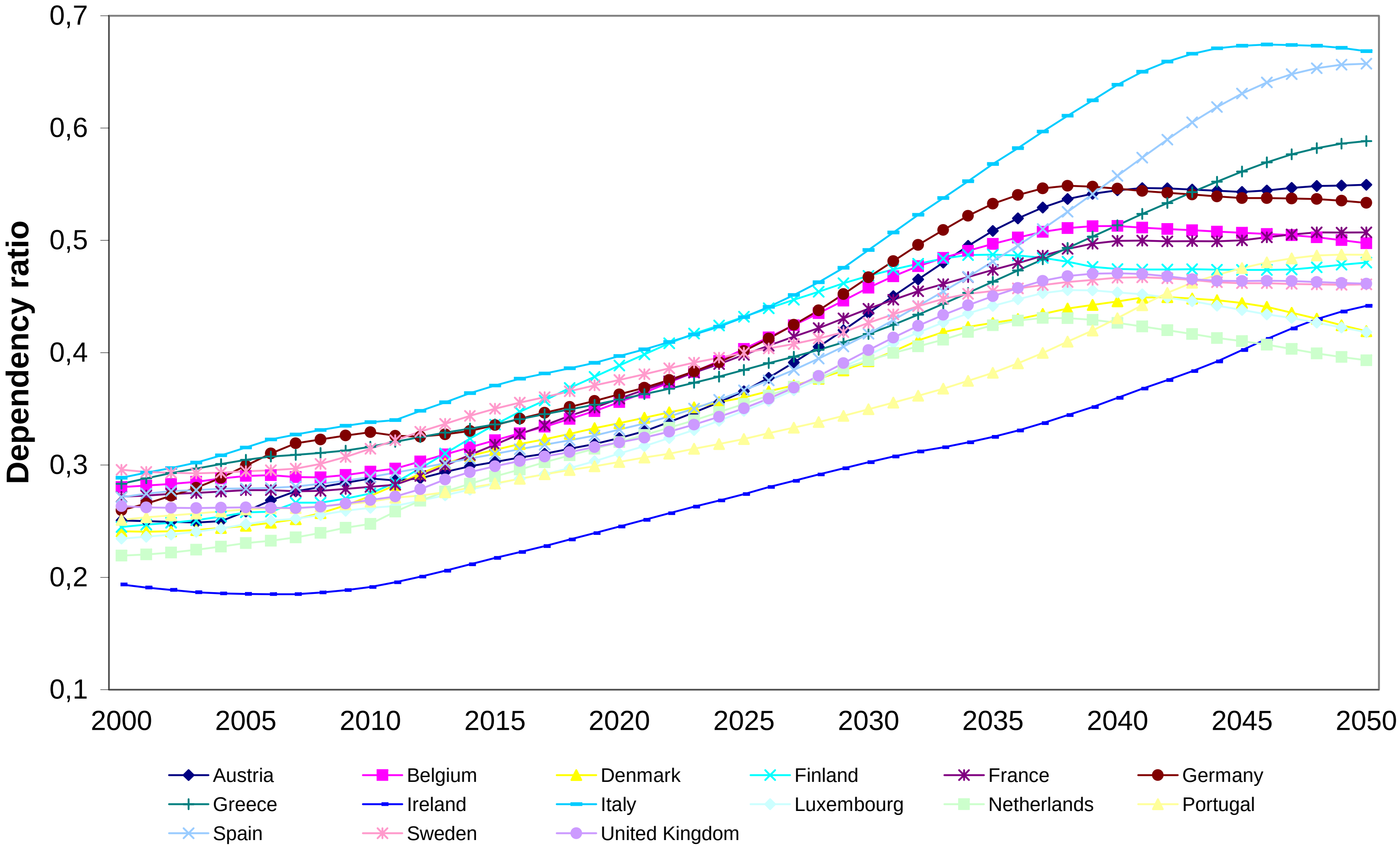


Figure 3.2 The development of the youth dependency ratio in the EU

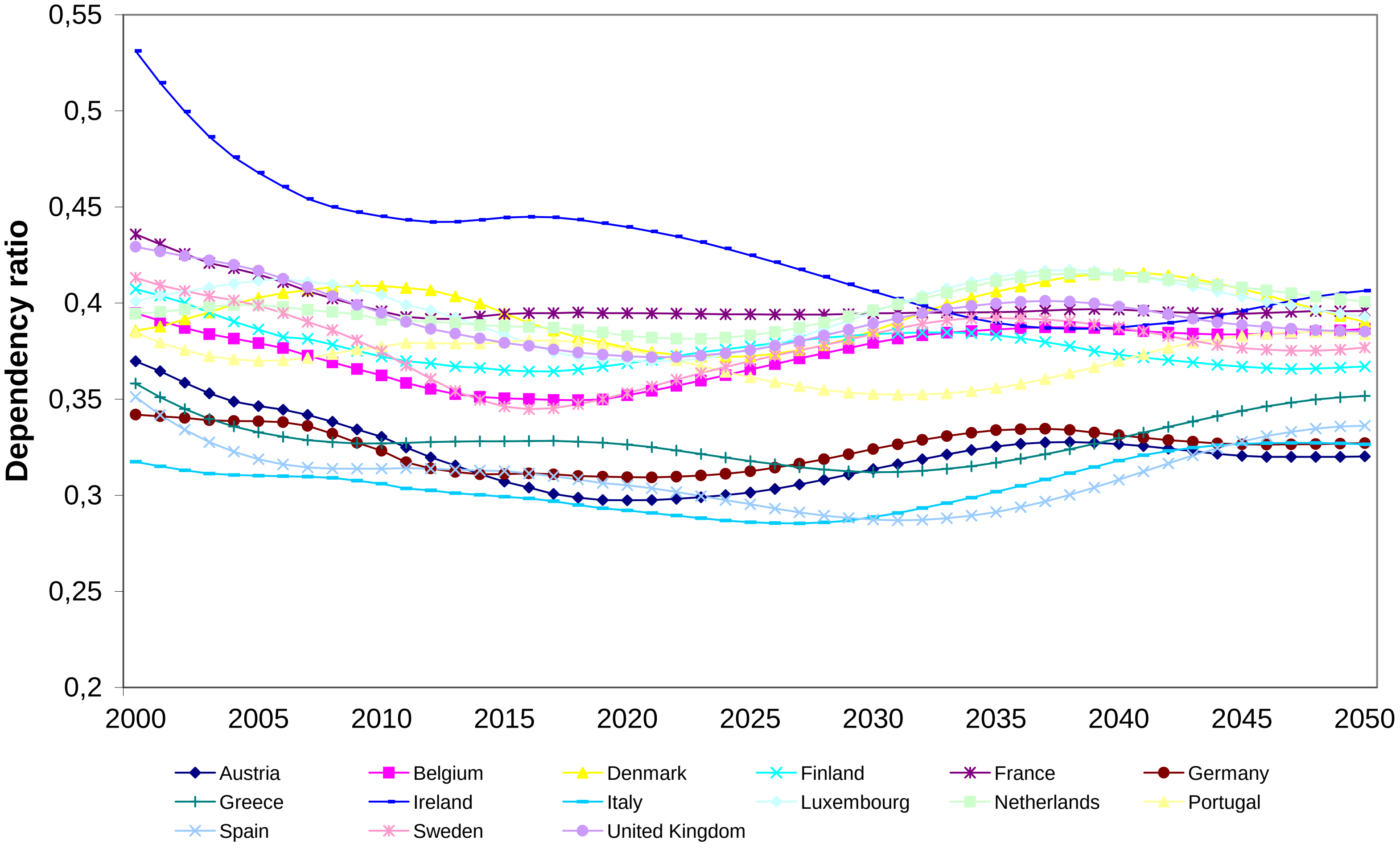
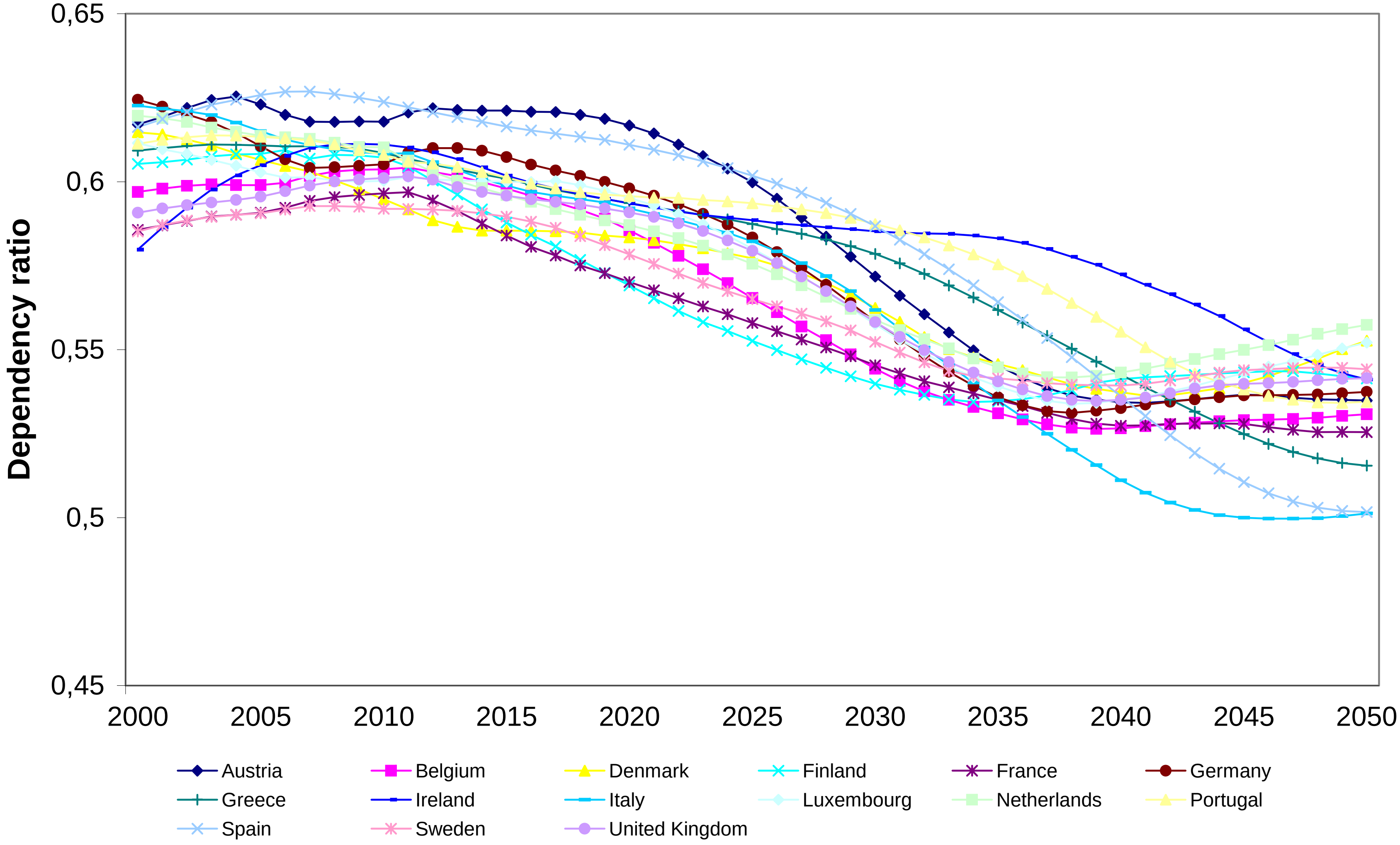


Figure 3.3 The development of the working-age population in the EU



In several countries the youth dependency ratio is expected to increase, which is the case for Italy and the Netherlands, although the increase is very small at 1%. The youth dependency ratio will stabilise in Denmark and Portugal. As the working-age population has to pay for both the young and the old, the overall impact of the demographic changes on the number of elderly and young persons indicates that the financial burden on the working-age population will increase significantly as the increase in the number elderly persons is far larger than the decrease in the number of young persons.

Working-age population

Figure 3.3 shows the development of the working-age population, defined as the number of people at working age (20-64) to the total population (aged 0-99). As can be concluded from the figure, this ratio will decline in all EU countries. Especially Italy and Spain will see their workforce decline at a relatively high rate. In 2050 their workforces will have declined by 12% and 11% respectively. The other countries can be distinguished in two groups: those that will face relatively high or low declines in their working-age population compared with the EU average. The former group includes Austria, Belgium, Finland, Germany, Greece and Portugal. The latter group includes Denmark, France, Ireland, Luxembourg, the Netherlands, Sweden and the UK; obviously these countries are better situated to face the challenges of population ageing than the first group.

3.2 Data

Demography

Population, mortality, migration and fertility figures were based on Eurostat 2000 data, the central variant, and are presented in the appendix. These figures are projected until the year 2050 by specific age category, i.e. age 0 to 90+. Because of the importance we attach to the oldest group in accurately determining the development of the use of health-care services and thereby expenditures, a further split in the oldest age group, i.e. 90+ was needed. In the appendix a description is given of the methodology that was used to obtain this desired split.

Table 3.1 shows the development of the mortality rates for four broad age groups in the period between 2002 and 2050. As one can see, the decline in mortality rates differs widely between EU countries when looking at a specific age group. The expected declines become smaller as age increases but are still quite substantial for the oldest old.

Table 3.1 Decline in mortality rates for four age categories to 2050

	0-64	65-79	80-89	90+
Austria	49%	45%	33%	26%
Belgium	45%	42%	28%	19%
Denmark	41%	38%	23%	7%
Finland	46%	42%	28%	18%
France	43%	40%	28%	12%
Germany	44%	39%	27%	15%
Greece	43%	41%	30%	22%
Ireland	44%	43%	29%	13%
Italy	44%	41%	30%	18%
Luxembourg	48%	42%	27%	0%
Netherlands	24%	29%	17%	7%
Portugal	47%	45%	31%	10%
Spain	34%	32%	21%	10%
Sweden	45%	43%	28%	8%
United Kingdom	45%	42%	29%	27%

Source: Eurostat (2000).

Health-care profiles

The age profiles for public health-care expenditure and long-term care expenditure were taken from the EPC (2001) study, which gives these age profiles for five-year age cohorts as a share of GDP per capita for most EU countries.[1] The first type of expenditures refers to the costs associated with cure activities and the latter to the costs associated with care activities or the costs that are required to help persons perform the essential tasks of living, which may be hampered through disability or other chronic illnesses.[2] These five-year age averages were divided to the respective age groups within those five years on an equal basis to obtain age profiles by age category.

As we do not have information on the age profiles of health-care expenditure and long-term care expenditure for every EU country, but for some countries we do have information on the aggregate figure spent on these components, we make some simplifying assumptions to construct age profiles for these countries. Since we do not have any information on health-care expenditures for Luxembourg, even on an aggregate level, we are not able to perform projections for this country and leave it out of the exercise. From the EPC study we have data by age profile on health-care expenditure for Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden and the UK. Aggregate figures are available for Greece, Ireland and Portugal. To construct age profiles for these countries we use the average age profile of the 11 EU countries for which we do have information and apply this profile to the three countries mentioned. If we multiply the age profiles (0-4 to 95+) for each respective age category with the associated population figures, total health-care expenditures can be derived. The age profiles are then corrected by a factor if the total health-care expenditures calculated in this way deviate from the original figures to resemble the original total health-care expenditures.

For long-term care we apply the same procedure to construct age profiles for the countries for which we have aggregate information but no age profiles. In this case we use the age profiles we have on long-term care for Austria, Belgium, Denmark, Finland, Italy, the Netherlands and Sweden to construct age profiles for France, Ireland and the UK. For Germany we prefer to use the figures provided by the DIW (the German partner in the AGIR project). These figures were constructed to closely match the definitions for health and long-term care costs as postulated by the EPC for this purpose.

Figures 3.4 and 3.5 show the age profiles of health and long-term care for the EU countries for which we have information. As can be expected, both categories of costs rise with age. We can see that the difference between countries can become quite large, especially at higher ages. While health-care costs rise gradually with age, the increase in long-term care costs is very steep after the age of 75. This can be explained by the fact that at that age people start to consume long-term care services on a large scale, such as nursing home services. As age increases from there onwards it will become more likely that individuals need more institutionalised care in a rapid manner.

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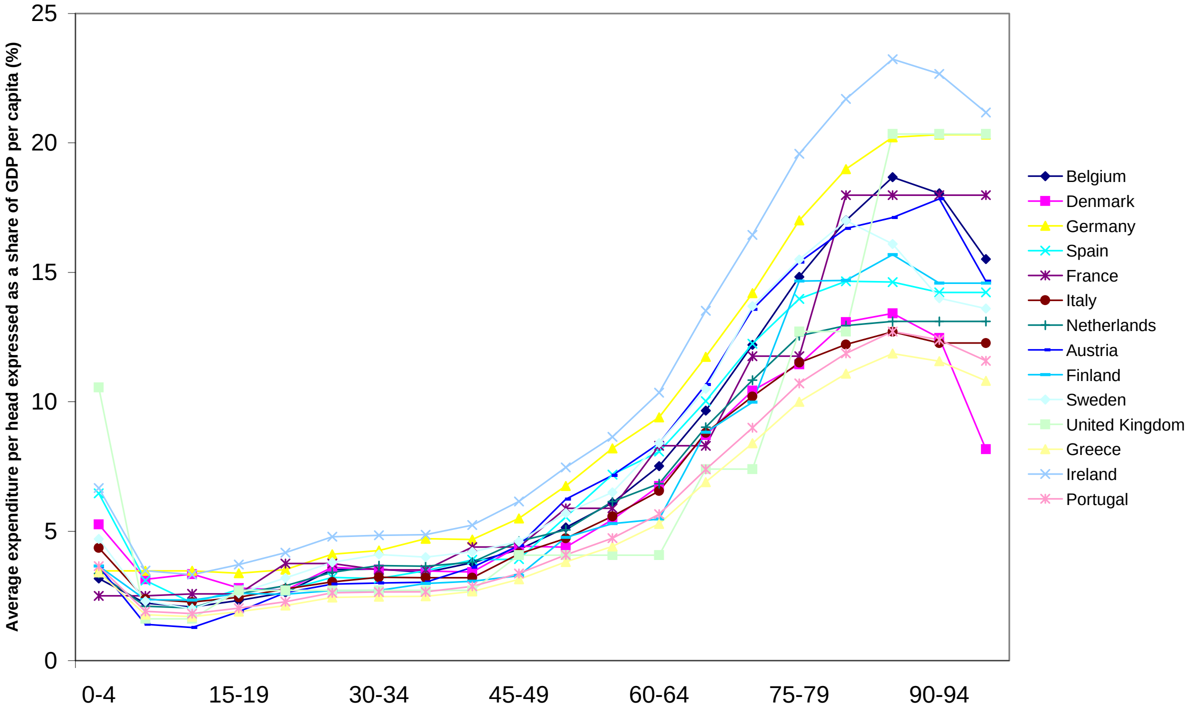
[1] The authors would like to thank Declan Costello of the EPC for supplying this information.

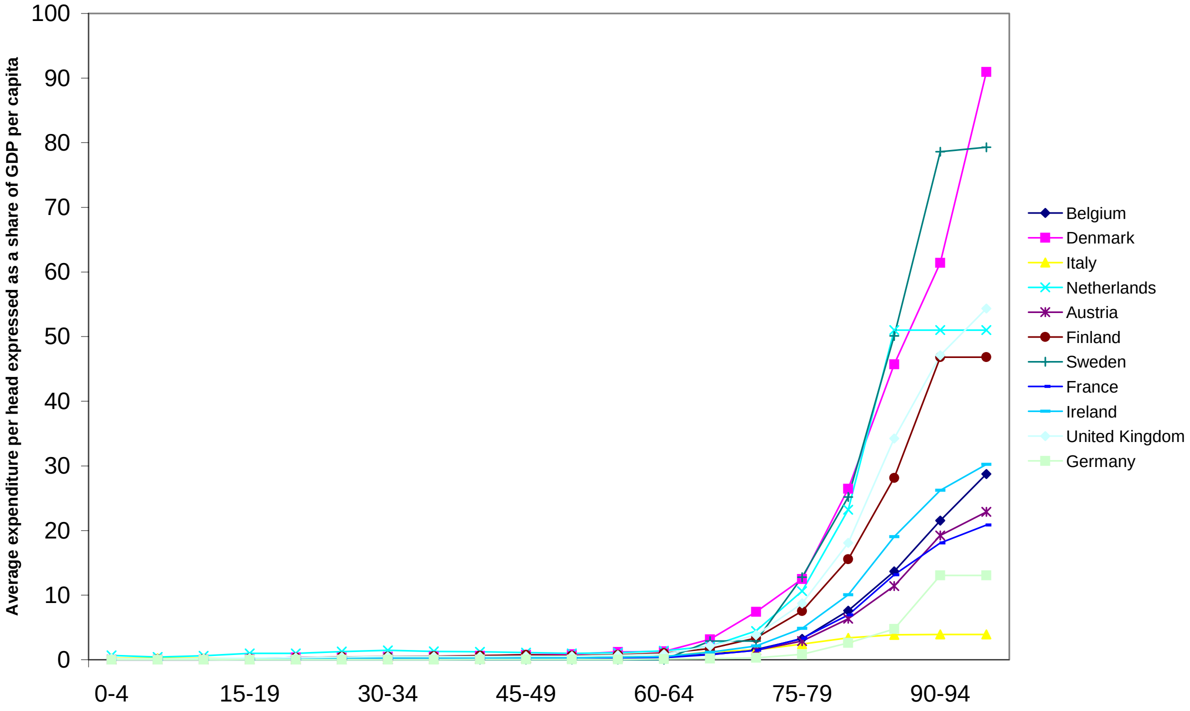
[2] For a precise definition of the kinds of services that belong to either health or long-term care, see the EPC (2001) report, annex 4.

Figure 3.4 Health-care expenditures by age profile



Sources: EPC figures, DIW for Germany, own calculations (see text).

Figure 3.5 Long-term care expenditures by age profile



Sources: EPC figures, DIW for Germany, own calculations (see text).

Cost of mortality, or total health-care costs during the last year of life

As reported in chapter 1, the inclusion of the cost of mortality either in a strong or weak form significantly influences the projection of health-care expenditures. The exclusion of these costs would lead to an overestimation of health-care costs if life expectancy and thus time remaining to mortality improves. Health-care profiles thus have to be adjusted correctly to take account of changing mortality rates, as was done in chapter 2. In that chapter, however, we did not pay explicit attention to how these costs of mortality were constructed, which we turn to now.

The studies mentioned in chapter 1 have either used hospital or insurance records to calculate the level of mortality costs by specific age category and sometimes by gender and race. In general these figures are expressed in either $USD figures or as a percentage of total budget expenditures. Owing to the difficulty of relating the precise outcomes in these studies to the health-care profiles we have,[3] as shown in Figures 3.4 and 3.5, we use the general implications that follow from these studies. Below we discuss some of the studies that have investigated patterns in the cost of mortality, usually both by age and specific expenditure category.

Serup Hansen et al. (2002) for example have investigated the difference in the costs of health care for survivors and non-survivors in Denmark for all ages, for both primary health-care services and hospital inpatient services. Owing to data limitations they did not include long-term care costs. They found that the costs of non-survivors, i.e. the costs of mortality, are substantially higher than for survivors for both health-care categories, although the differences are more marked for inpatient services. Moreover, they find that these costs decline with age and are highest at very young ages. Specifically, at young ages they find a large difference between the costs of survivors and non-survivors. At higher ages the average expenditures of both survivors and non-survivors are very similar. One possible reason they offer for these results regarding inpatient services is that individuals at younger ages may receive higher priority relative to older age groups, thus pushing down average expenditures by age category.

Levinsky et al. (2001) find similar evidence that health-care expenditure for decedents declines with age in an American study for California and Massachusetts. Their study embodies all kinds of Medicare expenditures for persons aged 65 and over. For example, they find that while the expenditures of non-survivors during the last years of life is on average $35,300 for those aged 65-74, it is lower for older age groups – $30,900 for those aged 75-84 and $22,000 for persons aged 85 and older. They do not, however, relate the amount of these costs to those of survivors in these age groups and do not include long-term care costs in their analysis.

Roos et al. (1987), in one of the earliest studies focusing on the importance of the cost of mortality when projecting future health-care expenditure, explore the difference in health costs between survivors and non-survivors during the last four years of life. They include hospital usage, nursing home usage and visits to physicians in their study of Manitoba in Canada. Not only do they find a significant difference in health-care usage between survivors and non-survivors, which increases as the time span until mortality becomes shorter, they also find that total health-care costs among decedents increase with age. This can be mainly attributed to the increase in mean days of residence in nursing homes, which increases rapidly with age. They find for example that while male decedents aged 45-64 stayed on average 7.2 days in nursing homes during the last year of their life, men aged 85 years and older stay on average 110.8 days. Similar results were found with regard to women. Overall, they find that the costs in the last

[3] This difficulty is among other reasons caused by the specific health-care and long-term care services investigated in the various studies, which do not match the composition of health-care and long-term care services incorporated in our EPC profiles.

four years of life of those aged 85 years and older are approximately 31% higher than those of individuals aged 75 to 84 and 79% higher than those of individuals aged 65 to 74.

Spillman and Lubitz (2000) analyse expenditures in the last two years of life for Medicare services as well as nursing home care and a variety of other services in a broader study on the effect of longevity on spending for acute and long-term care. They find the same decline in expenditures of health care with age, measured from age 65 to 100, as in Levinsky et al. (2001) and Serup Hansen et al. (2002), but like Roos et al. (1987) they also find a steep increase in nursing home care with age. On balance the rise in these long-term care costs outweighs the decline in Medicare services and leads to an upward trend in total health-care cost with age. Their study does not relate these figures to those of survivors at these ages and also only concentrates on those persons aged 65 and over.

From these studies it can be concluded that the cost of mortality can best be portrayed as a kind of u-shaped curve if related to age. At young ages the costs of mortality are relatively high owing to expensive high-tech medical treatments that are at that age usually used in order to save a young person’s life. From a certain age these costs then gradually decline. At higher ages, however, long-term care costs become important during the last years of life and result in an upward rise in total mortality costs by age.

As previously mentioned, we do not know the exact age profiles for the costs pertaining to non-survivors for the different EU countries and how these relate to the health-care profiles we do have, so our procedure is as follows. To obtain comparable results across countries, we follow a standard approach for each EU country. First we divide total population into four broad age groups, those aged 0-34, 35-64, 65-84 and 85+, to reflect the young, the middle-aged, the old and the oldest-old age categories respectively. The cost of mortality will differ between these four age groups but is the same within an age group. Second, we assume a constant cost of mortality as a benchmark that equals the highest average total cost of health and long-term care, i.e. those of a person aged 95 and older as can be seen in Figures 3.4 and 3.5. We then at least know that the cost of non-survivors will be higher than the cost of survivors for all age groups under 95 as total health costs increase with age and reach their maximum at age 95. To reflect the difference in the average mortality cost between ages we then multiply this benchmark cost by different factors to obtain a sort of u-shaped curve. In appendix A.3 we test the sensitivity of the assumption embodied in this chosen approach by using either lower or higher mortality costs for certain age categories.

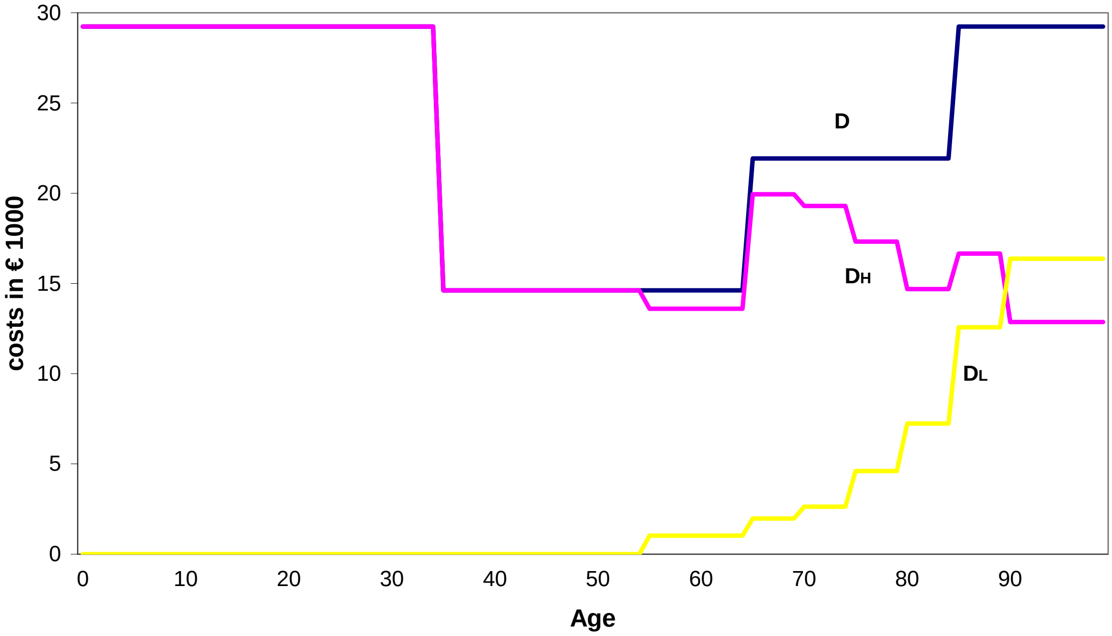
In our projections we now assume that the costs of mortality for the 0-34 age group equals twice the amount of our benchmark cost of mortality (that is the average health-care costs for a person aged 95), for those aged 35-64 it is equal to the benchmark, for those aged 65-84 it is one and a half times that amount and for those aged 85 and older it is twice that amount. This approach obviously has its shortcomings in that it may not adequately represent the real mortality costs; however, we prefer to include some measure of mortality costs in our model rather than none at all. Nevertheless, further investigation about the difference in mortality costs by age and, especially at ages under 65, specific country and specific composition in health-care and long-term care components seems warranted.

Various studies have found the costs of mortality to be relatively constant through time when corrected for any yearly cost increases[4] so we also assume them to be constant. A change in mortality costs affects health-care expenditures.

[4] See Lubitz and Riley (1993).

As the costs of mortality or the costs incurred during the last years of life consist of both health- and long-term care expenditures and the composition of total expenditures in both categories varies by age, the costs of mortality will be subtracted from these respective components by different percentages at different ages as explained in chapter 2. We use the division made in Table 2.1 for every EU country. Thus at age 65-69, the mortality costs are subtracted by 91% from the health-care costs and by 9% from the long-term care costs. As can be seen, at older ages a large part of the costs of mortality is subtracted from the average long-term care costs of an individual. Figure 3.6 shows this total mortality cost decomposed into health-care and long-term care for an illustrative[5] EU country with average mortality costs of €30,000. Here *D* represents total mortality costs, *DH* and *DL* the respective health-care and long-term care components to make up these total mortality costs.

Figure 3.6 Division of mortality costs into health- and long-term care components



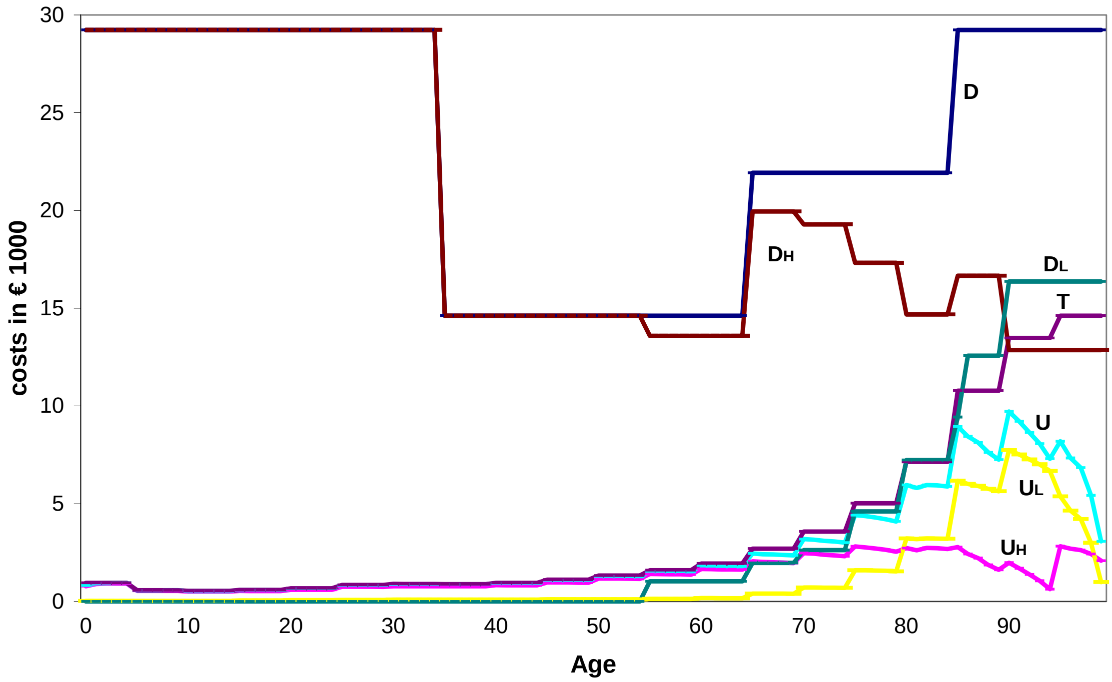
Costs of health per person

Figure 3.7 presents the costs of health care per person for an illustrative EU country and the various components it comprises as discussed in the previous paragraphs. *D* as in Figure 3.6 represents the cost of mortality. *T* represents total health costs and increases with age; it is the sum of mortality-related expenditures *D* and medical-related expenditures *U*. Using the age-specific mortality rates, *U* is calculated by subtracting the fraction of costs related to mortality from total medical expenditures. This fraction can be calculated as a weighted average of the probabilities of surviving and not surviving multiplied by the respective associated costs. As mortality rates increase with age, *T* and *U* diverge at later ages as a bigger part of total expenditures is then made up of costs related to mortality, which rise from age 65 and onwards. *DH*, *DL*, *UH* and *UL* in turn are the health-care costs and long-term care costs of which respectively the mortality costs *D* and total medical expenditures *U* are made up. *UH* and *UL*

[5] The illustrative EU country is a weighted average of the EU countries for which we have all the desired data needed to perform our projections. Countries for which we have no long-term care profiles, for example, are not used in the construction of this profile.

are corrected to include the cost of mortality component and thus decline at later ages when both mortality rates and the level associated with the cost of mortality increases. (For an overview of the various relations see also chapter 2.)

Figure 3.7 Costs of health per person for an illustrative EU country



Pension expenditures

Aggregate figures for pension expenditures are taken from the EPC (2001) study. Public pension expenditure including most public replacement revenues is given for those persons aged 55 and over as a percentage of GDP in the year 2000 for every EU country. As we want our base case scenario to resemble the 2050 figures for pension expenditures in the EPC study, we use the yearly indexation as a calibration tool to arrive approximately at these figures.[6] These calibrated yearly indexation figures are shown in Table 3.2. Thus both the figures in the beginning as well as at the end coincide largely with those of the EPC study in our base case scenario. The time path between these periods will, however, differ owing to the different dynamics of our own model.

As explained in chapter 2, we use the base figures of the EPC study to calculate average pension expenditures per person and from there on we are able to develop our own model from which we can calculate the development of pension expenditure until 2050 under different scenarios.

[6] Pension expenditures in 2050, expressed as a percentage of GDP, deviate marginally from the EPC (2001) projections in 2050 owing to our wish to obtain relatively straightforward indexation-percentages in the calibration procedure.

Table 3.2 Yearly calibrated indexation percentages for EU countries

Austria	0,7%	Italy	0,4%
Belgium	1,3%	Luxembourg	1,4%
Denmark	1,2%	Netherlands	1,9%
Finland	1,2%	Portugal	1,3%
France	1,2%	Spain	1,6%
Germany	1,4%	Sweden	1,2%
Greece	2,1%	United Kingdom	0,2%
Ireland	1,8%		

Source: Authors' calculations.

The model used in the EPC (2001) study to calculate pension expenditures incorporates a much finer structure and is based on richer and more detailed information than our calibration procedure. For example, we do not exactly know the number of beneficiaries aged 55 and older who are entitled to a pension, a pre-retirement, disability or unemployment benefit. To approximate for this number, we assume that everyone aged 65 and over, women and men, receive a pension as this is the most common mandatory retirement age in the EU for both. We revise this figure to account for any labour force participation that takes place at ages older than 65, since those persons will in general receive no pension benefits. For persons aged 55 to 64 we use data from wave 7 of the European Community Household Panel (ECHP) to obtain the percentage of those in this age category who receive either a pre-retirement pension, disability or unemployment benefit. We use the questions on income to retrieve the respective percentages of those who are unemployed, disabled or who have retired early by age category. We are then able to approximate for the number of persons who receive a benefit and thus are able to determine the total number of individuals who are eligible.

The number of persons who are eligible for a benefit may be overestimated in our model for several EU countries, which will lead to a lower average expenditure per person. This is especially true for those countries where for example a large number of women receive no pension or for those countries that have a relatively large percentage of persons out of the labour force who receive no entitlements. But the lower average pension expenditure per person that results from this overestimation will be corrected for in the projections by a larger number of persons who receive a benefit. A second shortcoming in our model is the use of uniform average pension expenditure per person, as this does not take account of the large differences that exist between persons who receive entitlements and pension systems across the EU. The level of the pension benefit depends on the work history of each individual and the amount of the respective salary before retiring in many EU countries, among other factors. Heterogeneity between persons is thus lost.

Yet we would like to emphasise that while our model may lack certain features that give it a more realistic character, its main quality lies in projecting the future trends for which it was designed. Thus while it may be wrong on the micro level, it is right at the macro level, which is most relevant for our projection exercises.

Health indicator

As has been extensively described in WP1, it has been difficult to both measure the health status of the population and predict the trend of the health status in the future. Although self-assessed health data are readily available for most countries from national sources and show consistent patterns across countries and age when taken at a moment in time, they face obvious shortcomings in terms of subjectivity and comparability through time. As FEDEA concludes in WP1, *Bio-Demographic Aspects of Ageing* (Ahn et al., 2004b), it is very hard to establish any clear trend in health status or health expectancies from the examination of data from national health surveys. Recent figures from the OECD (2003b) confirm this result for the variable perceived health status in the period ranging from 1978 to 2000. For the most part, a clear trend is not observable through time for a lot of countries and there are contradictory results when looking at specific age groups. For example, OECD data show a decline in perceived health status for the 15-24 age group for the countries for which data are available, a stabilisation or decline for the 25-44 age group, an increase in perceived health for the 45-64 group and no clear trend for the group aged 65+. The difference rather seems to point to a generational gap in interpreting one's own health than a real difference or trend. Self-assessed health data are also difficult to compare through time because people will adjust their view on health as they become used to receiving better care and cures as welfare improves. The perception of health thus may change through time. For a review of the reliability of self-assessed health data see also Ahn et al. (2004b) and Bound (1991).

To obtain a more objective measure for the change in health through time we therefore use the more standardised data calculated by FEDEA in Ahn et al. (2004b), which is life expectancy in good health. We use the projections that are calculated on the hypothesis of compression of morbidity. This compression theory points to the fact that while on average people will live longer as time elapses, the maximum age people can reach will stay the same. The above-mentioned expectancies are given at both age 15 and age 65 for both sexes. Our aim is to use the change in health status, which can be derived from changes in the remaining life expectancies, to measure the impact of changed health on labour force participation on the one hand and on the other hand to relate health changes to health-care expenditures. In the latter case we do not have separate health-care profiles for men and women and therefore use the aggregate figures that follow from the trend for men and women for life expectancy in good health. Table 3.3 shows the evolution of these indicators until 2025 and the implied percentage change in health status that can be derived from these developments, i.e. between 1996 and 2025. As we perform projections until 2050, we assume that health will develop at the same annual rate in the period between 2026 and 2050 as in the period between 2011 and 2025. For the countries for which this information is not available we have assumed that the health change corresponds to that of the unweighted EU average. This is the case for Austria, Finland, Luxembourg and Sweden.

Table 3.3 Remaining life expectancy in good health, until 2025

	Age 15					Age 65				
				% change by period					% change by period	
	1996	2010	2025	1996-2010	2011-2025	1996	2010	2025	1996-2010	2011-2025
Austria	n.a.	n.a.	n.a.	5,67	4,21	n.a.	n.a.	n.a.	28,6	19,2
Belgium	44,6	47,3	49,1	6,12	3,78	7,6	9,3	10,5	21,6	13,1
Denmark	46,2	48,6	50,3	5,18	3,54	8,2	9,6	10,7	16,2	11,8
Finland	n.a.	n.a.	n.a.	5,67	4,21	n.a.	n.a.	n.a.	28,6	19,2
France	36,6	39,0	40,8	6,75	4,60	5,3	6,7	7,8	26,1	17,2
Germany	28,6	32,1	33,9	11,98	5,48	3,0	4,7	5,9	59,4	26,0
Greece	47,4	48,4	50,1	2,22	3,51	5,8	6,8	8,0	16,9	17,9
Ireland	48,4	50,9	52,7	5,01	3,61	8,3	10,0	11,3	20,0	13,0
Italy	35,9	38,0	39,8	5,95	4,58	3,4	5,0	6,2	44,8	24,7
Luxembourg	n.a.	n.a.	n.a.	5,67	4,21	n.a.	n.a.	n.a.	28,6	19,2
Netherlands	45,0	47,0	48,6	4,30	3,46	7,7	9,2	10,4	19,6	12,5
Portugal	29,3	31,3	33,4	6,87	6,40	1,7	2,7	4,0	62,2	48,4
Spain	40,7	41,6	43,0	2,27	3,24	5,4	6,2	7,1	15,6	14,1
Sweden	n.a.	n.a.	n.a.	5,67	4,21	n.a.	n.a.	n.a.	28,6	19,2
United Kingdom	42,9	45,4	47,3	5,71	4,10	9,3	10,4	11,8	12,1	12,8

Source: Ahn et al. (2004b), figures for Austria, Finland, Luxembourg and Sweden are unweighted averages of other EU countries.

Relation between health and participation

As many studies have shown,[7] better health is positively correlated with actively being at work, especially at later ages. Persons with bad health are more likely to retire at earlier ages either through disability or unemployment schemes. Along with financial incentives,[8] health is the most important variable explaining the transition out of work before the legal retirement age.

For our projections we are especially interested in the impact of health on the decision to leave the labour force. For this purpose we use existing studies on this subject to calculate elasticities that present this relation. In our projections in chapters 8 and 9 we use the results found by Börsch Supan (2000). In a multi-period probit model of the retirement decision, he relates the dependent variable labour-force status 'retired' to such variables as financial incentives, health, age, education and a variety of other socio-economic variables. We use the results he finds in Table 2, model 1 of the report to calculate exit probabilities by age and health category, which ranges from 0 for very poor to 10 for excellent. Coupled with the respective population figures in the different health categories, we can calculate how many persons exit the labour force for each respective health category. We also have the average health status of the sample that he uses for his estimations. If we then simulate a health change, by for example letting 30% of the persons belonging to a certain health category move up a health category, from 1 to 2, from 2 to 3, etc., we can calculate how this influences the number of persons who exit the labour force. If the change in the number of exits is related to the respective average health change, elasticities guiding this relation can be obtained. For the research done by Börsch Supan we found an elasticity of 0.8. A 1% increase in average health would thus lead to 0.8% fewer persons quitting the labour force. By varying the health changes in the simulations we tested the sensitivity of this relation and found that this was robust to different changes and ages. This elasticity is applied in a uniform manner in all EU countries. (See also chapter 2 for a specific description of the effect of a health change on labour force participation.)

Heyma (2001) has also investigated the effect of simulated health effects on retirement using the Dutch panel data of CERRA. Using a multinomial logit model in which he distinguishes between three alternative exit routes, which are early retirement, disability and unemployment schemes, he calculates how a health change affects the probability of exit into any of these routes. He finds that the effect of a health change has the biggest impact on either entry to or exit from disability schemes (depending on whether health deteriorates or improves), with an elasticity of approximately 0.55 if health improves from the observed situation to a situation in which everyone has perfect health. The effects of improvements in health on early retirement are nevertheless very small (elasticity of about 0.1) indicating that the decision to retire earlier is not influenced much by health considerations. These effects are broadly consistent across ages.

These results show that the relation between health and labour force participation may substantially differ among countries and exit routes. Among other factors it will depend on the generosity of the available exit routes and the strictness of the eligibility requirements. More specific research in this field is needed.

Relation between health and health-care expenditures

Healthier persons are assumed to consume health-care services to a lesser extent than those with a worse health status. An improvement in health over time would thus lead to a decline in health-care expenditures for the average person. The magnitude of this change depends on

[7] See for example Börsch Supan (2000) and Kerkhofs et al. (1999). For an overview of the retirement/health literature, see Heyma (2001).

[8] See for example Piekkola and Leijola (2004) along with Gruber and Wise (2002).

several factors. It is linked first of all to the cause of this health improvement, whether this is achieved for example by undergoing better treatment or more medicines or by a genuine exogenous improvement in health without any associated increase in medical treatment or similar expenditures (for example owing to changed health behaviour in the past). Age will likewise be a determining factor. The older a person is, the more likely it is that the increase in health is related to more-intensive medical treatment and the less the eventual reduction in expenditures on health care is deemed to be. As Table 3.3 shows, we have life expectancies at both age 15 and age 65 and to keep things simple we therefore only use two percentages that relate health improvements to health-care expenditures, i.e. one for age 0 to 64 and one for age 65 and older. As we do not have specific information about the exact relation between health status and health-care expenditures we apply the same procedure as in the last paragraph and use results found in the literature, and apply this in a general manner to all EU countries for which we perform projections.

Lubitz et al. (2003) investigate the relation between health, life expectancy and health care for persons aged 70 and over for Medicare beneficiaries in the US. This study concentrates on the difference in lifetime expenditures between persons with various health states,[9] but average health-care expenditure by health status per broad age group is also reported. As we have already incorporated demography developments in our model, it is precisely the annual difference in expenditures between various health states that we are looking for.

Lubitz et al. for example find that active persons with no limitations spend on average $4,600 per year on health care, while persons with a Nagi limitation[10] spend on average $5,800 per year on health care. Healthier individuals thus spend on average 20% less on health care than those with a Nagi limitation. We use this relation to relate health changes to health-care expenditures for those persons aged 65 and over. A positive average health change, of for instance 5% per year, will then lead to a 1% reduction in total expenditures. For persons below that age we have no specific information. Using the fact that people are on average healthier at younger ages, we assume that their improvement in health can for 30% of the time be attributed to exogenous factors. A 1% increase in health will thus lead to 30% less expenditure on total health care.

Government statistics

Total government revenues, expenditures and debt figures for the year 2001 to 2004 are taken from the OECD (2003a) general government statistics. To calculate the amount spent on disability benefits and other social security benefits we use the percentages found in the social expenditure database of the OECD (2001), which gives the percentages of GDP spent on public social expenditure. Pension and health-care expenditures follow from our own calculations. Education expenditures as a percentage of GDP are taken from the EPC study in 2003. In this report the individual member states have supplied information on the development of education expenditures until 2050. Because the number of young persons will decline, in most member

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[9] They find that lifetime expenditures on health care do not differ between persons with different health states. This can be attributed to the fact that while persons in good health on average spend less on health care per year compared with those in bad health, they tend to live longer. Overall expenditures are therefore found not to differ much between various health states if one looks at health-care costs paid during the remaining lifetime.

[10] A Nagi limitation was defined as the difficulty performing or inability to perform at least one of five activities: stooping, crouching or kneeling; lifting or carrying objects weighing up to 4.5 kg (10 lb); extending the arms above the shoulder; grasping small objects; and walking two to three blocks (Lubitz et al., 2003).

states these expenditures are also expected to decline.[11] We apply the specified reduction by each country to these expenditures between 2002 and 2050 to incorporate this effect. From 2004 onwards government finances will develop as sketched out in chapter 2.

3.3 The assumptions in the base case scenario

Labour productivity

Labour productivity is assumed to grow at an annual rate of 1.75% for all EU countries. No difference is made between age categories, so that productivity does not rise with age. In chapter 8 we investigate how ageing may influence productivity and how this changes our base case results.

Labour force participation

The projection of labour force participation rates for the base case scenario are based on estimates used by the Economic Policy Committee of the European Commission as prepared by the working group on ageing. These are in part based on projections by the International Labour Organisation until 2010 and are adjusted from 2010 onwards in order to take account of the expected increase in the participation rates of women. The rise in labour force participation rates can thus be fully attributed to the rising participation by as those of men are held constant or decline slightly.

Risk-free interest rate

The nominal interest rate is set at 5.75% and inflation at 2%. In chapter 10 we investigate how a different interest rate, respectively 1% higher or lower, changes the base case results. In chapter 11 we consider in more detail the relation between population ageing and the interest rate and how the implementation of a more variable path for the interest rate taking account of this factor changes our base case results.

The impact of the business cycle

The government finance figures for the years 2001 and 2004 were taken from the OECD (2003a) and are not cyclically adjusted. As these figures mostly correspond to a time when all economies had low growth rates and thus larger government deficits than in a neutral economic environment, government finances and government debt would evolve more positively if we had taken the cyclically adjusted figures. But in general the effect would be very marginal and therefore we have chosen to use the unadjusted OECD figures.

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[11] Gradstein and Kaganovich (2003) argue that education expenditures may increase if enough people see the benefit of improved education on productivity. In an OLG economy with young people, persons of working age and the elderly, an expected increase in life expectancy may make the working-age population more aware of the need to increase productivity to pay for future pensions, as the period over which they receive a pension increases. This will increase their incentives to invest in education to boost productivity and may override the tendencies of elderly persons to cut education expenditures in order to spend this money on services from which they benefit.

Part I

In chapter 4 and the subsequent chapters in part II, projections of health-care expenditures, pension expenditures and government finances are carried out for the period from 2002 to 2050. We concentrate on public expenditures in these fields and abstract from any developments in private expenditures, as we focus on the impact of population ageing on public finances. The main aim of these exercises is to show how population ageing affects these expenditures and how the sustainability of government finances is influenced by this process. In this chapter we calculate how the development of health-care expenditures and pension expenditures evolves for the 15 members of the EU using the demographic projections from Eurostat and the various macroeconomic assumptions, regarding, among others, labour force participation, the interest rate and productivity growth as made in chapter 3. No account is taken of any other factors that are frequently mentioned to influence health-care expenditures, such as the introduction of new medical technologies or the price development in medicines, as a result of the difficulty of modelling these processes. The projections that result from this exercise will be treated as the base case scenario with which other scenarios will be compared. They should give a first impression of the effect of population ageing on health-care expenditure, pension expenditure and government finances using the best data currently available. These projections broadly coincide with the projections made for pension and health-care expenditure in the EPC study. The projections of health-care expenditure differ from the EPC (2001) study owing to the inclusion of the cost of mortality. This will lead to lower expenditures than projected in the EPC scenario. Also, our division of the health-care profiles by five-year cohorts to the specific age cohorts within that group may influence final projections. In our projections, we assume that health-care expenditures grow yearly at the rate of 1.75%, which is about equal to the rate of GDP per worker in the EPC study.

Chapter 4
Base case scenario

4.1 Projections for health- and long-term care expenditures

Health-care expenditures

Table 4.1 shows the projected development in health-care expenditure until 2050 for expenditures on health care, long-term care and total health care and long-term care. The development in these costs follows from the methodology explained in chapter 2 for the cure and care components. The respective health-care profiles by age category also rise annually with the yearly growth of labour productivity, which is set at 1.75%, to keep the share of health-care expenditures as a percentage of GDP approximately constant. The first six columns display health-care expenditure/GDP ratios for a number of selected years. The last column presents the rate of increase in percentage points between 2002 and 2050.

Health care

Health-care expenditures, expressed as a percentage of GDP, varied widely among countries in 2002, ranging from 3.9% in the UK to 6.5% in Germany and on average are some 5.4% of GDP in the EU. The EU average thus presents a weighted average of all EU countries. As Table 4.1 shows, the amount of spending on health care will rise steadily for all EU countries, as measured as a percentage of GDP, as populations start ageing.

The rise in expenditures varies from 0.6% in Denmark to 2.7% in Spain during the time period until 2050. For the EU as a whole these expenditures are expected to increase on average by 1.7% and will in 2050 account for 7.1% of GDP. Looking at the figures more closely one can see that the steepest rise in health- and long-term care expenditures take effect in the period from 2010 until 2040, when the baby-boom generation in most EU countries is making full use of the health-care system and the increase in expenditures rises by some 0.5% of GDP every 10 years in this period. From 2040 and onwards, expenditures rise at slower rates and one can see that expenditures in several countries, such as Belgium, Denmark, Sweden and the Netherlands actually start to decline, while expenditures in Finland, Germany and Italy have more or less stabilised at their 2040 level. Expenditures in Austria, France, Greece, Ireland, Portugal, Spain and the UK continue to grow however. *A priori* it is not straightforward to predict which countries will face the largest increases in expenditures on health care. This depends on demographic trends, the health-care profiles of each country and developments in the labour force participation of the population, which for a large part determines the development of the GDP. A comparison of respective increases in health-care expenditures between countries may also be troublesome because the definitions of which expenditure categories belong to health and which to long-term care differ somewhat among countries[1] and thus one should also look at the combined figures for health and long-term care.

[1] This is especially relevant for those countries for which no long-term care figures are available and where part of the services belonging to this category is incorporated in the health-care profiles in the first part of Table 4.1.

Table 4.1 Projections of public expenditure on health- and long-term care, base case scenario

Health care expenditure (% of GDP)

	2002	2010	2020	2030	2040	2050	*% incr. Exp 2002-2050*
Austria	5,1	5,5	6,1	7,0	7,5	7,7	*2,5*
Belgium	5,2	5,5	6,0	6,7	7,0	6,9	*1,7*
Denmark	4,0	4,2	4,4	4,6	4,7	4,6	*0,6*
Finland	4,8	5,3	6,0	6,5	6,7	6,7	*1,9*
France	5,5	5,8	6,3	7,0	7,3	7,4	*1,9*
Germany	6,5	6,8	7,5	8,3	8,9	8,9	*2,4*
Greece	4,7	4,9	5,1	5,5	6,0	6,1	*1,4*
Ireland	5,6	5,5	5,7	6,1	6,4	6,6	*1,0*
Italy	5,5	5,8	6,3	7,0	7,7	7,7	*2,2*
Luxembourg	n.a	n.a	n.a	n.a	n.a	n.a	
Netherlands	4,7	5,0	5,4	5,7	5,7	5,5	*0,8*
Portugal	5,3	5,6	5,8	6,2	6,8	7,0	*1,7*
Spain	6,2	6,4	6,8	7,6	8,6	8,9	*2,7*
Sweden	5,1	5,2	5,6	5,9	6,1	6,0	*0,9*
United Kingdom	3,9	3,9	4,1	4,5	4,8	4,9	*0,9*
EU average	**5,4**	**5,6**	**6,1**	**6,6**	**7,1**	**7,1**	***1,7***

Long term care expenditure (% of GDP)

	2002	2010	2020	2030	2040	2050	*% incr. Exp 2002-2050*
Austria	0,6	0,7	0,8	1,1	1,3	1,6	*1,0*
Belgium	0,7	0,9	1,0	1,2	1,5	1,6	*0,9*
Denmark	2,2	2,4	2,7	3,4	3,9	4,1	*1,9*
Finland	1,5	1,7	2,1	2,8	3,3	3,3	*1,9*
France	0,7	0,8	1,0	1,1	1,4	1,5	*0,8*
Germany	0,3	0,3	0,4	0,5	0,5	0,6	*0,4*
Greece	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Ireland	0,7	0,7	0,7	0,9	1,1	1,2	*0,6*
Italy	0,7	0,8	0,9	1,0	1,2	1,2	*0,5*
Luxembourg	n.a	n.a	n.a	n.a	n.a	n.a	
Netherlands	2,6	2,8	3,2	3,9	4,4	4,5	*1,9*
Portugal	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Spain	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Sweden	2,4	2,5	2,7	3,5	4,1	4,3	*2,0*
United Kingdom	1,7	1,8	2,0	2,5	3,0	3,4	*1,7*
EU average	**0,9**	**1,0**	**1,1**	**1,4**	**1,7**	**1,8**	***0,9***

Total health and long-term care expenditure (% of GDP)

	2002	2010	2020	2030	2040	2050	*% incr. Exp 2002-2050*
Austria	5,8	6,2	6,9	8,1	8,9	9,3	*3,5*
Belgium	5,9	6,3	7,0	7,9	8,5	8,5	*2,6*
Denmark	6,2	6,6	7,1	8,1	8,6	8,7	*2,5*
Finland	6,3	7,0	8,1	9,3	10,0	10,0	*3,7*
France	6,2	6,6	7,3	8,1	8,8	8,9	*2,7*
Germany	6,7	7,1	7,9	8,8	9,4	9,5	*2,8*
Greece	4,7	4,9	5,1	5,5	6,0	6,1	*1,4*
Ireland	6,3	6,1	6,5	6,9	7,5	7,9	*1,6*
Italy	6,2	6,6	7,2	8,0	8,8	8,9	*2,7*
Luxembourg	n.a	n.a	n.a	n.a	n.a	n.a	
Netherlands	7,3	7,8	8,6	9,6	10,1	10,0	*2,7*
Portugal	5,3	5,6	5,8	6,2	6,8	7,0	*1,7*
Spain	6,2	6,4	6,8	7,6	8,6	8,9	*2,7*
Sweden	7,5	7,8	8,3	9,5	10,1	10,4	*2,9*
United Kingdom	5,7	5,7	6,1	7,0	7,8	8,3	*2,6*
EU average	**6,2**	**6,6**	**7,2**	**8,0**	**8,7**	**8,9**	***2,7***

Source: Authors' calculations.

Long-term care

The projections for long-term care expenditures until 2050, for the countries for which information is available, are shown in the second part of Table 4.1.[2] At the onset, total expenditures vary from 0.3% of GDP in Germany to 2.6% for the Netherlands and on average account for 0.9% of GDP in the EU. As shown in other studies, the Netherlands and the Scandinavian countries, Denmark, Sweden and Finland are those that historically provide formal care on a large scale such as in nursing homes and other institutions for the elderly and thus spend a large part of their GDP on this care component. The countries that face the largest increases in expenditure are respectively Denmark, Finland, the Netherlands, Sweden and the UK. The average for the EU shows that long-term care expenditures are expected to double in the projection period under review. Looking at the figures in terms of GDP, Denmark, Sweden and the Netherlands will spend more than 4% of their GDP on long-term care in 2050. Expenditures on this care component will in time become almost equal in size to that of the cure component in these countries. This can be explained by the fact that the ageing of populations will lead to a greater increase in demand for care than for cure services. While cure expenditures tend to decline somewhat after 2040, this pattern is less obvious for long-term care as the development in the EU average from 1.7 to 1.8% in the period between 2040 and 2050 shows. But expenditures seem to stabilise in both Finland and Italy by 2040. In the other EU countries the rise in expenditures after 2040 is less steep than before this period, although the increases in Austria and the UK remain large, with respective increases of 0.3% and 0.4% of GDP during 2040 and 2050. A comparison of the projected increases in expenditures between health- and long-term care shows that the relative increase in expenditures for long-term care are much larger than for health care, an increase of 103.4% for long-term care compared with an increase of 32.8% for health care. This can be explained by the fact that long-term care is used more intensively by elderly persons and is thus influenced more by the ageing process as reflected in the demography figures in Figure 3.1.

Total health-care and long-term care expenditures

Total health- and long-term care expenditure varies at the onset between 4.7% of GDP for Greece to 7.5% for Sweden and on average accounts for 6.2% of GDP for the EU. The countries that will face the largest increases in total health-care expenditure are expected to be Austria and Finland, which will see their expenditures rise by 3.5% and 3.7%. Most other countries will see their expenditures rise in the range of 2.5% to 2.9% with positive exceptions being Greece, Ireland and Portugal. The EU average will grow by 2.7% during this period and reach 8.9% of GDP, with only a relatively small increase occurring in the period between 2040 and 2050. As a result of the unavailability of any information on long-term care for Greece and several other countries, it remains premature to accurately predict the development of expenditures on total health- and long-term care in these countries, as ageing especially influences the long-term care expenditures. For these countries the given projections should therefore be taken as minimum values. Overall figures tell us that total health-care expenditures have more or less stabilised after 2040 in Belgium, Denmark, Finland, France, Germany, Greece and Italy, while those of the Netherlands actually decline after this period. Expenditures in Austria, Ireland, Portugal,

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[2] In the projections of long-term care, we have not taken account of any relation between the increase in the labour force participation of women and the associated reduction in capacity to provide care on an informal basis to, for example, their spouse or other relatives. Especially in countries where this informal care is important, such as in the southern European countries, an increase in the labour market participation of women may underestimate the projected increase in long-term care expenditures. These projections should therefore be taken as in the lower boundary of estimates.

Spain, Sweden and the UK will, however, continue to increase, mostly owing to extra expenditures on long-term care in these countries for which this information is available.

The age structure

The age structure of total health-care expenditures changes markedly through time as Table 4.2 shows for an illustrative EU country.

Table 4.2 Health-care expenditures by broad age groups

	2000	2010	2020	2030	2040	2050
0-19	1,9%	1,6%	1,2%	1,0%	0,9%	0,7%
20-64	16,5%	14,4%	12,2%	10,1%	8,0%	6,8%
65-89	68,3%	72,3%	70,2%	70,4%	72,1%	71,3%
90+	13,2%	11,8%	16,4%	18,5%	19,1%	21,2%

Source: Authors' calculations.

The total amount of health-care expenditures accounted for by expenditures on the younger age groups, i.e. 0-19 and 20-64 declines rapidly through time, while expenditures on persons aged 65 and over increases. The percentage of total expenditures flowing to the group aged 90+ increases substantially. In 2050, this group will on average incur three times the expenditures on health-care than the total group aged 0-64, i.e. 21.2% for the group aged 90+ compared with 7.5% for the group aged 0-64. In 2000, the group aged 0-64 incurred on average 18.4% of the total expenditure outlays compared with 13.2% for the group aged 90+.

4.2 Projections of public pension expenditures

Public pension expenditures

Table 4.3 shows the projection of pension expenditures in the base case scenario, which approximately coincides with the projections made by the individual members of the EPC, although the dynamics in the years between the start and end year of the projection differ. The population ageing effect captured by the demographic changes occurring in this period is in most countries the most important factor contributing to the increase in expenditures on pensions.[3] The strange result for the UK can be attributed to the indexation mechanism that is used in this country, in which pension benefits are linked to inflation (which grows at a slower rate than GDP). Ultimately this results in a lowering of the pension expenditures when compared with the base case scenario.[4] The countries that are most affected by the coming population ageing process are Greece, Spain and the Netherlands. Countries that are least affected by it are the UK, Italy, Sweden and Luxembourg, with projected increases of less than

[3] The EPC (2001) study identifies four factors that drive the expected increase in expenditures on public pensions: a population ageing effect (reflecting changes in the ratio of persons aged 55 and over to the population aged 15 to 54); an employment effect (measuring changes in the share of the working-age population); an eligibility effect (measuring the share of the population who receive pensions); and a benefit effect (reflecting changes in the average pension benefit relative to output per worker). In the projection period, the population ageing effect will lead to an increase in pension expenditures. The employment and benefit effects will lower expenditures on public pensions while the eligibility effect shows mixed results among EU countries. The population ageing effect is, however, by far the most dominant factor contributing to the increase in expenditures on public pensions.

[4] The benefit effect in this country dominates the dependency effect.

2% in pension expenditures. As outlined in the EPC (2001) report, the main reason behind these relatively small increases for Italy and Sweden is the introduction of Notional Defined Contribution Schemes in the 1990s in these countries. These schemes not only directly link contributions and entitlements but also automatically adjust benefits to changes in life expectancy and thus reduce the burden of population ageing.

Table 4.3 Expenditures on public pensions, base case scenario (% of GDP)

	2002	2010	2020	2030	2040	2050	*% incr. Exp 2002-2050*
Austria	14,5	15,0	16,2	18,8	18,5	17,0	*2,5*
Belgium	10,0	10,9	12,6	14,3	14,2	13,2	*3,1*
Denmark	10,6	12,3	13,5	14,7	14,6	13,1	*2,5*
Finland	11,5	14,1	16,3	17,0	16,4	15,8	*4,3*
France	12,1	13,2	15,1	16,8	17,1	16,4	*4,2*
Germany	11,9	12,6	14,4	17,1	17,6	16,8	*4,9*
Greece	12,8	14,0	16,1	18,9	22,7	24,7	*11,9*
Ireland	4,6	4,8	5,8	6,8	7,8	8,7	*4,1*
Italy	13,9	14,3	14,8	16,1	16,2	14,1	*0,2*
Luxembourg	7,4	8,2	9,3	10,6	10,4	9,2	*1,7*
Netherlands	8,1	9,6	12,0	14,1	14,2	13,5	*5,4*
Portugal	9,8	10,2	10,7	11,7	13,1	13,1	*3,3*
Spain	9,5	10,0	11,3	13,7	16,7	17,4	*7,9*
Sweden	9,0	9,6	10,4	11,0	11,0	10,6	*1,6*
United Kingdom	5,4	5,4	5,3	5,6	5,1	4,4	*-1,0*
EU average	**10,5**	**11,1**	**12,2**	**13,8**	**14,2**	**13,4**	***2,9***

Source: Authors' calculations.

One can see a clear distinction between countries that see their expenditures on pensions gradually decline in time, usually after 2030 or 2040, and those countries that continue to be confronted by increases in pension expenditures. This latter group includes Ireland, Greece and Spain. For the EU, pension expenditures are on average expected to increase by 2.9% in the period from 2002 to 2050, increasing from 10.5% to 13.4% of GDP in this period. Compared with the expected increase in total health-care expenditures, the increase in pension expenditures is somewhat larger than that for total health care and long-term care.

4.3 Government finances

From the projections for health and pension expenditure in the previous sections it could be seen that the demographic changes awaiting the EU until 2050 will influence public expenditures significantly. In this section we investigate how the development in these expenditures influences government finances and more specifically whether government finances are sustainable. The term 'sustainability' refers to the point that government finances in the future should be solvent under the continuation of current social policy rules. It thus requires that the present value of the government's income is sufficient to cover the present value of its liabilities.

On this theme we use two ways to find out if government finances are sustainable for the EU and its individual countries. The first is a more intuitive one and will show the debt developments of the countries during the projection period. If government finances are sustainable, one would expect that debt would stabilise or decline through time as this would indicate that expenditures and income are in balance. A rise in the debt level would, however, indicate that government finances are not sustainable and imply that expenditures are rising faster than income. The second measure we use to investigate whether government finances are sustainable is the so-called 'sustainability gap'. As explained in chapter 2, the sustainability gap refers to the difference in the tax level in the starting year of the extrapolation of government finances and the level that is required to cover future public expenditure if current social policy rules remain unchanged. A positive sustainability gap would imply that taxes would have to be increased to cover future public expenditures and refers to a situation where government finances are not sustainable. A negative sustainability gap would refer to the opposite case and would imply that there may even be room to lower taxes without jeopardising the sustainability of government finances in the future.

Before we look at the sustainability of government finances of the EU countries, Table 4.4 first sums up the expected increase in public expenditures as a result of changes in health-care and pension expenditures. Public expenditures in the first column refer to the expenditures on pension and health in the starting year and not to overall public expenditures. As already highlighted in the previous sections of this chapter, public expenditures expressed as a percentage of GDP will increase in the period between 2002 and 2050. While public expenditures in 2002 ranged from 7.4% to 20.2% for Luxembourg and Austria respectively, in 2050 public expenditures on these categories will vary between 9.2% and 30.8% for Luxembourg and Greece. As the EU average shows, expenditures are generally expected to rise by 5.6% during the period between 2002 and 2050 from 16.7% of GDP to 22.3% of GDP. The expected contribution of pensions, as a percentage of GDP, to this increase is slightly higher than that for health-care expenditure, although the relative increase in health-care expenditure is higher than that for pension expenditure, as can be concluded from Tables 4.1 and 4.4, i.e. 42.9% against 27.7%.

Table 4.4 Net change in public expenditure on health and pension components (% of GDP)

			Change in expenditures			
		Public exp in 2002	Total health care	Pensions	Total	Public exp. In 2050
Austria	AT	20,2	3,5	2,5	6,0	26,2
Belgium	BEL	16,0	2,6	3,1	5,7	21,6
Denmark	DK	16,8	2,5	2,5	5,0	21,8
Finland	FIN	17,7	3,7	4,3	8,0	25,8
France	FRA	18,3	2,7	4,2	6,9	25,2
Germany	GER	18,6	2,8	4,9	7,6	26,3
Greece	GRE	17,5	1,4	11,9	13,3	30,8
Ireland	IRE	10,8	1,6	4,1	5,7	16,6
Italy	IT	20,0	2,7	0,2	3,0	23,0
Luxembourg	LUX	7,4	n.a.	1,7	1,7	9,2
Netherlands	NL	15,3	2,7	5,4	8,1	23,4
Portugal	PORT	15,2	1,7	3,3	5,0	20,1
Spain	SPA	15,7	2,7	7,9	10,6	26,3
Sweden	SWE	16,5	2,9	1,6	4,5	21,0
United Kingdom	UK	11,1	2,6	-1,0	1,6	12,7
EU average		**16,7**	**2,7**	**2,9**	**5,6**	**22,3**

Source: Authors' calculations.

Figures 4.1 to 4.4 show the debt developments of the EU countries in the period from 2002 to 2050. Group A comprises the countries where the debt ratio declines; these countries do not have to worry about any sustainability problems. Group B is the group of countries that face small sustainability problems and slowly increasing debt profiles. Groups C and D are the countries with large and very troublesome sustainability problems – which have very striking debt profiles. From these figures it can be concluded that all countries, except Denmark and Sweden, face sustainability problems under a continuation of current social policy rules as the debt profiles increase sharply in most countries.

Figure 4.1 Debt developments in group A

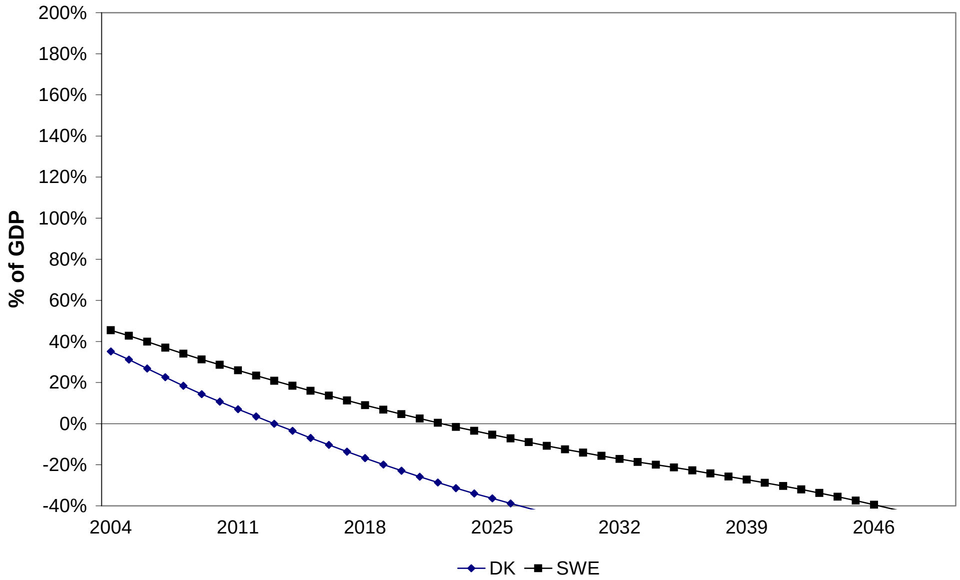


Figure 4.2 Debt developments in group B

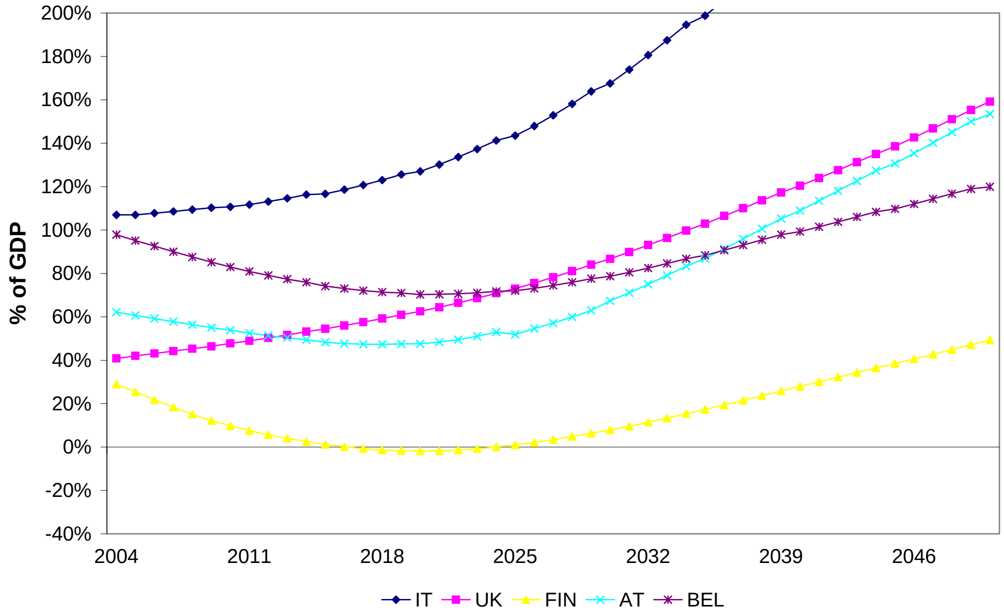


Figure 4.3 Debt developments in group C

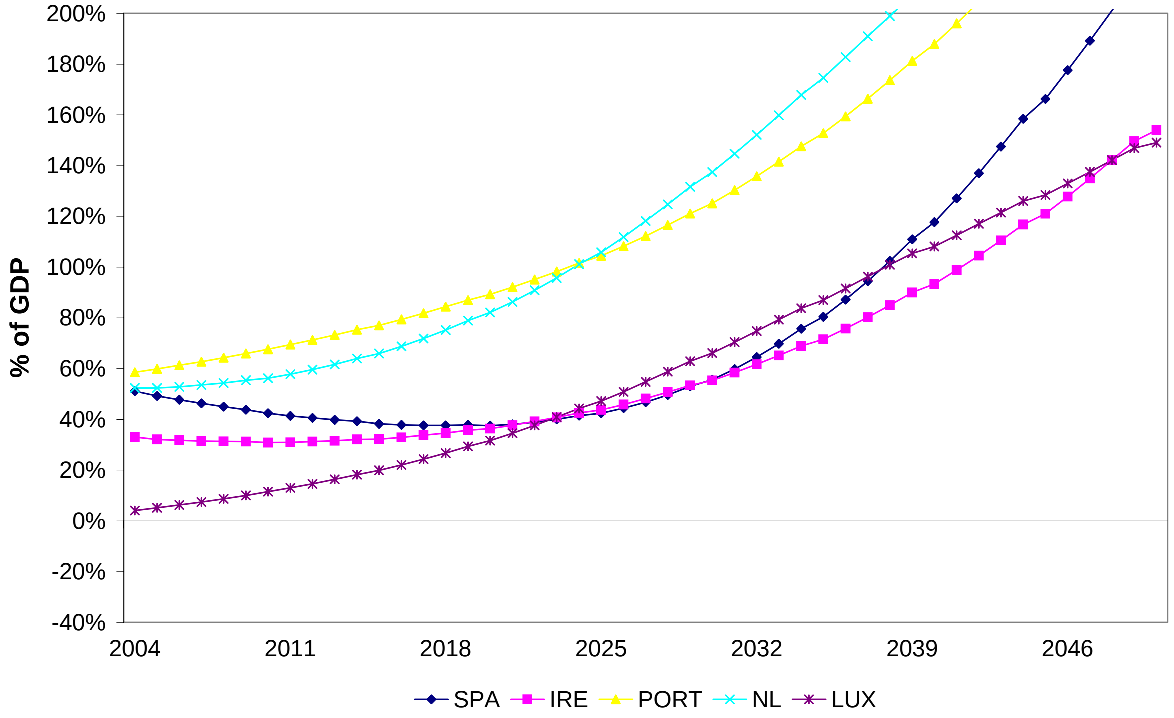


Figure 4.4 Debt developments in group D

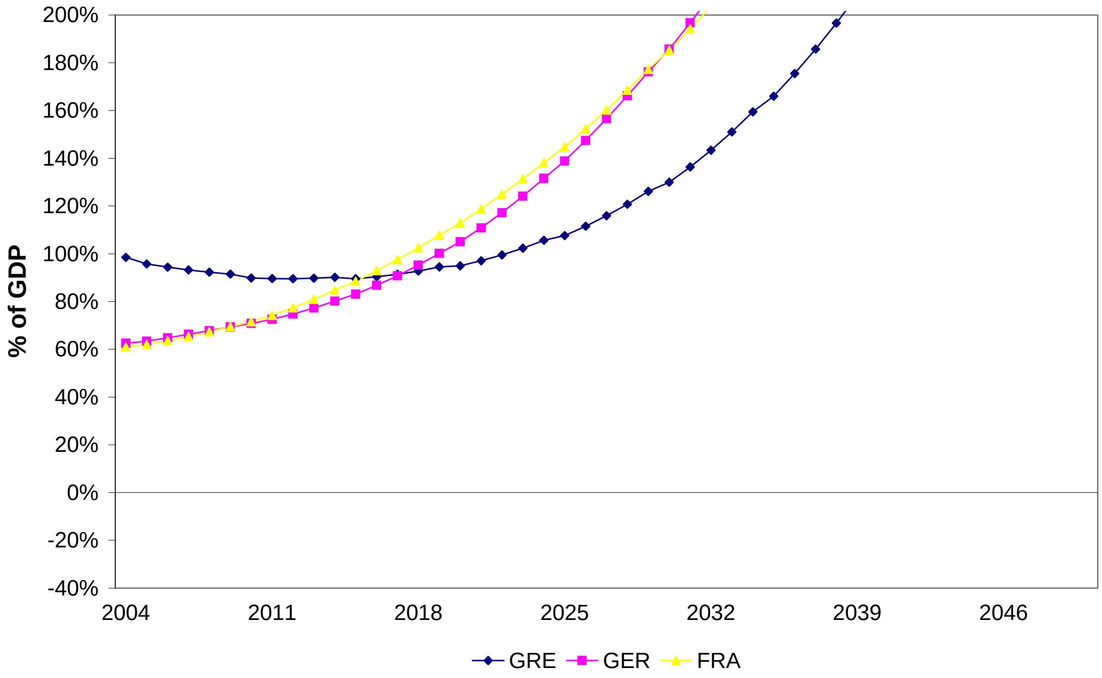


Table 4.5 shows the sustainability gaps for the EU or the increase in taxes that are needed to cover future public expenditures and to keep government finances sustainable. Countries are in group A if the required increase in taxes is less than 0%, in group B if the required increase in taxes is between 0 and 2%, in group C if the required increase in taxes is between 2 and 4.5% and in group D if it is above 4.5%. Under an unchanged social policy scenario, eight of the EU-15 countries in our analysis will face large sustainability problems, while only two countries will not face any sustainability problems. Government finances are thus influenced in a significant way by the coming demographic shift. These figures obviously coincide with the patterns shown in the graphs in the sense that the countries with the steepest debt profiles are also the countries with the largest sustainability gaps. Looking at the EU average, taxes have to be increased by 3.15% in 2005 to keep government finances sustainable in the EU in our base case scenario.

Table 4.5 Sustainability gaps in EU countries, base case scenario (% of GDP)

Group A	Denmark	-1,44	Group C	Ireland	3,80
	Sweden	-0,83		Luxembourg	2,64
				Netherlands	3,52
				Portugal	3,49
				Spain	3,43
Group B	Belgium	0,66	Group D	France	4,92
	Austria	1,32		Germany	5,14
	Finland	0,67		Greece	5,78
	Italy	1,61			
	United Kingdom	1,59			
	EU average	**3,15**			

Source: Authors' calculations.

In its 2003 report, the EPC has also calculated sustainability gaps for all EU countries. It is tempting to compare these results with the results in this paper. We stress again that our results should not be taken as the best possible projections of the effects of population ageing. Indeed, we have modelled several aspects of pension schemes and public finances on a very global level. Furthermore, we did not take into account the most recent information on policies to be implemented in the near future. Our projections should be viewed as indicative and a framework for assessing the implications of living longer in better health. In particular, we can ascribe differences between the EPC (2003) study and our paper to the following features.

First we incorporate the cost of mortality in our projections for health-care expenditure, leading to lower expenditures on health care when compared with the EPC study. Second, the EPC (2003) study uses different forecasts for pension expenditures than our study, which used the pension projections of the previous EPC (2001) study. Although the 2003 figures may incorporate more recent information, leading to lower projected expenditures on public pensions as the result of the inclusion of planned or enacted pension reforms, these figures have not yet been officially accorded and therefore we prefer to use the accorded figures of the earlier EPC (2001) study. Third, our method of extrapolating government finances and revenues differs from the EPC approach. We distinguish between more expenditure categories among others and explicitly incorporate the development of government revenues in our projections. Owing to these differences, the size of the sustainability gaps found by the EPC sometimes substantially differs from the sustainability gaps found in this paper. Nevertheless, the rank order of countries, when ordered from the countries with the lowest sustainability gaps to the countries with the highest sustainability gaps broadly correspond with each other.

Which countries are now generally better equipped to face the increase in expenditures on health and pensions as projected in Table 4.4? Are these by definition countries that have low debt levels at the beginning of the period or are countries that run large primary surpluses better situated to face the challenge confronting government finances by population ageing? In principle both effects matter. Countries with a low debt level do not face a large interest burden and should be able to control their government finances – and in particular the part that they are able to influence directly, that is expenditures, more easily. A look at the graphs in Figures 4.1 to 4.4, however, shows that several EU countries with relatively low debt levels in the starting year of our projection, such as Luxembourg, Ireland, the UK, Spain and Finland, are expected to see their debt levels increase sharply in the period between 2002 and 2050. The low debt level alone will not be enough to alleviate the increase in expenditures that population ageing is expected to cause. While the original debt level will partly determine the ultimate level of debt at the end of the projection period, the development in the primary surplus that a country runs is more important in explaining the direction or slope of the debt profile and therefore also more important in calculating the sustainability gap or increase in taxes that is necessary to keep government finances sustainable. In calculating the sustainability gaps shown in Table 4.6, one can basically distinguish between three variables that determine the ultimate size of the sustainability gap and the development in the debt profiles.

As discussed in chapter 2, the sustainability gap was calculated according to the following formula (equation 13):

$$t_{g0} = (r_t - g) \times \left[B_0 + \sum_{t=1}^{46} pt_t \times \frac{1}{(1+r_t)^t} + pt_{46} \times \frac{1}{(1+r_t)^{46}} \times \frac{1}{r-g} \right]$$

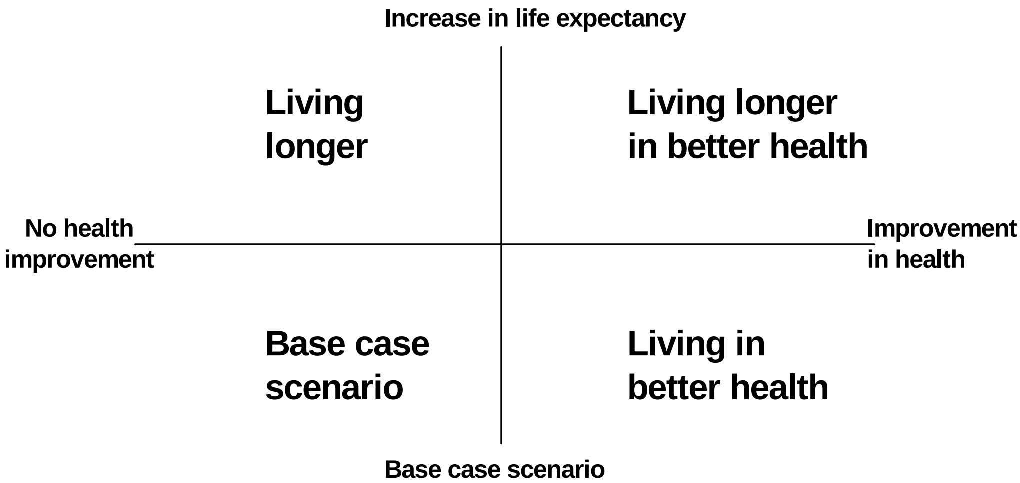
The three aspects that determine the ultimate size of the sustainability gap are thus the original debt level B_0, the present value of the sum of the primary deficits until 2050 (i.e. the second term in the square bracket) and the present value of the sum of the primary deficits after 2050 to say infinity (i.e. the third term in the square bracket). To show how important each of these terms is in determining the ultimate level or end value of the sustainability gap, we have calculated the contribution of each of these terms for the EU average. From these calculations it could be concluded that the original debt position is responsible for 25.7% of the size of the sustainability gap, the present value of the sum of primary deficits until 2050 for 30.5% and the sum of the third term accounts for 43.8% of this end value. The sum of the primary deficits together accounts for almost 75% of the sustainability gap. The development in the primary surplus thus seems to be a more important factor to keeping government finances sustainable than the size of the original debt level in the base case scenario. Yet the precise contribution of both factors differs by country.

Part II

In this second part of the paper alternative projections are performed to measure the sensitivity of the outcome of the projections in the base case scenario to various assumptions regarding developments in life expectancy and health. In chapter 5 projections are run to show how changing demographic circumstances and thus different life expectancy hypotheses influence the projections. We specifically examine how a further increase in life expectancy will influence health-care and pension expenditures, above the increase in life expectancy already incorporated in the Eurostat demographic projections. This scenario is labelled the ‘living longer’ scenario and concentrates on the effect of population ageing on expenditures and public finances. In chapter 6 we investigate how the projection of health-care and pension expenditures is influenced by the expected change in health status during the projection period, leading to a scenario labelled ‘living in better health’. Demographic circumstances are in this scenario the same as in the base case. In chapter 7 we finally run a scenario that investigates how living longer in better health influences the base case projections in which both an increase in life expectancy and a change in health are incorporated in the scenario. Demographic circumstances in this scenario are equal to those of the living longer scenario. This scenario should give an answer to the question of whether an improvement in health is sufficient to counteract the expected increase in expenditures owing to an increase in life expectancy.

Figure II.1 presents the four main scenarios that are analysed in this paper. The dimensions distinguished on the vertical axis relate to whether or not life expectancy will improve further compared with the Eurostat projections; those on the horizontal axis concern whether or not health effects are incorporated.

Figure II.1 The four main scenarios



Chapter 5
Living Longer Scenario

As mentioned in chapter 1, population ageing seems to have played only a minor part in explaining increases in health-care expenditure in the past. These studies conclude that other factors are deemed to be more important when predicting future health-care expenditures. The introduction of new medical technologies, price developments in medicines, institutional changes,[1] evolutions in disease patterns and alternative health behaviour are for example all pointed out to be more significant drivers of health-care expenditure than the population ageing process. As a result of the difficulty of implementing these factors in a quantitative manner in our projections, no account was taken of them in our base case projections. In chapter 9 we give more attention to these factors to illustrate the degree to which uncertainties surround the accurate prediction of health-care expenditures.

In this chapter we concentrate on only one aspect that determines total future health- and long-term care expenditures, which is the ageing effect. In line with the central theme of this paper, we specifically look at how a further increase in life expectancy will influence health-care expenditures in the future. To this end, the mortality rates of persons in different age categories will be reduced above the reductions already inherent in the Eurostat projections that were used in the base case scenario.

We distinguish between three scenarios, a low, middle and high scenario. In the low scenario the mortality rates for those aged 55 to 85 are shown as having declined by 20%, which takes effect in the period between 2000 and 2050 in gradual equal steps. This scenario corresponds to the belief that life expectancy may increase further in the future above the increase in life expectancy incorporated in the Eurostat demographic figures, but will not increase by very large margins. In the middle scenario the mortality rates are shown as having declined by 35.7% in the projection period and the reduction is applied to a broader age category, i.e. to those aged between 20 and 90. This scenario corresponds to the belief that life expectancy may significantly increase further in the future and that the mortality rates at older ages may decline at the same rate as those observed for young people. In the high scenario, the mortality rate is projected as having declined by 50% for those aged between 20 and 90;[2] just as in the previous simulations, this decline takes place in gradual equal steps in the projection period. This scenario corresponds to optimistic forecasts from demographers who state that the increase in life expectancy in the period between 2000 and 2050 will follow the same pattern as that depicted in the period between 1975 and 2000, in which life expectancy increased by some five years for the average person in the EU.[3] The latter scenario can also be seen as a proponent of the expansion theory of morbidity, which states that the maximum life span may increase further than the maximum ages observed until now.

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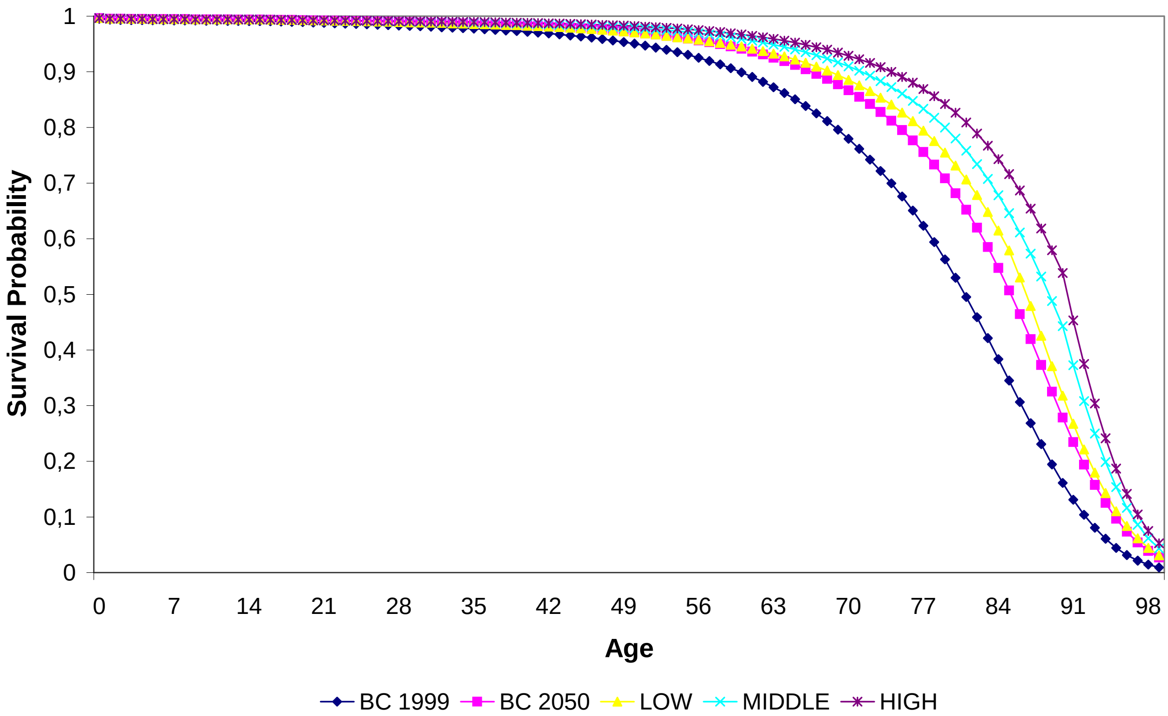
[1] See Jacobzone et al. (2000) and Newhouse (1992).

[2] This scenario follows the line of thinking in Vaupel (1998). Yet he argues that the decline in mortality rates for persons older than 80 may exponentially increase with age. The mortality rates for persons aged 100 and over are thus expected to decline at higher rates than those for a person aged 85. He attributes this to the compositional change of the population as frailer individuals drop out of the population at earlier ages and only strong persons survive at late ages. The chosen decline in mortality rates in our middle and high scenarios may therefore underestimate the growth of the population of those aged 90 and over or the oldest old if Vaupel is right. The implications for total pension and health-care expenditure will nevertheless be marginal.

[3] See also Ahn et al. (2004b).

The three scenarios described thus all correspond with extra increases in life expectancy above the increase already incorporated into the base case scenario. Figure 5.1 shows the effect of this assumption on the survival probability of the EU population for the different scenarios, where BC refers to the base case scenario.

Figure 5.1 Survival probability of EU population under different demographic scenarios



From Figure 5.1 it can be concluded that the larger the reduction in mortality rates compared with the base case scenario, the more the line representing the survival probability at specific ages becomes rectangularised. A complete rectangularisation of the figure would imply that almost no one would die before they reach the age of 90.

The initiated declines in the mortality rate in the various scenarios, i.e. low, middle and high, correspond to an extra increase in life expectancy of 1.2, 3.2 and 4.8 years respectively at birth compared with the increase in life expectancy projected in the base case scenario in 2050 using the Eurostat projections. That is, the projected life expectancy of a person born in 2050 at birth is 82.6 years in the base case scenario, 83.8 years in the low scenario, 85.8 years in the middle scenario and 87.4 years in the high scenario. In Table A.6 of the appendix, the development of the life expectancy figures for the EU as a whole and its individual member states in the base case and the various living longer scenarios are given.

Table 5.1 compares the projected expenditures in health and long-term care in the various living longer scenarios with those obtained in the base case scenario to see how a further increase in life expectancy influences health-care expenditures. The first three columns reflect the base case situation, the subsequent columns the respective living longer scenarios just mentioned and the last column reflects the extra increase in expenditures when comparing the living longer middle scenario with the outcomes presented in the base case scenario. This middle scenario is also the one that we use to calculate the impact of an increase in life expectancy on the sustainability of government finances later in the chapter and for our calculations in other chapters if a living longer scenario is incorporated in the projections.

Table 5.1 Projection of public exp. on health and long-term care, living longer scenario

Health care expenditure (% of GDP)							
	Base case			Living longer			
				low	middle	high	
	2002	2050	*% incr. Exp 2002-2050*	2050	2050	2050	*extra incr*
Austria	5,1	7,7	*2,5*	7,9	8,1	8,4	*0,5*
Belgium	5,2	6,9	*1,7*	7,0	7,3	7,4	*0,4*
Denmark	4,0	4,6	*0,6*	4,6	4,5	4,4	*-0,1*
Finland	4,8	6,7	*1,9*	6,8	6,9	7,1	*0,3*
France	5,5	7,4	*1,9*	7,6	7,8	7,9	*0,4*
Germany	6,5	8,9	*2,4*	9,1	9,5	9,8	*0,6*
Greece	4,7	6,1	*1,4*	6,3	6,6	6,8	*0,4*
Ireland	5,6	6,6	*1,0*	6,8	7,0	7,1	*0,3*
Italy	5,5	7,7	*2,2*	7,9	8,2	8,4	*0,5*
Luxembourg	n.a	n.a		n.a	n.a	n.a	
Netherlands	4,7	5,5	*0,8*	5,6	5,6	5,6	*0,1*
Portugal	5,3	7,0	*1,7*	7,3	7,5	7,8	*0,5*
Spain	6,2	8,9	*2,7*	9,2	9,5	9,8	*0,6*
Sweden	5,1	6,0	*0,9*	6,1	6,1	6,1	*0,0*
United Kingdom	3,9	4,9	*0,9*	4,9	5,0	5,0	*0,1*
EU average	**5,4**	**7,1**	***1,7***	**7,3**	**7,5**	**7,7**	***0,4***

Long term care expenditure (% of GDP)							
	Base case			Living longer			
				low	middle	high	
	2002	2050	*% incr. Exp 2002-2050*	2050	2050	2050	*extra incr*
Austria	0,6	1,6	*1,0*	1,7	1,9	2,0	*0,3*
Belgium	0,7	1,6	*0,9*	1,7	1,9	2,1	*0,3*
Denmark	2,2	4,1	*1,9*	4,4	4,9	5,4	*0,9*
Finland	1,5	3,3	*1,9*	3,6	4,0	4,4	*0,7*
France	0,7	1,5	*0,8*	1,6	1,7	1,9	*0,2*
Germany	0,3	0,6	*0,4*	0,7	0,7	0,8	*0,1*
Greece	n.a.	n.a.		n.a.	n.a.	n.a.	
Ireland	0,7	1,2	*0,6*	1,3	1,5	1,6	*0,2*
Italy	0,7	1,2	*0,5*	1,3	1,3	1,4	*0,1*
Luxembourg	n.a	n.a		n.a	n.a	n.a	
Netherlands	2,6	4,5	*1,9*	4,9	5,5	6,0	*1,0*
Portugal	n.a.	n.a.		n.a.	n.a.	n.a.	
Spain	n.a.	n.a.		n.a.	n.a.	n.a.	
Sweden	2,4	4,3	*2,0*	4,7	5,3	5,8	*1,0*
United Kingdom	1,7	3,4	*1,7*	3,7	4,1	4,4	*0,7*
EU average	**0,9**	**1,8**	***0,9***	**2,0**	**2,2**	**2,4**	***0,4***

Total health and long-term care expenditure (% of GDP)							
	Base case			Living longer			
				low	middle	high	
	2002	2050	*% incr. Exp 2002-2050*	2050	2050	2050	*extra incr*
Austria	5,8	9,3	*3,5*	9,6	10,0	10,4	*0,8*
Belgium	5,9	8,5	*2,6*	8,8	9,2	9,5	*0,7*
Denmark	6,2	8,7	*2,5*	9,0	9,4	9,8	*0,8*
Finland	6,3	10,0	*3,7*	10,4	11,0	11,4	*1,0*
France	6,2	8,9	*2,7*	9,2	9,5	9,8	*0,6*
Germany	6,7	9,5	*2,8*	9,8	10,2	10,6	*0,7*
Greece	4,7	6,1	*1,4*	6,3	6,6	6,8	*0,4*
Ireland	6,3	7,9	*1,6*	8,1	8,4	8,7	*0,5*
Italy	6,2	8,9	*2,7*	9,2	9,5	9,8	*0,6*
Luxembourg	n.a	n.a		n.a	n.a	n.a	
Netherlands	7,3	10,0	*2,7*	10,4	11,1	11,7	*1,1*
Portugal	5,3	7,0	*1,7*	7,3	7,5	7,8	*0,5*
Spain	6,2	8,9	*2,7*	9,2	9,5	9,8	*0,6*
Sweden	7,5	10,4	*2,9*	10,8	11,4	11,8	*1,0*
United Kingdom	5,7	8,3	*2,6*	8,6	9,1	9,5	*0,8*
EU average	**6,2**	**8,9**	***2,7***	**9,2**	**9,7**	**10,1**	***0,8***

Source: Authors' calculations.

5.1 Projections for health- and long-term care expenditures

Health-care expenditures

A further increase in life expectancy in all countries (except for Denmark in the middle and high scenarios) will lead to an increase in health-care expenditures. Here it can be observed that the larger the projected reduction in mortality rates is, the larger the increase in health-care expenditures. Concentrating on the middle scenario we can see that an extra increase in life expectancy will have the greatest impact on expenditures in Spain and Germany, where expenditures rise by an additional 0.6% when compared with the base case scenario. For the EU they will on average increase by 0.4%. Countries that are least influenced by a possible further increase in life expectancy are Denmark, Sweden, the Netherlands and the UK respectively. Why a decrease in mortality rates leads to an increase in expenditures for this expenditure category is more explicitly analysed in Box 5.1, which shows the dynamics at work for an illustrative EU country.

Box 5.1 The effect of an increase in life expectancy on health-care expenditures

As shown in Table 5.1, an increase in life expectancy will lead to an increase in health- and long-term care expenditures. The outcome of this result is, however, not as straightforward as it seems. A decline in mortality rates leads in principle to two opposing effects. First of all, fewer people die and this leads to a reduction in mortality costs and thus a decline in expenditures on health- and long-term care as the costs of those who die are assumed to be higher than the cost of survivors. This could be seen in Figure 3.7. Second, the reduction in mortality rates will lead to an increase in the number of people, as fewer people die, who consume health for a longer period of time, the latter being equal to the expected increase in life expectancy. This increase in population will thus lead to an increase in total health- and long-term care expenditure. The balance between on the one hand a reduction in costs owing to a decrease in the number of mortalities and on the other hand an increase in the population with a related increase in health-care expenditure determines the amount that expenditures will rise or decline. The amount of savings or extra expenditures varies by age and by respective year, as the example below for an illustrative EU country shows.

We calculate the difference in health-care expenditure owing to a 20% decline, i.e. the low scenario, in mortality rates at two dates, the year 2000 (which is the first year in which this effect will take place) and the year 2050 (which is the last year for which health-care expenditures are projected). Table B.1 illustrates the dynamics at work for the year 2000. In the first and second columns the change in the number of mortalities and total population are shown. In the third, fourth and fifth columns the cost profiles for the average person are shown, in terms of Figure 3.7 *D*, *UH* and *UL* respectively. In the year 2000, a decline in mortality rates of 20% will lead to a reduction of the number of mortalities in the group aged 55-85 and a similar increase in total population. In the very first year of this simulation the demographic effect is relatively small and will lead to a reduction in the number of mortalities and an increase in the population of 484 persons. As mortality rates increase with age, a decline in these rates at higher ages will lead to larger effects on the number of mortalities and total population as age increases.

Changes in health-care expenditure and long-term care expenditure can now be calculated in columns six and seven by multiplying the change in the number of mortalities and total population with their respective cost components in the previous columns. As the mortality costs are subtracted from the health- and long-term care components by percentages, which differ by age (see Table 2.1), these changes cannot straightforwardly be calculated from the table itself, which only shows the health-care profiles in the year 2000.

Table B.1 Decomposition of the effect of a 20% decline in the mortality rate of persons aged 55-85 on health-care expenditures in 2000

2000	*Change in number of deaths*	*Change in total population*	*Costs of death per person*	*Health care exp. per person*	*Long term care exp. per person*	*Change in health care expenditure*	*Change in long term care exp.*	*Total impact on health costs (mln euros)*
Age								
55	-5	5	14617	1405	136	0,06	0,00	0,06
56	-5	5	14617	1395	135	0,07	0,00	0,07
57	-6	6	14617	1386	135	0,07	0,01	0,08
58	-7	7	14617	1385	135	0,08	0,01	0,09
59	-8	8	14617	1375	134	0,09	0,01	0,10
60	-8	8	14617	1667	168	0,10	0,01	0,11
61	-9	9	14617	1653	167	0,11	0,01	0,11
62	-9	9	14617	1641	166	0,11	0,01	0,12
63	-10	10	14617	1634	166	0,12	0,01	0,13
64	-11	11	14617	1624	165	0,13	0,01	0,14
65	-11	11	21926	2051	401	0,20	0,02	0,22
66	-11	11	21926	2016	398	0,20	0,02	0,22
67	-12	12	21926	2012	397	0,22	0,02	0,24
68	-13	13	21926	1989	395	0,24	0,02	0,27
69	-15	15	21926	1963	393	0,27	0,02	0,30
70	-16	16	21926	2470	716	0,27	0,03	0,30
71	-17	17	21926	2446	713	0,29	0,03	0,32
72	-18	18	21926	2392	707	0,31	0,03	0,34
73	-19	19	21926	2357	703	0,33	0,04	0,36
74	-20	20	21926	2310	698	0,35	0,04	0,39
75	-21	21	21926	2817	1604	0,31	0,06	0,38
76	-22	22	21926	2773	1594	0,33	0,07	0,40
77	-24	24	21926	2714	1582	0,36	0,07	0,43
78	-26	26	21926	2642	1567	0,39	0,08	0,47
79	-27	27	21926	2541	1547	0,41	0,08	0,49
80	-22	22	21926	2733	3224	0,27	0,09	0,36
81	-19	19	21926	2622	3187	0,23	0,08	0,31
82	-19	19	21926	2737	3225	0,23	0,08	0,31
83	-22	22	21926	2722	3220	0,26	0,09	0,35
84	-25	25	21926	2680	3206	0,31	0,10	0,41
85	-28	28	29234	2777	6174	0,40	0,18	0,59
86	0	0	29234	2428	6013	0,00	0,00	0,00
87	0	0	29234	2213	5914	0,00	0,00	0,00
88	0	0	29234	1867	5754	0,00	0,00	0,00
89	0	0	29234	1617	5639	0,00	0,00	0,00
90	0	0	29234	1979	7739	0,00	0,00	0,00
91	0	0	29234	1697	7516	0,00	0,00	0,00
92	0	0	29234	1379	7264	0,00	0,00	0,00
93	0	0	29234	1059	7010	0,00	0,00	0,00
94	0	0	29234	630	6670	0,00	0,00	0,00
95	0	0	29234	2823	5374	0,00	0,00	0,00
96	0	0	29234	2700	4641	0,00	0,00	0,00
97	0	0	29234	2628	4212	0,00	0,00	0,00
98	0	0	29234	2424	2998	0,00	0,00	0,00
99	0	0	29234	2087	991	0,00	0,00	0,00
Total	**-484**	**484**				**7,1**	**1,3**	**8,5**

Source: Authors' calculations.

Table B.2 Decomposition of the effect of a 20% decline in the mortality rate of persons aged 55-85 on health-care expenditures in 2050 (cumulative effects after 50 years)

2050	Change in number of deaths	Change in total population	Costs of death per person	Health care exp. per person	Long term care exp. per person	Change in health care expenditure	Change in long term care exp.	Total impact on health costs (mln euros)
Age								
55	-136	271	14617	1405	136	3,57	0,25	3,81
56	-153	439	14617	1395	135	3,55	0,23	3,79
57	-171	625	14617	1386	135	3,52	0,22	3,74
58	-188	824	14617	1385	135	3,43	0,20	3,63
59	-211	1060	14617	1375	134	3,41	0,18	3,59
60	-228	1281	14617	1667	168	2,34	0,04	2,38
61	-250	1536	14617	1653	167	2,09	0,00	2,09
62	-269	1782	14617	1641	166	1,78	-0,05	1,73
63	-293	2068	14617	1634	166	1,47	-0,10	1,36
64	-319	2377	14617	1624	165	1,15	-0,16	0,99
65	-349	2729	21926	2051	401	3,29	-0,98	2,30
66	-383	3131	21926	2016	398	3,23	-1,19	2,04
67	-426	3609	21926	2012	397	2,99	-1,44	1,55
68	-466	4084	21926	1989	395	2,87	-1,68	1,19
69	-515	4645	21926	1963	393	2,82	-1,96	0,85
70	-558	5161	21926	2470	716	-4,79	-5,39	-10,18
71	-613	5796	21926	2446	713	-5,69	-6,10	-11,79
72	-673	6505	21926	2392	707	-6,25	-6,85	-13,10
73	-737	7280	21926	2357	703	-7,11	-7,70	-14,80
74	-805	8114	21926	2310	698	-7,77	-8,58	-16,35
75	-883	9068	21926	2817	1604	-24,84	-25,38	-50,21
76	-948	9969	21926	2773	1594	-27,19	-27,93	-55,13
77	-1048	11282	21926	2714	1582	-30,21	-31,56	-61,77
78	-1156	12775	21926	2642	1567	-33,23	-35,60	-68,83
79	-1234	14049	21926	2541	1547	-34,71	-38,87	-73,57
80	-1337	15695	21926	2733	3224	-56,33	-99,15	-155,48
81	-1407	17226	21926	2622	3187	-59,35	-108,32	-167,68
82	-1459	18680	21926	2737	3225	-71,94	-120,38	-192,32
83	-1487	20279	21926	2722	3220	-80,83	-132,15	-212,98
84	-1449	21509	21926	2680	3206	-88,05	-141,65	-229,71
85	-1381	22794	29234	2777	6174	-97,61	-298,83	-396,44
86	1611	17071	29234	2428	6013	-165,44	-297,70	-463,14
87	1572	14441	29234	2213	5914	-140,87	-254,73	-395,60
88	1523	12124	29234	1867	5754	-116,31	-215,38	-331,68
89	1488	9807	29234	1617	5639	-98,47	-179,27	-277,75
90	1358	7789	29234	1979	7739	-79,66	-199,89	-279,55
91	1173	6011	29234	1697	7516	-61,27	-155,97	-217,25
92	1006	4652	29234	1379	7264	-46,90	-121,77	-168,68
93	844	3487	29234	1059	7010	-35,24	-92,67	-127,91
94	683	2552	29234	630	6670	-25,16	-68,30	-93,47
95	550	1807	29234	2823	5374	-20,15	-54,70	-74,85
96	413	1250	29234	2700	4641	-14,02	-37,44	-51,46
97	314	848	29234	2628	4212	-9,85	-26,45	-36,30
98	229	551	29234	2424	2998	-6,48	-16,95	-23,43
99	170	334	29234	2087	991	-4,10	-10,44	-14,54
Total	-8599	319368				-1418	-2833	-4251

Source: Authors' calculations.

Box 5.1 cont'd.

As the last column shows, a decline in mortality rates leads to a reduction in both health-care and long-term care expenditures, where a positive sign indicates a saving and a minus sign indicates an increase in expenditures, and thus total expenditures for all ages. The reduction in the number of mortalities and its associated costs thus outweigh the increase in health-care expenditure owing to an increase in population in the first year of the projection.

Table B.2 shows the expected change in health-care expenditure by its various components at the end of the projection period. As the demographic situation has changed considerably in the period until 2050, the population aged 55 and over has increased substantially compared with the base case scenario. A decline in the mortality rate at the beginning of the projection period will lead to a cumulative process of changes in the population and number of mortalities during the projection period. A decrease in mortality rates at the year 2000 for persons aged 55 will notably not only lead to more persons in the next year, who are then aged 56, but also the year after that and so on. As mortality rates stay the same for those aged 86 and over, an increase in population through time caused by a reduction in mortality rates between ages 55 and 85 will from that age on lead to a larger number of mortalities as can be seen in the table. This will thus lead to an increase in expenditures on health care as the costs of mortality are higher than the cost of survivors at these ages. For a person aged 86, the cost of mortality is for example €29,234 while the combined health-care and long-term care costs for a survivor are only €8,441.

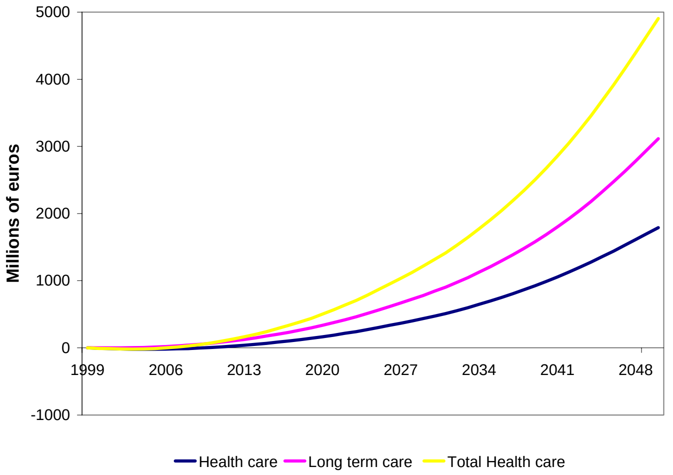
As can be seen in Table B.2, the number of mortalities in 2050 and the increase in population are very different from each other. The total number of mortalities is 8,599 persons less in 2050 compared with the base case scenario. A decline in the number of mortalities from age 55 to 85 is, however, countered by increases in the number of mortalities of persons aged 86 and over. The population increases by 319,368 persons if we compare the population in 2050 with that in the base case scenario. When looking at the development in health-care expenditure it can be seen that these expenditures decline for people aged 55 to 69 and increase for those aged 70 and over. These expenditures reach a peak at age 86 and from there on the difference in expenditures decreases.

For long-term care expenditures we see a similar pattern, although the age at which a reduction in mortality rates leads to less expenditure only applies for those aged 55 to 61. We can also see that while most of the reduction in expenditures can be attributed to savings on health-care expenditures, the increase in expenditures can mostly be attributed to increases in long-term care spending. This follows from Table 2.1, which shows that the cost of mortality until the age of 90 largely consists of expenditure on health care and not on expenditure on long-term care. If we look at age 85 for example, we can see that while health-care expenditures can be expected to increase by €97.6 million, those of long-term care are expected to increase by almost triple this figure, €298.8 million. Looking at the total figures, health-care expenditures are expected to increase by €4.3 billion in 2050 if mortality rates develop as sketched. Figure B.1 shows the expected development of the change in health-care, long-term care and total health-care costs until 2050.

Figure B.1 shows that in the first years – 2009 for health-care expenditure, 2003 for long-term care expenditure and 2006 for total health-care expenditure – a decline in mortality rates will lead to a reduction in health-care expenditure. After that initial period, health-care expenditures will increase substantially. The increase in total health-care expenditure is mainly driven by the increase in long-term care expenditures as depicted in the figure.

To detect how sensitive the chosen reduction in mortality rates was to the outcome of the above result, we also ran four other scenarios, with varying rates of decline and increase in mortality rates. Not surprisingly, it turned out that the higher the rate of decline in mortality rates was, the higher the increase in expenditures. An increase in mortality rates on the other hand (a reduction in life expectancy), would lead to a reduction in total health-care expenditure. The picture sketched in Tables 5.3 and 5.4 would in this case be reversed. The number of mortalities would increase and this will result in a smaller population over time as fewer people will survive during consecutive years. The amount of savings would thus increase with time.

Figure B.1 Development of the difference in health-, long-term and total health-care expenditures when mortality rates are projected as having declined by 20% compared with the base case scenario



Long-term care expenditures

Long-term care expenditures are expected to increase on the same scale as those of health-care expenditures, but the results differ much more widely among countries. Although the projected increase in life expectancy in the middle scenario only marginally influences long-term care expenditures in Germany and Italy, it significantly influences these expenditures in the Scandinavian countries and the Netherlands. In the latter group of countries long-term care expenditures will increase by approximately 1%. If we compare expenditures on health care and long-term care for Denmark we can now see that the long-term care expenditures in the middle scenario are larger than those of health-care expenditures. As already seen in the base case scenario, long-term care expenditures are more sensitive to the ageing process than health-care expenditures. A further decline in mortality rates will in almost all countries for which information is available lead to a doubling of long-term care expenditures in the year 2050 when compared with the base case scenario in the starting year.

Total health- and long-term care expenditures

Compared with the base case scenario, total health- and long-term care expenditures will increase on average by 0.8% for the EU, ranging from 0.4 percentage points in Greece to 1.1 percentage points in the Netherlands. When we look at the percentage of GDP that is spent on health care, Austria, Finland, Germany, the Netherlands and Sweden are expected to spend more than 10% of their GDP on total health- and long-term care in 2050 in the middle living longer scenario. A further increase in life expectancy will thus significantly increase total health- and long-term care expenditures.

5.2 Projection of public pension expenditures

Table 5.2 presents the influence of a decline in mortality rates on pension expenditures, as incorporated in the respective low, middle and high scenarios described earlier. A decline in mortality rates will lead to an increase in expenditures in all countries as the number of persons who are eligible for pension benefits increases and they will receive pensions over a longer period. In these projections we have not taken account of any specific rules in pension arrangements that lower pension benefits when life expectancy increases, which, as was pointed out in section 4.2, are important elements of the pension systems in Sweden and Italy. Just as was the case for health-care expenditures, the greater the postulated reduction in mortality rates is, the greater the expected increase in pension expenditures. The postulated decline in mortality rates in the middle scenario will have the greatest impact on Germany, Greece and Spain, where pension expenditures would increase by 1.9%, 2.5% and 1.8% respectively if life expectancy was to improve further. Ireland, Luxembourg and the UK on the other hand are the countries that would be least affected by a further increase in life expectancy. Compared with the base case scenario, the postulated decline in mortality rates will lead to an increase of 1.4% in pension expenditures for the average EU country.

Table 5.2 Public pension expenditures, living longer scenario (% of GDP)

	Base case			Living longer			
				Low	Middle	High	
	2002	2050	*% incr. Exp 2002-2050*	2050	2050	2050	*extra incr.*
Austria	14,5	17,0	*2,5*	17,7	18,7	19,6	*1,7*
Belgium	10,0	13,2	*3,1*	13,7	14,5	15,1	*1,3*
Denmark	10,6	13,1	*2,5*	13,8	14,7	15,5	*1,5*
Finland	11,5	15,8	*4,3*	16,4	17,2	17,9	*1,5*
France	12,1	16,4	*4,2*	16,9	17,7	18,3	*1,3*
Germany	11,9	16,8	*4,9*	17,6	18,6	19,5	*1,9*
Greece	12,8	24,7	*11,9*	25,7	27,2	28,4	*2,5*
Ireland	4,6	8,7	*4,1*	9,1	9,6	10,0	*0,9*
Italy	13,9	14,1	*0,2*	14,7	15,5	16,3	*1,5*
Luxembourg	7,4	9,2	*1,7*	9,6	10,1	10,6	*0,9*
Netherlands	8,1	13,5	*5,4*	14,2	15,1	16,0	*1,7*
Portugal	9,8	13,1	*3,3*	13,7	14,4	15,1	*1,4*
Spain	9,5	17,4	*7,9*	18,2	19,2	20,1	*1,8*
Sweden	9,0	10,6	*1,6*	11,0	11,6	12,1	*1,0*
United Kingdom	5,4	4,4	*-1,0*	4,6	4,9	5,1	*0,5*
EU average	**10,5**	**13,4**	***2,9***	**14,0**	**14,8**	**15,5**	***1,4***

Source: Authors' calculations.

5.3 Government finances

As could be seen in the previous paragraphs, a further decline in mortality rates will increase expenditures on total health- and long-term care as well as pensions. In this section we investigate how this will impact on the sustainability of government finances following the same approach that was used in section 4.3. The projected increase in expenditures here refers to the increase in life expectancy as postulated in the middle living-longer scenario. Table 5.3 sums up the difference in the increase in public expenditures between the base case and this alternative demographic scenario.

Table 5.3 Net change in public expenditures compared with base case scenario (% of GDP)

			Change in expenditures			
	Public exp. In 2002, Base case	Total increase in expenditures Base case	Health and long term care	Pensions	Total	Public exp. In 2050, Living longer scenario
Austria	20,2	6,0	0,8	1,7	2,5	28,8
Belgium	16,0	5,7	0,7	1,3	2,0	23,6
Denmark	16,8	5,0	0,8	1,5	2,3	24,1
Finland	17,7	8,0	1,0	1,5	2,4	28,2
France	18,3	6,9	0,6	1,3	1,9	27,1
Germany	18,6	7,6	0,7	1,9	2,6	28,9
Greece	17,5	13,4	0,4	2,5	2,9	33,8
Ireland	10,8	6,3	0,5	0,9	1,5	18,6
Italy	20,0	3,0	0,6	1,5	2,1	25,1
Luxembourg	7,4	1,7	n.a.	0,9	0,9	10,1
Netherlands	15,3	8,1	1,1	1,7	2,8	26,2
Portugal	15,2	5,1	0,5	1,4	1,9	22,2
Spain	15,7	10,6	0,6	1,8	2,4	28,7
Sweden	16,5	4,5	1,0	1,0	2,0	23,0
United Kingdom	11,1	1,6	0,8	0,5	1,3	14,0
EU average	**16,7**	**5,6**	**0,8**	**1,4**	**2,2**	**24,5**

Source: Authors' calculations.

An increase in life expectancy of 3.2 years will on average lead to a 2.2% increase in public expenditures. Luxembourg and the UK are the countries that are least affected by the postulated increase in life expectancy, while Greece and the Netherlands will face the greatest increase in expenditures. Looking at the contributions of the health and pension components to this increase one can depict that the increase in pensions is on average almost twice as large as that of total health- and long-term care, i.e. 1.4% compared with 0.8%. This result differs from that in the base case scenario, where health-care expenditures and pension expenditures contributed equally to the total increase in public expenditures. As explained in Box 5.1, this can partly be ascribed to the fact that a decline in mortality rates leads to two opposing effects on health-care and long-term care expenditures. On the one hand a decline in mortality rates will lead to a reduction in health-care costs as fewer people will die and on the other hand it will lead to an increase in health-care costs for the respective components as total population and thus total health consumption increases. Pensions are affected in a direct manner and in only one way. An increase in life expectancy will lead to more years of pensions being paid out and thus an increase in total expenditures. As previously mentioned, no account is taken of any correction mechanisms that may reduce the benefit level of pensions as a response to the projected increase in life expectancy and this may also influence the projected increase in public pension expenditures.

Table 5.4 shows the change in sustainability gaps caused by the projected increase in life expectancy in our middle scenario compared with that of the base case scenario. To keep government finances sustainable in this alternative demographic scenario, taxes have to be increased by an additional 0.89% for the average EU country. If we look at the individual countries we can see that the Netherlands, Greece and Germany would have to increase their taxes the most to keep their government finances sustainable. This corresponds to the findings in Table 5.3, where those same countries showed the highest increase in public expenditures in the middle living-longer scenario. As explained there, most of the necessary adjustment in sustainability gaps can be attributed to the increase in pension expenditures. The UK and Luxembourg on the other hand are the countries that are least affected by a further increase in life expectancy. In the UK the required adjustment in taxes can mainly be attributed to the increase in health-care expenditures, while the figures for Luxembourg are not very reliable owing to the lack of essential information on the development of health- and long-term care expenditures.

Table 5.4 Change in sustainability gaps in EU countries in the living longer scenario (% of GDP)

Group A	Denmark	1,00	Group C	Ireland	0,87
	Sweden	0,91		Luxembourg	0,47
				Netherlands	1,49
				Portugal	0,85
				Spain	0,97
Group B	Belgium	0,86	Group D	France	0,89
	Austria	1,00		Germany	1,10
	Finland	1,02		Greece	1,38
	Italy	0,74			
	United Kingdom	0,46			
	EU average	**0,89**			

Source: Authors' calculations.

Chapter 6
Living in Better Health

In this chapter we investigate how an improvement in health will impact on the projections of health-care and pension expenditures and government finances in the base case scenario. As outlined in chapter 3 and shown in Table A1.5 in the appendix, the Eurostat demographic projections show that life expectancy will continue to increase in the near future. Part of this can be explained by the evolution of medical technologies and the introduction of new and better medicines. It seems plausible, however, that part of this increase in life expectancy can also be attributed to the fact that health, without any medical intervention, genuinely improves as a result of changed health behaviour and nutrition, for example. If so, this improvement in health may dampen the projected increase in health and pension expenditures as sketched in our base case scenario.

In the case of health care, healthier people can be assumed to need less medical attention and an increase in the average health status of a population could thus lead to savings on health-care expenditures. Regarding pension expenditures, better health may postpone early retirement, retirement in general and is expected to reduce the inflow into disability schemes. Better health will therefore increase the labour force participation rate and will reduce the number of persons aged 55 and over who are dependent on benefits. An improvement in the average health status of a population may therefore have quite a significant impact on both health-care and pension expenditures. In this chapter we investigate how large this impact is, using the assumptions we have made in chapter 3 and using the methodology described in chapter 2. Although it is clear that an improvement in the health status of a population will lead to less expenditure, as follows from our assumptions, the more interesting question is to what extent this effect may dampen the projected increase in expenditures as pictured in the base case scenario. Following Jacobzone et al. (2000), in this sense it is interesting to seek an answer the following question: Is the health of people in the EU improving fast enough to compensate for population ageing?

6.1 Projections for health- and long-term care expenditures

As outlined in chapter 3 we assume that health improves according to the variable life expectancy in good health, the development of which is shown in Table 3.3. As reported in chapter 3, we assume relatively low elasticities guiding the relation between health changes and health-care expenditures, assuming an elasticity of -0.3 for the ages 0-64 and -0.2 for the ages 65 and over. A 10% increase in the average health status of the population will thus lead to a 3% decline in health- and long-term care expenditures for persons aged 0 to 64 and 2% less expenditure for those aged 65 and over. As an improvement in health will lead to higher labour force participation and thus an increase in GDP and more generally in welfare, we assume that health- and long-term care expenditures will rise in line with this welfare increase. This relation follows from earlier studies, which show a clear link between health-care expenditure and welfare. This effect thus partly offsets the reduction in expenditures owing to better health. Table 6.1 shows the projections of health- and long-term care expenditures when the above-mentioned features are incorporated into the projections. The respective scenario is labelled the ‘living in better health scenario’.

Table 6.1 Projections of public expenditure on health- and long-term care (% of GDP), living in better health scenario

Health care expenditure (% of GDP)					
	Base case			Living in better health	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	5,1	7,7	*2,5*	6,9	*-0,8*
Belgium	5,2	6,9	*1,7*	6,4	*-0,5*
Denmark	4,0	4,6	*0,6*	4,3	*-0,3*
Finland	4,8	6,7	*1,9*	6,0	*-0,6*
France	5,5	7,4	*1,9*	6,7	*-0,7*
Germany	6,5	8,9	*2,4*	7,5	*-1,3*
Greece	4,7	6,1	*1,4*	5,6	*-0,5*
Ireland	5,6	6,6	*1,0*	6,2	*-0,4*
Italy	5,5	7,7	*2,2*	6,6	*-1,0*
Luxembourg	n.a	n.a		n.a	
Netherlands	4,7	5,5	*0,8*	5,1	*-0,3*
Portugal	5,3	7,0	*1,7*	5,6	*-1,5*
Spain	6,2	8,9	*2,7*	8,3	*-0,6*
Sweden	5,1	6,0	*0,9*	5,5	*-0,6*
United Kingdom	3,9	4,9	*0,9*	4,6	*-0,3*
EU average	**5,4**	**7,1**	***1,7***	**6,3**	***-0,8***

Long term care expenditure (% of GDP)					
	Base case			Living in better health	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	0,6	1,6	*1,0*	1,4	*-0,2*
Belgium	0,7	1,6	*0,9*	1,5	*-0,1*
Denmark	2,2	4,1	*1,9*	3,8	*-0,3*
Finland	1,5	3,3	*1,9*	2,9	*-0,4*
France	0,7	1,5	*0,8*	1,3	*-0,2*
Germany	0,3	0,6	*0,4*	0,5	*-0,1*
Greece	n.a.	n.a.		n.a.	
Ireland	0,7	1,2	*0,6*	1,1	*-0,1*
Italy	0,7	1,2	*0,5*	1,0	*-0,2*
Luxembourg	n.a	n.a		n.a	
Netherlands	2,6	4,5	*1,9*	4,1	*-0,3*
Portugal	n.a.	n.a.		n.a.	
Spain	n.a.	n.a.		n.a.	
Sweden	2,4	4,3	*2,0*	3,7	*-0,6*
United Kingdom	1,7	3,4	*1,7*	3,1	*-0,3*
EU average	**0,9**	**1,8**	***0,9***	**1,6**	***-0,2***

Total health and long-term care expenditure (% of GDP)					
	Base case			Living in better health	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	5,8	9,3	*3,5*	8,3	*-1,0*
Belgium	5,9	8,5	*2,6*	7,8	*-0,7*
Denmark	6,2	8,7	*2,5*	8,1	*-0,6*
Finland	6,3	10,0	*3,7*	8,9	*-1,1*
France	6,2	8,9	*2,7*	8,1	*-0,9*
Germany	6,7	9,5	*2,8*	8,0	*-1,5*
Greece	4,7	6,1	*1,4*	5,6	*-0,5*
Ireland	6,3	7,9	*1,6*	7,3	*-0,5*
Italy	6,2	8,9	*2,7*	7,7	*-1,2*
Luxembourg	n.a	n.a		n.a	
Netherlands	7,3	10,0	*2,7*	9,3	*-0,7*
Portugal	5,3	7,0	*1,7*	5,6	*-1,5*
Spain	6,2	8,9	*2,7*	8,3	*-0,6*
Sweden	7,5	10,4	*2,9*	9,2	*-1,2*
United Kingdom	5,7	8,3	*2,6*	7,7	*-0,6*
EU average	**6,2**	**8,9**	***2,7***	**8,0**	***-0,9***

Source: Authors' calculations.

Health-care expenditures

An improvement in health will lead to a decrease in health-care expenditures when compared with the base case scenario. On average, expenditures will decrease by 0.8% for this category for the EU. The effect differs by country, and the reduction in expenditures will be greatest in those countries with the largest expected health improvement (which are Germany, Italy and Portugal as can be gauged from Table 3.3).

Long-term care expenditures

An improvement in health will likewise lead to a reduction in expenditures on long-term care. For the EU average, Table 6.1 shows that expenditures in the living in better health scenario will be 0.2% lower than those in the base case scenario. As those aged 65 and over use these services, the conditions that apply to this group determine the impact of an improvement in health on long-term care expenditures. Relatively speaking, the reduction in expenditures is smaller than that for health care, which can be attributed to the lower elasticity between health and health-care expenditures for persons aged 65 and over. Nevertheless, the expected improvement in health can in some countries lead to substantial savings on long-term care expenditures, especially in the Scandinavian countries, the Netherlands and the UK.

Total health- and long-term care expenditures

Total health- and long-term care expenditures will on average decline by 0.9% for the EU when compared with the base case scenario. An improvement in health will thus require less public expenditure on health care, i.e. 8.0% of GDP instead of 8.9% of GDP in the base case scenario in 2050. Yet as one can see from Table 6.1, the expected improvement in health is not large enough to offset the impact of population ageing as highlighted in the base case scenario in the first three columns. It will, however, lead to a rosier picture on the development of these expenditures.

6.2 Projection of public pension expenditures

Table 6.2 shows the projected pension expenditures in the living in better health scenario. As previously explained, an improvement in health will lead to a decline in the number of recipients and thus less expenditure on pension benefits. Here we abstract from any direct link between the number of years worked and the amount of the pension benefit, as we do not want to digress into any tedious calculations about the actuarial fairness of pension systems in the respective EU countries for which we perform projections. An improvement in health will lead to a decline in expenditures on pensions of 0.9% compared with the base case scenario for the average EU country. The countries that will benefit most from the incorporation of a health trend in the projections are once again the countries with the largest health improvements. This can of course be attributed to our assumption of equal elasticities for all EU countries. The projected decline in expenditures is about equal in size to the projected reduction in expenditures on health and long-term care in Table 6.1.

Table 6.2 Expenditures on public pensions in the living in better health scenario (% of GDP)

	Base case			Living in better health	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	14,5	17,0	*2,5*	16,0	*-0,9*
Belgium	10,0	13,2	*3,1*	12,4	*-0,8*
Denmark	10,6	13,1	*2,5*	12,4	*-0,7*
Finland	11,5	15,8	*4,3*	14,7	*-1,1*
France	12,1	16,4	*4,2*	15,1	*-1,2*
Germany	11,9	16,8	*4,9*	15,7	*-1,1*
Greece	12,8	24,7	*11,9*	23,6	*-1,0*
Ireland	4,6	8,7	*4,1*	8,2	*-0,4*
Italy	13,9	14,1	*0,2*	13,4	*-0,7*
Luxembourg	7,4	9,2	*1,7*	8,2	*-1,0*
Netherlands	8,1	13,5	*5,4*	12,4	*-1,0*
Portugal	9,8	13,1	*3,3*	11,5	*-1,6*
Spain	9,5	17,4	*7,9*	16,7	*-0,7*
Sweden	9,0	10,6	*1,6*	9,9	*-0,7*
United Kingdom	5,4	4,4	*-1,0*	4,0	*-0,4*
EU average	**10,5**	**13,4**	***2,9***	**12,4**	***-0,9***

Source: Authors' calculations.

6.3 Government finances

Table 6.3 shows the impact of an improvement in health on total public expenditures compared with the base case scenario. It sums up the conclusions reached in the previous two paragraphs. The first two columns summarise the situation in the base case. The second column shows the total change in expenditures in the projection period in the base case scenario, i.e. in the period between 2002 and 2050. The third and fourth columns show the respective changes in expenditures in health care and pensions compared with the base case scenario if health improves according to our living in better health scenario. The sixth column shows total public expenditures in 2050 in our living in better health scenario.

An improvement in health when measured at the end of the projection period will lead to a 1.9 percentage point decline in GDP on expenditures for health- and long-term care and pensions. Public expenditures will, however, still increase on average by 3.7% during the period between 2002 and 2050 when the projected improvement in health is incorporated. As can be concluded from the table, the results vary widely among countries. Especially Portugal, Germany, Finland and France will benefit from an improvement in health as can be seen in column five of the table. The results for these countries can mainly be attributed to the fact that the expected health of men and women will improve rapidly and following our premises this will lead to less expenditure on health care and pensions. While the pension and health- and long-term care components contribute equally to the decline in total public expenditures, this is not the case for all countries. For Germany, Italy and Sweden, for example, the reduction in public expenditures can mostly be attributed to the decline in health- and long-term care expenditures. On the other hand, for the Netherlands, Greece and France, the projected decline in expenditures is mostly caused by savings on pension expenditures.

Table 6.3 Net change in public expenditures (% of GDP)

			Change in expenditures			
	Public exp. In 2002, Base case	Total increase in expenditures Base case	Health and long term care	Pensions	Total	Public exp. In 2050, Living in better health scenario
Austria	20,2	6,0	-1,0	-0,9	-1,9	24,3
Belgium	16,0	5,7	-0,7	-0,8	-1,5	20,2
Denmark	16,8	5,0	-0,6	-0,7	-1,3	20,6
Finland	17,7	8,0	-1,1	-1,1	-2,1	23,6
France	18,3	6,9	-0,9	-1,2	-2,1	23,1
Germany	18,6	7,6	-1,5	-1,1	-2,5	23,7
Greece	17,5	13,4	-0,5	-1,0	-1,5	29,3
Ireland	10,8	6,3	-0,5	-0,4	-1,0	16,2
Italy	20,0	3,0	-1,2	-0,7	-1,9	21,1
Luxembourg	7,4	1,7	n.a.	-1,0	-1,0	8,2
Netherlands	15,3	8,1	-0,7	-1,0	-1,7	21,7
Portugal	15,2	5,1	-1,5	-1,6	-3,1	17,2
Spain	15,7	10,6	-0,6	-0,7	-1,3	25,0
Sweden	16,5	4,5	-1,2	-0,7	-1,9	19,1
United Kingdom	11,1	1,6	-0,6	-0,4	-1,0	11,7
EU average	**16,7**	**5,6**	**-0,9**	**-0,9**	**-1,9**	**20,4**

Source: Authors' calculations.

Sustainability gaps in the living in better health scenario

Compared with the base case scenario, the living in better health scenario will lead to less pressure on government finances. Table 6.4 shows the corresponding change in sustainability gaps. All countries show much more favourable government finances and on average the sustainability gap will decline by 0.65%, i.e. from 3.15% in the base case scenario to 2.50% in the living in better health scenario. If the respective changes in the sustainability gaps are subtracted from the base case figures for the individual countries, one can see that in the living in better health scenario four countries would face no sustainability problems. Besides the countries already mentioned in the base case scenario (Denmark and Sweden), Finland and Belgium would also not have to increase their taxes in light of the increase in expenditures caused by the ageing of the population. Notwithstanding this improvement, the sustainability of government finances will remain a serious problem for the EU.

Table 6.4 Change in the sustainability gaps in the living in better health scenario (% of GDP) compared with the base case scenario

Group A	Denmark	-0,48	Group C	Ireland	-0,22
	Sweden	-0,67		Luxembourg	0,23
				Netherlands	-0,66
				Portugal	-0,73
				Spain	-0,43
Group B	Belgium	-0,66	Group D	France	-0,67
	Austria	-0,88		Germany	-1,12
	Finland	-0,95		Greece	-0,52
	Italy	-0,83			
	United Kingdom	0,00			
	EU average	**-0,65**			

Source: Authors' calculations.

Chapter 7
Living in Worse Health

In a sense, this chapter considers the opposite question of that in the previous chapter. It focuses on the implications of a worsening of the health status of the population. The motivation for such a scenario is the rise in obesity that has occurred since 1980 in the US and also in other industrialised countries. Sturm (2002) calculates that in 1998 obesity accounted for a 36% increase in inpatient and outpatient spending. Finkelstein et al. (2003) finds that more than 9% of American medical spending must be attributed to weight problems. As obesity has become more widespread, its contribution to medical spending has grown over time. Indeed, the proportion of the growth in medical spending over the 1987-2001 period that must be attributed to both the increasing number of people with weight problems and the rise in spending on obese persons relative to those of normal weight is more than 25% (Thorpe et al., 2004).

If these trends in body mass continue in the future, we can expect to see more individuals with weight problems, more persons reporting fair or poor health and higher rates of medical spending (Sturm et al., 2004). That is not to say that medical spending per se will go up. The trend of a decline in disability rates over more than 10 years time (Manton et al., 1997) may continue in the future as well and outweigh the effects of the increase of persons with weight problems. But the opposite may also be true. As especially young cohorts suffer from weight problems, the impact of this trend may grow over time as the older cohorts, which have relatively large numbers of persons, with normal weight gradually die off (Lakdawalla et al., 2003).

Although there is some evidence now on the effects of obesity and being overweight, there is still far too little to derive an estimate of the likely rate of growth of disability rates over the coming decades in the EU area. Therefore, we have simply taken the change in health status over time that underlies the calculations in the previous chapter and reversed its sign. The elasticities that describe the relation between health status on the one hand and health-care expenditure, labour force participation and the use of social security on the other hand are identical to the ones used in the previous chapter.

7.1 Projections for health- and long-term care expenditures

Tables 7.1 through 7.3 show the projections of health- and long-term care expenditures when the above-mentioned features are incorporated into the projections. The respective scenario is labelled as the ‘living in worse health scenario’.

The worsening of the health status increases acute health-care expenditure. On average, the ratio of acute health-care expenditure to GDP will increase by 0.8%. Worse health will likewise increase the spending on long-term care. For the EU, this effect amounts to 0.2 percentage points of GDP.

Table 7.1 Projections of public expenditure on health care, living in worse health scenario, acute health-care expenditure (% of GDP)

	Base case			Living in worse health	
	2002	2050	2002-50 Incr. in exp.	2050	Extra increase
Acute health-care expenditure					
Austria	5.1	7.7	2.5	8.5	0.8
Belgium	5.2	6.9	1.7	7.4	0.5
Denmark	4.0	4.6	0.6	4.9	0.3
Finland	4.8	6.7	1.9	7.3	0.6
France	5.5	7.4	1.9	8.1	0.7
Germany	6.5	8.9	2.4	10.2	1.3
Greece	4.7	6.1	1.4	6.6	0.5
Ireland	5.6	6.6	1.0	7.0	0.4
Italy	5.5	7.7	2.2	8.7	1.0
Luxembourg	n.a.	n.a	–	–	–
Netherlands	4.7	5.5	0.8	5.8	0.3
Portugal	5.3	7.0	1.7	8.4	1.4
Spain	6.2	8.9	2.7	9.5	0.6
Sweden	5.1	6.0	0.9	6.5	0.5
United Kingdom	3.9	4.9	0.9	5.2	0.3
EU average	**5.4**	**7.1**	**1.7**	**7.8**	**0.7**

Source: Authors' calculations.

Table 7.2 Projections of public expenditure on health care, living in worse health scenario, long-term care expenditure (% of GDP)

	Base case			Living in worse health	
	2002	2050	2002-50 Incr. in exp.	2050	Extra increase
Long-term care expenditure					
Austria	0.6	1.6	1.0	1.8	0.2
Belgium	0.7	1.6	0.9	1.7	0.1
Denmark	2.2	4.1	1.9	4.4	0.3
Finland	1.5	3.3	1.9	3.7	0.4
France	0.7	1.5	0.8	1.7	0.2
Germany	0.3	0.6	0.4	0.7	0.1
Greece	n.a.	n.a.		n.a.	
Ireland	0.7	1.2	0.5	1.3	0.1
Italy	0.7	1.2	0.5	1.4	0.2
Luxembourg	n.a	n.a			
Netherlands	2.6	4.5	1.9	4.8	0.3
Portugal	n.a.	n.a.		n.a.	
Spain	n.a.	n.a.		n.a.	
Sweden	2.4	4.3	2.0	4.9	0.6
United Kingdom	1.7	3.4	1.7	3.7	0.3
EU average	**0.9**	**1.8**	**0.9**	**2.0**	**0.2**

Source: Authors' calculations.

Table 7.3 Projections of public expenditure on health care, living in worse health scenario, total health- and long-term care expenditure (% of GDP)

	Base case			Living in worse health	
	2002	2050	2002-50 Incr. in exp.	2050	Extra increase
Total health- and long-term care expenditure					
Austria	5.8	9.3	3.5	10.3	1.0
Belgium	5.9	8.5	2.6	9.2	0.7
Denmark	6.2	8.7	2.5	9.3	0.6
Finland	6.3	10.0	3.7	11.1	1.1
France	6.2	8.9	2.7	9.8	0.9
Germany	6.7	9.5	2.8	11.0	1.5
Greece	4.7	6.1	1.4	6.6	0.5
Ireland	6.3	7.9	1.6	8.4	0.5
Italy	6.2	8.9	2.7	10.1	1.2
Luxembourg	n.a	n.a	–	n.a.	–
Netherlands	7.3	10.0	2.7	10.7	0.7
Portugal	5.3	7.0	1.7	8.4	1.4
Spain	6.2	8.9	2.7	9.5	0.6
Sweden	7.5	10.4	2.9	11.6	1.2
United Kingdom	5.7	8.3	2.6	8.9	0.6
EU average	**6.2**	**8.9**	**2.7**	**9.8**	**0.9**

Source: Authors' calculations.

7.2 Projection of public pension expenditures

Table 7.2 shows the projected pension expenditure in the living in worse health scenario. A worsening of health will reduce labour market participation and increase the number of persons living on social security. It will also lead to an increase in expenditures on pensions of 0.9% compared with the base case scenario for the average European country. The projected increase in expenditure is therefore about equal in size to the projected increase in expenditure on health care in Table 7.1.

7.3 Government finances

Table 7.4 shows the impact of worse health on total public expenditures compared with the base case scenario. The first two columns summarise the base case scenario. The second column shows the total change in expenditures in the projection period in the base case scenario. The third and fourth columns show the respective changes in expenditures in health care and pensions compared with the base case scenario if health deteriorates according to our living in worse health scenario. The sixth column shows total public expenditures in 2050.

A worsening of health when measured at the end of the projection period will imply a 1.9 percentage point increase of GDP in expenditure for health care and pensions. Public expenditure will on average increase by 7.6 percentage points of GDP during the period between 2002 and 2050 when the projected worsening of health is incorporated (Table 7.5).

Table 7.4 Expenditures on public pensions, living in worse health scenario (% of GDP)

	Base case			Living in worse health	
	2002	2050	2002-50 Incr. in exp.	2050	Extra increase
Austria	14.5	17.0	2.5	18.0	1.0
Belgium	10.0	13.2	3.1	14.1	0.9
Denmark	10.6	13.1	2.5	13.8	0.7
Finland	11.5	15.8	4.3	16.9	1.1
France	12.1	16.4	4.2	17.8	1.4
Germany	11.9	16.8	4.9	17.9	1.1
Greece	12.8	24.7	11.9	25.8	1.1
Ireland	4.6	8.7	4.1	9.2	0.5
Italy	13.9	14.1	0.2	15.2	0.8
Luxembourg	7.4	9.2	1.7	10.3	1.1
Netherlands	8.1	13.5	5.4	14.6	1.1
Portugal	9.8	13.1	3.3	14.9	1.8
Spain	9.5	17.4	7.9	18.1	0.7
Sweden	9.0	10.6	1.6	11.4	0.8
United Kingdom	5.4	4.4	– 1.0	4.9	0.5
EU average	**10.5**	**13.4**	**2.9**	**14.3**	**0.9**

Source: Authors' calculations.

Table 7.5 Net change in public expenditures (% of GDP)

	Public exp. in 2002 Base case	Total increase in exp. Base case	Health care	Pensions	Total	Public exp. in 2050, living in worse health scenario
Change in expenditures						
Austria	20.2	6.0	1.0	1.0	2.0	28.2
Belgium	16.0	5.7	0.7	0.9	1.6	23.3
Denmark	16.8	5.0	0.6	0.7	1.3	23.1
Finland	17.7	8.0	1.1	1.1	2.2	27.9
France	18.3	6.9	0.9	1.4	2.3	27.5
Germany	18.6	7.6	1.5	1.1	2.6	28.8
Greece	17.5	13.4	0.5	1.1	1.6	32.5
Ireland	10.8	6.3	0.5	0.5	1.0	18.1
Italy	20.0	3.0	1.2	0.8	2.0	25.0
Luxembourg	7.4	1.7	n.a.	1.1	1.1	10.2
Netherlands	15.3	8.1	0.7	1.1	1.8	25.2
Portugal	15.2	5.1	1.4	1.8	3.2	23.5
Spain	15.7	10.6	0.6	0.7	1.3	27.6
Sweden	16.5	4.5	1.2	0.8	2.0	23.0
United Kingdom	11.1	1.6	0.6	0.5	1.1	13.8
EU average	**16.7**	**5.6**	**0.9**	**0.9**	**1.8**	**24.1**

Source: Authors' calculations.

Sustainability gaps in the living in worse health scenario

Compared with the base case scenario, the living in worse health scenario puts a larger pressure on public finances. Table 7.6 shows the corresponding change in sustainability gaps. All countries show less favourable public finances and on average the sustainability gap will increase by 0.7%, i.e. from 3.3% in the base case scenario to 4.0% in the living in worse health scenario. Not surprisingly, worsening health aggravates public finance problems in all the EU countries considered.

Table 7.6 Change in the sustainability gaps in the living in worse health scenario (% of GDP) compared with the base case scenario

Group A	Denmark	0.36	**Group C**	Ireland	0.24
	Sweden	0.53		Luxembourg	0.05
	–	–		Netherlands	0.54
	–	–		Portugal	0.85
	–	–		Spain	0.37
Group B	Belgium	0.52			
	Austria	0.78	**Group D**	France	0.73
	Finland	0.83		Germany	1.18
	Italy	0.81		Greece	0.45
	United Kingdom	0.06		–	–
	EU average	**0.71**		–	–

Source: Authors' calculations.

Chapter 8
Living Longer in Better Health

In this chapter we combine the scenarios we ran in chapters 5 and 6 to present a living longer in better health scenario. We thus assume that people will live longer than the already inherent increase in life expectancy incorporated in the Eurostat demographic projections as postulated in the middle living-longer scenario, but also assume that their health improves according to the premises made in chapter 6.

8.1 Projections for health- and long-term care expenditures

Table 8.1 shows the projections for health- and long-term care expenditures in the living longer in better health scenario when compared with the base case scenario. Just as in chapter 6 we assume that the increase in health will lead to a higher growth of GDP and that health-care expenditures will grow in line with this extra increase in welfare.

Health-care expenditures

Living longer in better health will lead to a decline in expenditures on health care if compared with the base case scenario. The reason behind this decline is the fact that the positive health effect dominates the negative living longer effect in terms of expenditures. This can readily be seen when looking at Tables 5.1 and 6.1. By comparing these tables we can note that the effect of an improvement in health has a much greater effect on health-care expenditures (a decline of 0.8% of GDP in expenditures) than the impact of an increase in life expectancy in the living longer scenario (an increase of 0.4% in expenditures). This of course depends on the specific scenario we have chosen for demography, i.e. a general increase in life expectancy of 3.2 years. As can be seen in Table 8.1, living longer in better health will lead to a decline in expenditures of 0.4%.

Long-term care expenditures

Long-term care expenditures will on the other hand increase in the living longer in better health scenario, although only by a very small margin, i.e. 0.1% for the average EU country. As outlined in chapters 5 and 6, the living longer effect dominates the improvement in health effect for long-term care expenditures. The living longer effect leads to an increase of 0.4% of GDP in expenditures, while the improvement in health leads to a decline of 0.2% of GDP in expenditures. The results differ widely among countries. It is interesting in this sense that in some countries the living longer in better health scenario will lead to a decline in long-term care expenditures when compared with the base case scenario. This is the case for Germany and Italy, countries with large projected health improvements. The increase in long-term care expenditures on the other hand is largest in the Netherlands and Denmark.

Total health- and long-term care expenditures

The combination of living longer in better health will lead to a 0.3% decline in expenditures compared with the base case scenario. For the EU average the health effect thus dominates the living longer effect.

Table 8.1 Projections of public expenditure on health and long-term care in the living longer in better health scenario

	Health care expenditure (% of GDP)				
	Base case			Living longer in better health	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	5,1	7,7	*2,5*	7,3	*-0,4*
Belgium	5,2	6,9	*1,7*	6,7	*-0,2*
Denmark	4,0	4,6	*0,6*	4,2	*-0,4*
Finland	4,8	6,7	*1,9*	6,3	*-0,4*
France	5,5	7,4	*1,9*	7,0	*-0,4*
Germany	6,5	8,9	*2,4*	8,0	*-0,8*
Greece	4,7	6,1	*1,4*	6,0	*-0,1*
Ireland	5,6	6,6	*1,0*	6,5	*-0,2*
Italy	5,5	7,7	*2,2*	7,1	*-0,6*
Luxembourg	n.a	n.a		n.a	
Netherlands	4,7	5,5	*0,8*	5,3	*-0,2*
Portugal	5,3	7,0	*1,7*	5,9	*-1,2*
Spain	6,2	8,9	*2,7*	8,8	*0,0*
Sweden	5,1	6,0	*0,9*	5,5	*-0,5*
United Kingdom	3,9	4,9	*0,9*	4,7	*-0,2*
EU average	**5,4**	**7,1**	***1,7***	**6,6**	***-0,4***

	Long term care expenditure (% of GDP)				
	Base case			Living longer in better health	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	0,6	1,6	*1,0*	1,6	*0,0*
Belgium	0,7	1,6	*0,9*	1,7	*0,1*
Denmark	2,2	4,1	*1,9*	4,5	*0,5*
Finland	1,5	3,3	*1,9*	3,5	*0,2*
France	0,7	1,5	*0,8*	1,5	*0,0*
Germany	0,3	0,6	*0,4*	0,6	*-0,1*
Greece	n.a.	n.a.		n.a.	
Ireland	0,7	1,2	*0,6*	1,3	*0,1*
Italy	0,7	1,2	*0,5*	1,1	*-0,1*
Luxembourg	n.a	n.a		n.a	
Netherlands	2,6	4,5	*1,9*	5,1	*0,6*
Portugal	n.a.	n.a.		n.a.	
Spain	n.a.	n.a.		n.a.	
Sweden	2,4	4,3	*2,0*	4,5	*0,2*
United Kingdom	1,7	3,4	*1,7*	3,8	*0,4*
EU average	**0,9**	**1,8**	***0,9***	**1,9**	***0,1***

	Total health and long-term care expenditure (% of GDP)				
	Base case			Living longer in better health	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	5,8	9,3	*3,5*	8,9	*-0,3*
Belgium	5,9	8,5	*2,6*	8,4	*0,0*
Denmark	6,2	8,7	*2,5*	8,8	*0,1*
Finland	6,3	10,0	*3,7*	9,8	*-0,2*
France	6,2	8,9	*2,7*	8,6	*-0,3*
Germany	6,7	9,5	*2,8*	8,6	*-0,9*
Greece	4,7	6,1	*1,4*	6,0	*-0,1*
Ireland	6,3	7,9	*1,6*	7,8	*-0,1*
Italy	6,2	8,9	*2,7*	8,2	*-0,7*
Luxembourg	n.a	n.a		n.a	
Netherlands	7,3	10,0	*2,7*	10,3	*0,4*
Portugal	5,3	7,0	*1,7*	5,9	*-1,2*
Spain	6,2	8,9	*2,7*	8,8	*0,0*
Sweden	7,5	10,4	*2,9*	10,1	*-0,3*
United Kingdom	5,7	8,3	*2,6*	8,4	*0,2*
EU average	**6,2**	**8,9**	***2,7***	**8,6**	***-0,3***

Source: Authors' calculations.

Again, the results differ widely among countries. Overall the EU countries can be divided into three groups. First there are those countries that will see their expenditures increase in the living longer in better health scenario, as is the case for the Netherlands, the UK and Denmark. This can largely be attributed to the increase in long-term care expenditures caused by population ageing. Second, there is a group in which the positive health and negative living longer effect cancel each other out, which is the case for Belgium and Spain. Third, we have a group of all the other countries in which the improvement in health is larger than the negative effect of an increase in life expectancy and the combination of both trends leads to a decline in expenditures on health and long-term care. This is especially true for Germany, Portugal and Italy.

8.2 Projections of public pension expenditures

Table 8.2 shows the projections for pension expenditure for the living longer in better health scenario using the premises made in chapters 5 and 6 regarding demography and health. For convenience of comparison, we again include the projections of pension expenditure in the base case in the first three columns of the table.

Table 8.2 Public pension expenditures in the living longer in better health scenario (% of GDP)

	Base case			Living longer in better health	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	14,5	17,0	*2,5*	17,7	*0,7*
Belgium	10,0	13,2	*3,1*	13,6	*0,4*
Denmark	10,6	13,1	*2,5*	13,9	*0,8*
Finland	11,5	15,8	*4,3*	16,1	*0,3*
France	12,1	16,4	*4,2*	16,3	*0,0*
Germany	11,9	16,8	*4,9*	17,5	*0,7*
Greece	12,8	24,7	*11,9*	26,0	*1,4*
Ireland	4,6	8,7	*4,1*	9,1	*0,4*
Italy	13,9	14,1	*0,2*	14,8	*0,7*
Luxembourg	7,4	9,2	*1,7*	9,1	*-0,1*
Netherlands	8,1	13,5	*5,4*	14,0	*0,5*
Portugal	9,8	13,1	*3,3*	12,7	*-0,4*
Spain	9,5	17,4	*7,9*	18,4	*1,0*
Sweden	9,0	10,6	*1,6*	10,9	*0,3*
United Kingdom	5,4	4,4	*-1,0*	4,4	*0,0*
EU average	**10,5**	**13,4**	***2,9***	**13,7**	***0,4***

Source: Authors' calculations.

Table 8.2 shows that living longer in better health will for the average European country lead to a 0.4% increase in expenditures on pensions when compared with the base case scenario. As outlined in chapters 5 and 6, the combination of an increase in life expectancy and an improvement in health yields quite direct effects. The first factor leads to an increase in expenditures on pensions (of 1.4%), the second factor to a decline (of 0.9%), resulting in an overall increase of 0.4% in expenditures. Greece and Spain would suffer the largest increase in expenditures on public pensions in this scenario, while Luxembourg and Portugal would see their expenditures decline.

Contrary to the results we found for total health care and long-term care in the previous paragraph, the negative living longer effect dominates the improvement in health effect for pension expenditures. As reported in chapter 6, an improvement in health has an approximately similar positive effect on a reduction in pension and health-care expenditures, of which the difference can be attributed to the increase in life expectancy. As discussed, this stems from the fact that while an increase in life expectancy will lead to a direct increase in expenditure on pension benefits, the effect of living longer on health-care expenditures is more complex. On the one hand it will lead to a reduction in expenditures, as fewer people die; on the other hand an increase in life expectancy will lead to more health-care consumption in time and therefore lead to an increase in expenditure. An increase in life expectancy will therefore have a much greater impact on pension expenditures when compared with that of health-care expenditures.

8.3 Government finances

Table 8.3 sums up the effect of the living longer in better health scenario on public expenditures and specifically the change in expenditures compared with the increase in expenditures in the base case scenario. In general, living longer in better health will not lead to any increase in expenditures when compared with the base case scenario for the average European country. Although total expenditures on health and long-term care decline in the living longer in better health scenario, this decline is exactly balanced by an increase in expenditures on public pensions. When looking at the individual EU countries that benefit most from the described developments, one can see that only Portugal, France, Germany, Sweden and Luxembourg would see their public expenditures decline. In the other countries the increase in expenditures caused by living longer far outweighs the benefits of the reduction in expenditures caused by health improvements.

Table 8.3 Change in public expenditures in the living longer in better health scenario

			Change in expenditures			
	Public exp. In 2002, Base case	Total increase in expenditures Base case	Health and long term care	Pensions	Total	Public exp. In 2050, Living longer in better health scenario
Austria	20,2	6,0	-0,3	0,7	0,4	26,7
Belgium	16,0	5,7	0,0	0,4	0,4	22,0
Denmark	16,8	5,0	0,1	0,8	0,9	22,7
Finland	17,7	8,0	-0,2	0,3	0,1	25,9
France	18,3	6,9	-0,3	0,0	-0,3	24,9
Germany	18,6	7,6	-0,9	0,7	-0,2	26,1
Greece	17,5	13,4	-0,1	1,4	1,3	32,1
Ireland	10,8	6,3	-0,1	0,4	0,4	17,6
Italy	20,0	3,0	-0,7	0,7	0,0	23,0
Luxembourg	7,4	1,7	n.a.	-0,1	-0,1	9,1
Netherlands	15,3	8,1	0,4	0,5	0,9	24,3
Portugal	15,2	5,1	-1,2	-0,4	-1,6	18,7
Spain	15,7	10,6	0,0	1,0	1,0	27,3
Sweden	16,5	4,5	-0,3	0,3	-0,1	20,9
United Kingdom	11,1	1,6	0,2	0,0	0,2	12,9
EU average	**16,7**	**5,6**	**-0,3**	**0,4**	**0,0**	**22,3**

Source: Authors' calculations.

Sustainability gaps, living longer in better health scenario

Table 8.4 shows the sustainability gaps in this scenario. Compared with the base case scenario, the sustainability gap for the average EU country will increase by 0.2%. As previously discussed, the sustainability gap declined by 0.65% in our living in better health scenario while it increased by 0.89% in the living longer scenario. Contrary to the results found in Table 8.3, which reveals that four countries would see their public expenditures decline in the living longer in better health scenario, Table 8.4 shows that only two countries would see their government finances improve.

This result seems especially strange for Portugal, which saw its expenditures decline in the living longer in better health scenario by 1.6% of GDP, but sees its sustainability gap increase by 0.05%. One can be recalled, however, that most other expenditures and revenues rise in line with economic growth as previously discussed in chapter 3. An improvement in health will lead to higher labour force participation and therefore economic growth. These effects will in turn lead to a rise in expenditures and revenues. In the beginning year of the projection, i.e. the year 2005, expenditures in Portugal were much larger than revenues; Portugal ran a government deficit of more than 3% of GDP and therefore an increase in economic growth has a greater impact on expenditures than on revenues. For Portugal, it is thus the case that the decline in expenditures on health and long-term care and pensions is outweighed by the increase in expenditures on other items. The same reasoning applies to other countries with the same characteristics.

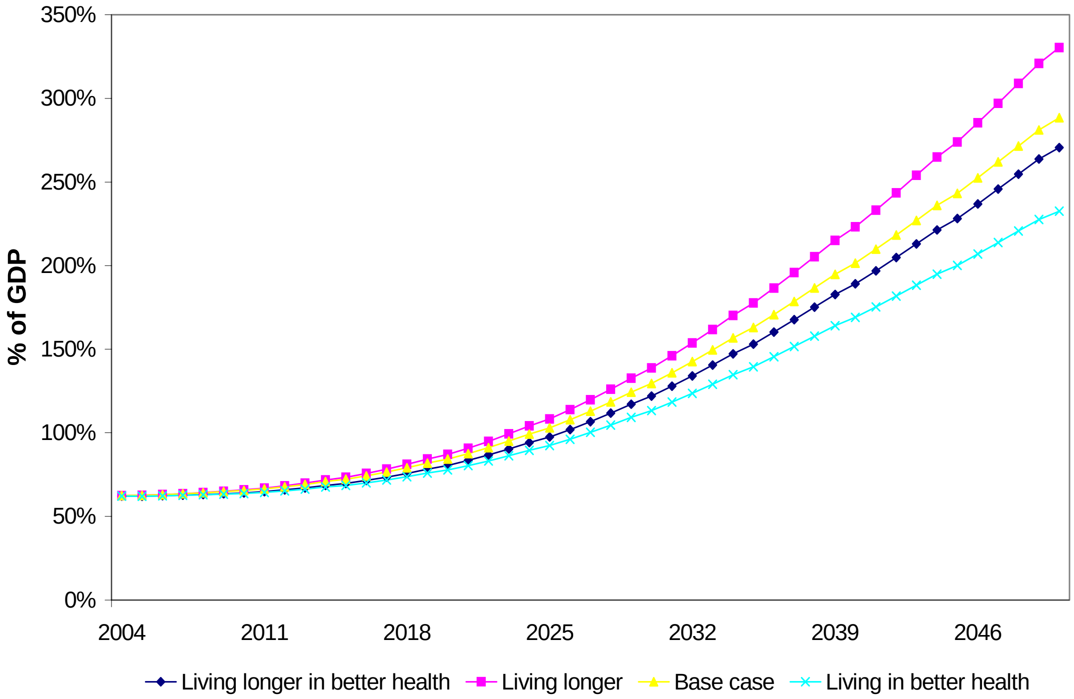
Table 8.4 Change in the sustainability gaps of EU countries in the living longer in better health scenario

Group A	Denmark	0,50	Group C	Ireland	0,63
	Sweden	0,19		Luxembourg	0,70
				Netherlands	0,80
				Portugal	0,05
				Spain	0,51
Group B	Belgium	0,17	Group D	France	0,19
	Austria	0,08		Germany	-0,08
	Finland	0,03		Greece	0,84
	Italy	-0,14			
	United Kingdom	0,46			
	EU average	**0,20**			

Source: Authors' calculations.

Figure 8.1 shows the debt development for the average EU country in the four scenarios discussed so far. As can be seen in the figure, the debt development and thus the sustainability problems are respectively the highest and severest in the living longer scenario. It is obviously the best in the living in better health scenario.

Figure 8.1 Debt developments – EU average in four scenarios



Compared with the base case scenario, the debt ratio in the living in better health scenario will be some 55% lower, which is a debt of 233% in 2050 compared with one of 288% in the base case. Figure 8.1 also shows, however, that the EU will face large sustainability problems if current social policies remain unchanged.

Part III

In this third part of the analysis we first investigate how population ageing may affect the interest rate and the rate of productivity growth to determine how sensitive the results in the base case scenario are to assumptions about these crucial variables. This is done in chapter 9. We compare the outcome of these tests with the results we obtained in part II of this paper to see if the incorporation of possible demographic and health trends really influence the projections of health care and pension expenditure or if these results are overshadowed by uncertainties regarding assumptions in the interest rate and productivity growth. In chapter 10 we investigate how a change in the labour force participation rate influences the base case results and we also present a best- and worst-case scenario. In chapter 11 we finally consider some other factors that may influence the development of health-care expenditures and specifically focus on the role of medical technology. In that chapter we also run a scenario where health-care expenditures grow at a faster rate than productivity growth (with an elasticity higher than 1 with respect to GDP), to see how this influences our base case results.

Chapter 9

Effect of Population Ageing on the Interest Rate and Productivity Growth

In the projections that have been performed so far we have assumed that the interest rate remained constant during the whole projection period at a nominal rate of 5.75%. In this chapter we explore the relation between population ageing and the interest rate more thoroughly and investigate how societal ageing influences the development of the interest rate during the projection period. Instead of a constant interest rate, the interest rate will thus vary year by year depending on how population ageing affects certain macroeconomic variables and especially how it influences saving and investment decisions, which ultimately determine the amount of the interest rate. Likewise we pay some attention to the effect of population ageing on labour productivity, which until now we have also assumed to grow at a constant rate of 1.75% per year, but the main focus will be on the effect of population ageing on the interest rate.

For this purpose we use the results from studies that have undertaken similar investigations. These studies do not reach a conclusive agreement on how population ageing ultimately affects the amount of the interest rate in the period until 2050. The French INGENUE group (2001) for example predicts that ageing will lead to a lowering of the interest rate in the period between now and 2050. Fehr et al. (2003) conclude otherwise and state that societal ageing may lead to a higher interest rate in the same period. De Mooij and Tang (2003) developed four different scenarios to show how the future of Europe may evolve and conclude that population ageing may either lead to a lower or higher interest rate depending on the specific scenario involved. We discuss each of these studies to see which assumptions underlie their outcomes and use the results found in the studies with regard to the development of the real interest rate and labour productivity in our projections. From this we are then able to infer how a different interest rate and productivity rate path will influence the size of the sustainability gaps as obtained in our base case scenario. Here we wish to emphasise that we only use the projected changes in the path of the interest rate and productivity rate and will not alter any other assumptions that may differ between this and the above mentioned studies.

9.1 The INGENUE study

The INGENUE group uses a computable, general equilibrium, multi-regional overlapping-generations model to simulate how population ageing will affect international capital flows in the world economy. The world economy in their model is divided into six regions. These are three developed and three developing regions. Their focus, however, is specifically targeted on the impact of population ageing on the world as a whole, where world markets are assumed to be perfectly integrated. In their model labour supply is exogenous and determined by the demographic projections for each region. Labour is also assumed to be immobile among regions. An important feature in their model is that given the labour supply there are decreasing returns to capital; an increase in the capital labour ratio in each region will thus lead to a decline in the return on investment or capital. Capital is mobile and will flow to the region where the return on investment is highest.[1] Owing to the different time paths of demographic transition in

[1] As Canton et al. (2003) argue, international capital may not be that mobile between developed and developing countries. For example, they assert that domestic investment rates closely follow domestic savings rates, that the share of foreign assets in investment portfolios is small and interest rate differentials between developed and developing countries continue to exist. The explanations they offer

the various regions there are thus opportunities for countries that start their population ageing process early, such as Europe and Japan, to invest their savings in regions that still have rising working-age populations (which are not invested in their own domestic economy because of a decline in the labour force). In the baseline scenario the world real interest rate is expected to gradually decline from approximately 4.25% to 3.6% in 2030, after which it gradually recovers to 3.75% in 2050.

The development in the world interest rate can both be explained by changes in the demand and the supply of capital. As a result of perfect capital mobility and the different time path of demographic transition between regions, the demand for capital will not fluctuate much and therefore the decline in the interest rate can mostly be explained by changes on the supply side of the capital market. In this regard the various fluctuations in the regional savings rates are important. Following the life cycle hypothesis, people save during their working lives and especially between the ages of 45 and 65 and dissave when they retire, that is after age 65. Combining this feature with the observed demographic changes in the various regions leads to the observed path of the world interest rate. In the period up to 2025 the world capital supply increases as the rise in the working-age population is greater than the rise in the number of elderly persons. After 2025 it will increase marginally as the old-age dependency ratio will then increase at a faster rate than the working-age population. At 2050 the real interest rate will have stabilised at a rate of 3.75% and compared with the year 2000 will have declined by 0.5%.

With regard to productivity, the INGENUE study predicts that the annual growth rate of GDP will decline from 2.2% in 2000 to 1% in 2025 for the EU. From 2025 to 2050 it will rise gradually to 1.5% in 2040 and keep this level until 2050. The profile of this path can largely be explained by the changes in the working-age population that take place during this period. No specific attention is paid to the separate effect of population ageing on labour productivity.

9.2 Fehr et al.

Fehr et al. (2003) use a dynamic, intergeneration and interregional demographic life cycle model to study among others how population ageing may affect national income, the capital stock, the effective labour supply, the interest rate and the rates of wage and social contributions. In their model they distinguish between three regions, the US, Europe and Japan, whereby we concentrate on the simulations they have performed for the EU as a closed economy.[2] A striking feature of the outcomes of their simulations is that the effective labour supply increases, despite population ageing in Europe. This can be attributed to the fact that they incorporate labour-augmenting technical progress in their model, which increases the effective labour supply every year and in total by 61% in 2050. This more than compensates for the decline in the participation rate of the population in Europe. The capital stock on the other hand is expected to decline, which is caused by the expectation that the pressure on public budgets because of increases on spending on public pensions and health care (among others) has to be financed by tax increases. This tax increase will come at the expense of lower savings, which will lead to an increase in the cost of capital and a decline in its stock. There is thus a shortage of capital to accommodate the rise in the effective labour supply and that will lead to an increase in the real interest rate over time. In their closed economy version, the real interest

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for this limited capital mobility are restrictions on international trade in capital, the imperfect integration of goods markets and asymmetric information between domestic and foreign investors.

[2] Their focus in this study is actually concentrated on the question of how immigration and a reform of the pension system from PAYG to a funded system in Europe will influence the development of the macro-economic variables mentioned here. From their baseline scenario for a closed economy, however, the effect of ageing population on these variables can be gauged.

rate under these assumptions will increase by 4% for the EU during the period between 2000 and 2050. The majority of this increase, i.e. 3.3%, takes place during 2030 and 2050. A crucial assumption that determines these results is of course their assumption about labour-augmenting technical progress. Although not shown in their results, the effect of population ageing on productivity in their simulations is obviously negative, as the effective labour supply increases and the capital stock declines.

9.3 The CPB's four futures study

In the *Four Futures of Europe* (de Mooij and Tang, 2003), four different scenarios for the future of Europe are sketched. These are "strong Europe", "regional communities", "global economy" and "transatlantic market". The various scenarios can be broadly described as pertaining to the following dimensions. The first dimension concerns how Europe will respond to the various challenges it will be confronted with regarding its public sector, such as population ageing, policy competition, the divide between low- and high-skilled labour, individualisation and so on. Will Europe in this sense opt for strong public responsibilities or put more emphasis on private responsibilities? A second sphere relates to the issue of how countries will succeed in international cooperation to deal adequately with cross-border issues, such as EU integration, trade relations with the world, the stance against immigration and so on. In this sense, governments can choose between international cooperation in these fields or treasure their national sovereignty. Figure 8.1 shows how the above-mentioned scenarios can be divided according to these lines of reasoning.

Figure 9.1 The four scenarios on the future of Europe

Source: De Mooij and Tang (2003).

For a detailed description of these scenarios we refer to the report. In this regard, it is important for our study that the economic growth and the development of the interest rate show large divergences across the four scenarios depending on the assumptions underlying the various scenarios. We look more closely at two of these scenarios where the effect of population ageing and other assumptions is greatest on the development of the interest rate. These are the regional communities and transatlantic markets scenarios. These scenarios correspond to a situation where public expenditures on pensions and health care increase significantly owing to the ageing of populations just as in our scenarios.

9.4 Regional communities scenario

In the regional communities scenario a context is projected where on the issue of international cooperation the integration of new European countries in the EU is not successful and the EU fails to reform its institutions. In the field of trade, the world is characterised by a number of trade blocks and multilateral cooperation is modest. At the level of the public sector, governments are unsuccessful in the reform of their welfare systems and public expenditures on health care and pensions rise significantly because of population ageing. The overall lack of competition on products, labour markets and government policy in general leads to a low projection of productivity growth. The real interest rate in this scenario is expected to decline from 3.6% in 2000 to 2.6% in 2050. The development of the interest rate in this scenario once again depends on changes in the demand and supply of capital. On the demand side the demand for capital depends on the cost of capital and its marginal productivity. The latter is largely dependent on developments in the labour market.

Population ageing will cause employment growth to be negative, as the participation rate will decline. The capital labour ratio will thus increase, reducing the marginal productivity of labour and this will lower the rate of return on investment. Investment and thus the demand for capital will decline, leading to a lower interest rate. On the supply side, the ageing of the population will lead to a lower savings rate and this may exert some upward pressure on the interest rate. The demand effect however dominates the supply effect and the interest rate will decline by approximately 1% until 2050 in a rather gradual manner. Labour productivity will decline by 0.75% in the same period. This is not so much the result of population ageing but rather a lack of innovation and competition in the economy.

9.5 Transatlantic market scenario

In the transatlantic market scenario, EU countries limit the role of the state and rely more on market exchange. Nevertheless, the reform of a large public sector is problematic and efficiency gains are not universally achieved. Elderly persons use their political power and make sure that the provision of health-care services and pensions do not deteriorate. This comes at the expense of intra- and intergenerational equity. In the international dimension, EU countries focus on their national sovereignty and the integration of new members in the EU fails as a result. Consequently, the EU intensifies its relations with the US and agrees upon deeper transatlantic economic integration, increasing welfare on both sides of the Atlantic. On the economic front the intensified competition will lead to higher labour productivity growth, mostly driven by rapid technological change. Reforms of welfare programmes contribute to increased labour force participation and longer working hours, increasing overall employment, which also enhances economic growth. The real interest rate in this scenario will increase from 3.6% at the onset to 4.5% in 2050. This can be explained by the fact that on the supply side the elderly will dissave because of ageing, while on the demand side high GDP growth will stimulate investments and thus increase the demand for capital. Both effects thus reinforce each other, leading to a relatively gradual rise in the interest rate in the period between 2000 and 2050 of 0.9%. Labour productivity growth will rise by 0.4% in the period between 2000 and 2020, while it will marginally decline by 0.1% in the period until 2050. As previously mentioned, this higher labour productivity can mainly be attributed to relatively high investments in the ICT sector, which also positively influences productivity in other sectors and especially those in the services sectors.

9.6 The effect of population ageing on sustainability gaps when implementing the predicted change in interest and productivity rates from other studies

Table 9.1 shows the combined effect of implementing a variable path for the interest and productivity rates in our base case scenario as implied by the direction both variables follow in the period between 2000 and 2050 in the discussed studies. We wish to emphasise here the relatively simple nature of this exercise as we only use the specified changes in the interest rate and productivity growth in the respective studies without worrying about other assumptions in these models that may differ substantially from our own study. In the Fehr et al. (2003) study for example, the expected increase in the interest rate is a direct consequence of their assumption that if government finances get out of hand this will lead to an increase in taxes. This will limit the amount people will be able to save and thus exerts an upward pressure on the interest rate. Owing to the great importance of this assumption in their study, we choose not to show the effect of the Fehr et al. assumptions in Table 9.1, as their assumptions differ too much from those in our own study.

Table 9.1 Change in the sustainability gaps from other studies in our base case scenario when implementing the interest rate and productivity rate paths

	Base case scenario	INGENUE	Four Futures, Regional Communities	Four Futures, Transatlantic markets
Austria	1,32	-0,14	-0,21	0,21
Belgium	0,66	-0,03	-0,15	0,27
Denmark	-1,44	0,01	-0,05	-0,44
Finland	0,67	-0,13	-0,12	-0,18
France	4,92	-0,34	-0,36	0,87
Germany	5,14	-0,36	-0,30	0,81
Greece	5,78	-0,38	-0,03	0,36
Ireland	3,80	1,48	2,23	0,03
Italy	1,61	0,78	0,81	0,78
Luxembourg	2,64	1,79	2,35	0,17
Netherlands	3,52	-0,13	-0,27	0,76
Portugal	3,49	-0,23	-0,20	0,57
Spain	3,43	2,10	2,98	-0,11
Sweden	-0,83	0,01	0,09	-0,26
United Kingdom	1,59	0,60	0,73	0,32
EU average	**3,15**	**0,20**	**0,34**	**0,53**

Source: Authors' calculations.

As can be seen in the table, insertion of the predicted paths of the interest and productivity rates by INGENUE (2001) in our base case scenario only marginally increases the sustainability gap compared with the base case scenario. The predicted decrease in the productivity rate will lead to an increase in the sustainability gap, as many pension schemes in Europe are indexed to price inflation and expenditures on pensions will thus not decline when productivity declines. The predicted decline in the interest rate on the other hand will improve government finances, although the results differ widely among countries. As the effect of productivity on the sustainability gap (0.43%) is slightly greater than the effect of the interest rate (-0.23%), the sustainability gap increases by 0.2% for the average EU country. The same reasoning applies to the regional communities scenario, where the predicted decline in productivity growth will lead to an increase in the sustainability gap, but this is again partly compensated for by the positive effect of a decline in the interest rate on the sustainability gap. Because of the relatively larger decline in productivity growth, the sustainability gap increases at a relatively higher rate than in the INGENUE study. The insertion of the respective interest and productivity paths from the transatlantic market scenario has the biggest influence on the sustainability gap. Although the predicted increase in productivity will only lead to a marginal increase in the sustainability gap, the increase in the interest rate will worsen government finances further, leading in total to a 0.53% increase in the sustainability gap for the average EU country. This is the only scenario where both effects reinforce each other.

If we compare the outcome of these exercises with the change in sustainability gaps found in chapters 5 and 6, where the influences of living longer and living in better health on the sustainability gap were investigated, the following conclusions can be drawn. In chapters 5 and 6 we found that an increase in life expectancy increased the sustainability gap by 0.89%, while the incorporation of an improving health trend decreased the sustainability gap by 0.65%. The results of implementing a more variable path for the interest rate and productivity growth will thus not significantly alter these indications if we only compare the size of the changes in the sustainability gaps. Yet, as the transatlantic market scenario shows, the combination of a possible decrease in productivity and a rise in the interest rate may substantially increase the need to raise taxes and significantly reduce the effect of savings on health-care expenditures and pensions if health improves. The results, however, differ widely between countries as the respective figures in Table 9.1 show and therefore it is difficult to draw general implications.

Chapter 10

Projection of Health-Care Expenditures by Varying Cost Assumptions

Table 5.1 showed that the process of population ageing will lead to higher expenditures on health care. The magnitude of the increase in expenditures, however, depends on the specific demographic transition that will take place. As could be seen in Table 5.1 a substantial reduction in mortality rates will lead to significant increases in health-care expenditures. But how does this compare with other factors that influence the development of total health costs? As reported in other studies the introduction of new medical technologies, price changes in medicines and institutional changes that influence the supply and demand for medical services have been found to be more important factors in determining total health- and long-term care expenditure in the past than population ageing. The transition for example from a budget-oriented approach in which expenditures are determined by the use of health-care services compared with a managed care system that puts a ceiling on medical expenditures will have a big influence on the development of health-care expenditures in the future. It is nevertheless very difficult to take account of such changes in policy behaviour, as it is not certain how these policy processes develop. Societal preferences are also likely to be a determining factor behind institutional changes and such preferences may differ widely among countries.

Likewise expenditures on long-term care are influenced by factors other than population ageing alone. Next to gender and race, marital status, the number of children and their location, income and wealth are important factors that drive these expenditures. Wealthier individuals for instance are able to live longer in their own home, while a larger increase in the life expectancy of men compared with women will lead to reductions in the time spent in widowhood and the need for public long-term care services. All of the above factors were not incorporated in the projections made in chapter 4 but are mentioned here to emphasise the complex nature of accurately projecting future health-care expenditures.

Prior to implementing a scenario that may, although imperfectly, take account of such factors we first elaborate a bit more on the relation between medical technological progress, economic growth and health-care expenditure.

10.1 Economic growth and medical technological progress

Apart from demographic factors, growth in medical expenditure may be driven by GDP and medical technological progress. The elasticity of health-care expenditure with respect to GDP is often found to be larger than 1, suggesting health care is a luxury good (Gerdtham et al., 1992). The role of medical technological progress is also often found to be large. There is much uncertainty about whether population ageing will affect GDP, the size of the income elasticity of health care demand and at what pace medical technological progress will develop. To make this explicit, we perform a sensitivity analysis on these issues.

To assess the effect upon GDP, note that because of population ageing, labour market participation will decline as there will be fewer persons aged 20 to 64. Worldwide population ageing may depress interest rates and increase wage rates (Turner et al., 1998; Miles, 1999). Chapter 11 further elaborates on this. The implication of these factors is that whereas the number of workers will decrease, GDP per worker may increase. What will happen to GDP is then unknown. Nevertheless, using numerical simulations, Miles (1999) is able to tell the sign of the total effect. He finds that the effect of reduced labour supply is much larger than that of higher labour productivity, from which it follows that per capita GDP will fall. Other numerical simulation exercises confirm this prediction (Turner et al., 1998; Hviding and Mérette, 1998).

Cutler et al. (1990) argue that labour scarcity as reflected in high wage rates may also foster technological change. Hence, population ageing may speed up economic growth and possibly increase per capita GDP after some time. Fougère and Mérette (1999) elaborate on the idea that the combination of falling interest rates and increasing wage rates fosters the accumulation of human capital. They confirm that GDP may achieve higher levels because of population ageing. Yet they also show that this effect would occur only after about 100 years. Moreover, during the first decades the fall of GDP could be larger as human capital formation requires resources that cannot be used for production.

We conclude that GDP may decline, which may reduce health-care expenditure. What is the role of medical technological growth? As stressed by the literature on endogenous growth models, the production of new technologies is driven by the prospects of reaping the benefits from the use of new technologies. Hence, market size determines how many entrepreneurs will invest in innovations. If ageing causes health care markets to grow, this would induce more research and development in medical technologies. Acemoglu and Linn (2003) present empirical evidence that supports this hypothesis for pharmaceutical markets. New technologies will be included in insurance packages. Hence, through the channel of technological growth, population ageing may increase health-care expenditure (Weisbrod, 1991).

Jones (2003) develops a model in which health-care expenditures and life expectancy are endogenous variables driven by technological progress. Using this model he tries to give an explanation as to why health-care expenditures as a share of GDP have risen so much since 1960 in the OECD and specifically in the US. In the US, health-care expenditures have for example risen from 5.1% to 13.6% of GDP. Like Newhouse (1992), he finds that the major part of this increase, about 50%, can be attributed to what he calls the "march of science" and medical advances. Although the role of GDP growth is important in explaining the rise in health-care expenditures and the introduction of new medical technologies, he argues that a critical determinant of health-care expenditures as a share of GDP is the willingness of society to transfer resources to persons near the end of life. In his model the latter group is the biggest consumer of new medical innovations and health-care expenditure in general, absorbing some 25% of total medical expenditures. As long as governments impose no restrictions on this transfer rate, health-care expenditures as a share of GDP will continue to grow. If restrictions are applied, health-care expenditures as a share of GDP will stabilise in the long term. A cap of this kind may come at the expense of increased mortalities and limit the possible increases in life expectancy that may occur if the technologies are adopted. Despite having run several simulations, he consistently finds that large differences in aggregate health-care expenditures are typically associated with only marginal differences in life expectancy. The latter fact can be attributed to differences in other factors that influence life expectancy, such as health behaviour, environment, nutrition and so on.

Ideally, we would like to run different scenarios to show the influence of for example the introduction of new medical technologies on total health- and long-term care expenditure. This is, however, very tedious and no studies to date have been able to model this correctly. Cutler and Sheiner (2001) elaborate on the various aspects that have to be taken in account if one wants to forecast the rate of technological change in medicine or treatment. As they explain, one would not only need insight into which diseases would in the future be curable and currently are not, one would also need to take account of possible shifts in treatment and prevention and the costs associated with both practices. For many diseases it is usually only after a considerable time period that knowledge about the treatment of a disease can ultimately be used to prevent it. Further, the costs differ between treatment and prevention. The prevention of measles for instance will usually involve far more persons and probably cost more than treating patients who suffer from this disease, although that does not imply that prevention is not valuable.

Yet the introduction of new medical technologies may in time lead to a decline in health-care expenditures if these technologies are able to cure very costly diseases. As Thomas (1999) argues, the speed at which new chemical entities are screened and tested to identify and treat disease is increasing seven-fold in the US. If this research leads to major advances in understanding and treating disease it may eventually reduce health-care expenditures. In this respect the difference between partial and fully developed technologies is important. Partial technologies do not prevent or cure disease, but they do treat the symptoms, although usually at a considerable cost. Fully developed technologies on the other hand offer the prevention or complete cure of diseases, decrease the burden of disease and may in time lead to substantial savings on health-care expenditures if these technologies are really introduced.

For a number of reasons, health-care expenditure may increase at a faster pace than can be derived from the application of our projection method. In our sensitivity analysis, we therefore present some alternative calculations.

Until now we have let total health-care expenditures grow by 1.75% annually in line with the increase in the rate of labour productivity growth. To see the influence of an increase in the percentage of this cost factor, or the assumption of an elasticity higher than 1 with respect to GDP, we increase this percentage to 2% or by an extra 0.25% annually and assume all other conditions to be as in the base case. We thus take account of a variation of the Baumol effect and let health-care expenditures grow at a faster rate than GDP. This experiment can give us some insight into the importance of this cost factor in determining total health-care expenditures. We can then use the results of this exercise and view it alongside the results obtained in section 5.1, i.e. the living longer scenario, to see how both effects compare.

The introduction of medical technologies could likewise be projected in this manner, although imperfectly. Following the above arguments it seems most likely that the cost increase would generally impact (an increase) health-care expenditures as long-term care expenditures are expected to be less influenced by technological developments. Also the effect would differ by age, with higher increases on expenditure for medical technology for older persons. We do not, however, take account of these aspects in our simulation. Table 10.1 shows the effect of an increase in expenditures of 0.25% above the annual productivity growth rate of 1.75% for all ages in the base case scenario. The first three columns reflect the situation in the base case scenario. The fourth column shows expenditures if those on health care grow by an extra 0.25% annually. The last column reflects the extra increase in expenditures if this assumption is applied when compared with the base case scenario.

10.2 Health-care expenditures

As can be concluded from Table 10.1, a 0.25% extra increase in the yearly cost parameter for the health-care sector leads to a significant increase in health-care expenditures. For the EU they will on average increase by 0.9% of GDP – from 7.1% of GDP to 8.0% of GDP. The increase in health-care expenditures is the same in all countries but the extra increase differs among countries as a result of deviations in the amount of the original figures for health care. If we compare the results in Table 10.1 with those found in Table 5.1 in the living longer scenario, we find that an increase in the cost parameter by 0.25% will have a significantly greater effect on health-care expenditures than the initiated reduction in mortality rates in the middle living longer scenario, which corresponded to an extra increase in life expectancy of 3.2 years for the average person living in the EU.

Table 10.1 Projection of public expenditure on health- and long-term care, increasing cost scenario (% of GDP)

	Health care expenditure (% of GDP)				
	Base case			0,25% incr.in cost	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*
Austria	5,1	7,7	*2,5*	8,7	*1,0*
Belgium	5,2	6,9	*1,7*	7,8	*0,9*
Denmark	4,0	4,6	*0,6*	5,2	*0,6*
Finland	4,8	6,7	*1,9*	7,6	*0,9*
France	5,5	7,4	*1,9*	8,4	*1,0*
Germany	6,5	8,9	*2,4*	10,1	*1,2*
Greece	4,7	6,1	*1,4*	7,0	*0,8*
Ireland	5,6	6,6	*1,0*	7,5	*0,9*
Italy	5,5	7,7	*2,2*	8,7	*1,0*
Luxembourg	n.a	n.a		n.a	
Netherlands	4,7	5,5	*0,8*	6,2	*0,7*
Portugal	5,3	7,0	*1,7*	8,0	*0,9*
Spain	6,2	8,9	*2,7*	10,1	*1,2*
Sweden	5,1	6,0	*0,9*	6,8	*0,8*
United Kingdom	3,9	4,9	*0,9*	5,5	*0,6*
EU average	**5,4**	**7,1**	***1,7***	**8,0**	***0,9***
	Long term care expenditure (% of GDP)				
	Base case			0,25% incr.in cost	
	2002	2050	*% incr. Exp 2002-2050*	2050	*Extra incr.*
Austria	0,6	1,6	*1,0*	1,8	*0,2*
Belgium	0,7	1,6	*0,9*	1,8	*0,2*
Denmark	2,2	4,1	*1,9*	4,6	*0,5*
Finland	1,5	3,3	*1,9*	3,8	*0,4*
France	0,7	1,5	*0,8*	1,7	*0,2*
Germany	0,3	0,6	*0,4*	0,7	*0,1*
Greece	n.a.	n.a.		n.a.	
Ireland	0,7	1,2	*0,6*	1,4	*0,2*
Italy	0,7	1,2	*0,5*	1,4	*0,2*
Luxembourg	n.a	n.a		n.a	
Netherlands	2,6	4,5	*1,9*	5,1	*0,6*
Portugal	n.a.	n.a.		n.a.	
Spain	n.a.	n.a.		n.a.	
Sweden	2,4	4,3	*2,0*	4,9	*0,6*
United Kingdom	1,7	3,4	*1,7*	3,8	*0,5*
EU average	**0,9**	**1,8**	***0,9***	**2,1**	***0,2***
	Total health and long-term care expenditure (% of GDP)				
	Base case			0,25% incr.in cost	
	2002	2050	*% incr. Exp 2002-2050*	2050	*Extra incr.*
Austria	5,8	9,3	*3,5*	10,5	*1,2*
Belgium	5,9	8,5	*2,6*	9,6	*1,1*
Denmark	6,2	8,7	*2,5*	9,8	*1,2*
Finland	6,3	10,0	*3,7*	11,3	*1,3*
France	6,2	8,9	*2,7*	10,1	*1,2*
Germany	6,7	9,5	*2,8*	10,8	*1,3*
Greece	4,7	6,1	*1,4*	7,0	*0,8*
Ireland	6,3	7,9	*1,6*	8,9	*1,1*
Italy	6,2	8,9	*2,7*	10,1	*1,2*
Luxembourg	n.a	n.a	*n.a*	n.a	
Netherlands	7,3	10,0	*2,7*	11,3	*1,3*
Portugal	5,3	7,0	*1,7*	8,0	*0,9*
Spain	6,2	8,9	*2,7*	10,1	*1,2*
Sweden	7,5	10,4	*2,9*	11,8	*1,4*
United Kingdom	5,7	8,3	*2,6*	9,4	*1,1*
EU average	**6,2**	**8,9**	***2,7***	**10,1**	***1,2***

Source: Authors' calculations.

10.3 Long-term care expenditures

Long-term care expenditures will increase in a similar fashion albeit to a lesser degree than those of health-care expenditures. This can be attributed to the fact that in many countries the health-care profile for long-term care shows no expenditure for those aged 0-54 and thus expenditures on long-term care are less influenced by changes in the cost parameter than health-care expenditures. For the European Union average they will increase by 0.2%, i.e. from 1.8% of GDP to 2.1% of GDP. If we compare the results once again with those found in Table 5.1, we can now see that expenditures in the living longer scenario increase to a greater extent than those in the increasing-cost parameter scenario. This can be explained by the fact that an increase in life expectancy will impact expenditures on long-term care the most. The incorporated population ageing effect in the living longer scenario will thus have a larger impact on long-term care expenditures than possible increases in the cost parameter above productivity growth.

10.4 Total health- and long-term care expenditures

Overall, the postulated increase in the cost parameter will lead to an increase in expenditures on health care of 1.2% of GDP compared with the base case. A relatively small increase in the rate of growth in total health- and long-term care expenditures above the annual rate of labour productivity thus influences the development of expenditures in quite a significant way and to a larger extent than the results found in the middle living longer scenario in Table 5.1. This result can of course partly be attributed to the fact that an increase in the cost parameter of 0.25% influences health-care expenditures in a direct way. As previously explained in Box 5.1, that is not the case for the effect of an increase in life expectancy on health-care expenditures where two opposing forces are at work. Indeed, the cost parameter could be the effect that especially makes other factors more important to the development of health-care expenditures than population ageing.

10.5 Government finances

Table 10.2 shows the effect of this postulated increase in the cost parameter on the sustainability of government finances. As pension expenditures are not influenced by any cost parameter changes, the change in sustainability gaps compared with the base case scenario can solely be attributed to the increase in expenditures on health care. For the average EU country the sustainability gap will have to increase by 0.7% to keep government finances sustainable. If health-care expenditures increase at a faster rate than GDP, it will significantly increase the sustainability problems for the European Union countries in the future. If we compare the change in the required adjustment in the sustainability gap in Table 10.2 with that found in the living longer scenario in Table 5.4, we can see that the necessary increase in taxes is higher in the living longer scenario. It is important to recall, however, that the living longer scenario also included the effect of an increase in life expectancy on expenditures on public pensions and that the latter expenditure outweighed the increase in expenditures on both health care and long-term care.

Table 10.2 Change in the sustainability gaps in the increasing-cost parameter scenario compared with the base case scenario (% of GDP)

Group A	Denmark	0,73	Group C	Ireland	0,88
	Sweden	0,88		Luxembourg	0,00
				Netherlands	0,92
				Portugal	0,61
				Spain	0,66
Group B	Belgium	0,68	Group D	France	0,75
	Austria	0,68		Germany	0,72
	Finland	0,75		Greece	0,51
	Italy	0,61			
	United Kingdom	0,68			
	EU average	**0,70**			

Source: Authors' calculations.

Chapter 11
Several More Scenarios

In this chapter we explore the effect of different assumptions about the development in the labour force participation rates on the sustainability gaps and present a best- and worst-case scenario.

With regard to the labour force participation rate, we assume that the participation rate increases relatively by an extra 5%, which gradually takes place in the projection period. An increase of 5% during the projection period of 50 years thus amounts to a 0.1% increase in the labour force participation each year. We apply this increase to all age groups and make no difference between genders.

11.1 Effect of changes in the labour force participation rate

The effect of a gradual, relative increase of the labour force participation rate of 5% on the sustainability gap is shown in the second column of Table 11.1. An increase in the labour force participation rate will lead to a decline in the sustainability gap for all EU countries, except Luxembourg. For the average EU country, the sustainability gap will decline by 0.26%. This result follows from the fact that an increase in labour force participation will have a bigger effect on government revenues than on expenditures and thus alleviates the financial burdens of governments. An increase in the labour force participation rate will for instance lead to a higher wage base and thus an increase in revenues from direct taxes. On the expenditure side, health-care costs are not related to any change in the labour force participation rate; disability benefits for those persons younger than 55 will fall and pension expenditures will decline if labour force participation increases at older ages as we have assumed. In this regard one should recall that pension expenditures also comprise expenditures on other public replacement schemes such as disability benefits and unemployment benefits for those aged 55 and over.

Table 11.1 Change in the sustainability gaps compared with the base case for various scenarios

	Base case	5% incr. In labour force part.	Worst case scenario	Best case scenario
Austria	1,32	-0,36	2,10	-1,76
Belgium	0,66	-0,31	1,91	-1,31
Denmark	-1,44	-0,31	2,11	-1,02
Finland	0,67	-0,45	2,30	-1,93
France	4,92	-0,21	1,90	-1,47
Germany	5,14	-0,31	2,18	-2,41
Greece	5,78	-0,31	2,25	-1,02
Ireland	3,80	-0,05	1,88	-0,72
Italy	1,61	-0,29	1,68	-1,78
Luxembourg	2,64	0,10	0,37	0,33
Netherlands	3,52	-0,40	2,91	-1,38
Portugal	3,49	-0,15	1,67	-2,04
Spain	3,43	-0,27	1,94	-0,91
Sweden	-0,83	-0,30	2,17	-1,69
United Kingdom	1,59	-0,13	1,34	-0,32
EU average	**3,15**	**-0,26**	**1,90**	**-1,47**

Source: Authors' calculations.

As can be seen in Table 11.1, Finland, the Netherlands and Austria would benefit most from an increase in the labour force participation rate. Luxembourg is the only country that would not benefit from any increase in the labour force participation rate. This is also the only country for which we do not have any information on expenditures on health care; these costs are thus part of the category of other expenditures that grow at the same rate as economic growth. The result for Luxembourg can therefore be attributed to poor data.

11.2 Worst-case scenario

This section explores future budgets in a pessimistic scenario. Compared with the base case scenario, we replace a number of assumptions with those that will entail more of a burden to government finances. The first deviation is that we assume that life expectancy will increase further, following the demographic scenario as postulated in the middle living longer scenario. Second, we assume that health-care expenditures will grow faster than GDP by 0.25%, as postulated in chapter 9. Third, we assume that the labour force participation rate will decrease relatively by 5% for all ages in a gradual manner as presented in Table 11.1, although the change is now in the opposite direction. Fourth, we assume that health will not improve in the projection period. Table 11.1 shows the impact of these assumptions on the change in the sustainability gaps compared with the results in the base case scenario.

As expected, government finances show a substantial deterioration in this scenario when compared with the base case. The sustainability gap will have to be increased by 1.9% to 5.05% to keep government finances sustainable.

11.3 Best-case scenario

In this section future budgets in a best-case scenario are assessed. More specifically, we assume that the health improvements as shown in Table 3.3 will improve at an even faster rate and will show a relative increase of an extra 20%. Second, we assume that the impact of a health improvement on labour force participation is stronger, with an elasticity of 1 instead of 0.8. Third, we assume that the relation between health changes and health-care expenditures is stronger. The latter assumption implies that an improvement in health will be achieved with less medical intervention. To realise this we have increased the elasticities guiding the relation between a health improvement and the associated reduction in health- and long-term care expenditures by 0.2% respectively for the distinguished age groups. Table 11.1 shows the change in the sustainability gaps in this scenario compared with those of the base case.

A further improvement in health will lead to substantially lower sustainability gaps. For the EU average, this gap will decline by 1.47% compared with the base case scenario. The positive effect of a health improvement on government finances can mostly be attributed to savings on health-care expenditures. Pension expenditures will also decline for all EU countries but at slower rates. But the increase in labour force participation that stems from a health improvement will also lead to increases on other expenditure categories and will tend to worsen government finances. Luxembourg and the UK are most affected by the latter tendency as can be seen by the difference in the sustainability gaps compared with the base case scenario. (For the explanation of an increase in the sustainability gap for Luxembourg, see section 11.1.)

Chapter 12
Summary and Conclusions

This report has investigated the effect of population ageing on public health- and long-term care expenditures, public pension expenditures and government finances in EU countries in the projection period 2002-50. We have paid specific attention to new insights about the development of demography and health on these projections. In this regard, the view has been expressed that people may live substantially longer in the future than estimated by current demographic projections, and may spend part of these additional years in better health. Both developments have obvious implications for the correct projection of public expenditures on health and long-term care, pensions and public finances. To assess the effects of living longer in better health, we developed four core scenarios: a base case and scenarios for living longer, living in better health and living longer in better health.

The base case scenario serves as a benchmark against which the calculations in the other scenarios can be judged. It is not meant to be taken literally, since it does not include all the recent institutional details in the countries covered that may be relevant for the purpose of assessing fiscal sustainability. For calculations that offer this perspective, we refer to the EPC (2001) study, which is to our knowledge the most comprehensive and accurate report presenting projections on health care and pensions for the EU. Our study focuses on the impact of life expectancy and health status, relative to a general base case scenario, which in itself is only relevant for the study.

Our analysis also contains a number of new elements. First, we include the costs incurred during the last years of life in our projections. The inclusion of these costs is important because an increase in life expectancy will postpone these costs to later ages. Hence, our calculations correct for the overestimation of future health-care expenditure that arises when no account is made for mortality-related costs. Second, we decompose the cost of mortality into a health- and long-term care component, which differs by age. Third, we explicitly incorporate tax revenues into our projections for government finances. Using all of the above information we are able to project government finances in the future and more specifically consider whether government finances are sustainable under current social policy rules. To this end we use a measure – the sustainability gap – that is also used in other studies and which indicates whether government finances are sustainable or not. If the sustainability gap is positive, sustainability problems are expected to arise.

The living longer scenario differs from the base case scenario in its assumption about future possible demographic developments. There is huge uncertainty about how demography may develop in the future. We run three scenarios to take account of this uncertainty, respectively labelled the ‘low’, ‘middle’ and ‘high living longer scenario’. All scenarios assume that life expectancy will increase further than standard projections have suggested so far, which is 82.6 years at birth in an average European country. This is realised by reducing the mortality rates for specific ages. In the low scenario, life expectancy at birth increases further by 1.2 years, assuming that the reduction in mortality rates does not take place at old ages, which is above age 85. In the middle scenario, life expectancy increases further by 3.2 years and the reduction in mortality rates then takes place at relatively older ages, i.e. above 85 years old. The high scenario assumes that life expectancy increases further by 4.8 years. Here, the assumptions are those of the middle scenario, except that the rate of reduction in mortality rates is higher.

The living in better health scenario uses the same assumptions as the base case scenario, except that it incorporates a positive trend in the health status of the population. This follows the reasoning of many authors who have found that the disability rate or occurrence of specific health problems has been falling through time, implying that health on average has been improving. An improvement in health will not only influence expenditures on health, but also on pensions. Healthier persons are assumed to need less medical attention and are able to work longer. To incorporate the effect of an improvement in health on pension and health-care expenditures, we use the results found in the literature where this relation is directly or indirectly estimated. For health-care expenditures, we have made use of estimates of the elasticity of health-care expenditure with respect to health status. For pension expenditures, we have used estimates of the elasticity representing the relation between a change in health and outflow from the labour market. Coupled with projections of the development of life expectancy in good health, the influence of health on health-, long-term care and pension expenditures can then be calculated.

The living longer in better health scenario finally combines the demographic and health status assumptions made in the living longer and living in better health scenarios respectively. Table 12.1 shows the results of the projected increase in health- and long-term care expenditures, pension expenditures, total expenditures and the sustainability gap for the various scenarios for the EU average as measured in the period between 2002 and 2050. Except for the base case scenario, the scenarios reflect changes in the previously mentioned variables compared with the base case.

Table 12.1 Change in expenditures in the projection period between 2002 and 2050 (% of GDP)

	Base case 2050	Living longer 2050	Living in better health 2050	Living longer in better health 2050
Health and long term care expenditures	2,7	0,8	-0,9	-0,3
Pension expenditures	2,9	1,4	-0,9	0,4
Total expenditures	5,6	2,2	-1,9	0
Sustainability gap	3,2	0,9	-0,7	0,2

Source: Authors' calculations.

As shown in the base case scenario, population ageing will significantly increase both total health-care and pension expenditures and make government finances unsustainable, reflected in the fact that taxes have to be increased by 3.2% of GDP to achieve sustainability. A further increase in life expectancy, as postulated in the living longer scenario, will lead to higher expenditures and thus a deterioration of government finances, reflected by the fact that taxes will have to be increased by an additional 0.9%. Note that the positive effect of higher life expectancy upon health-care expenditure is not trivial. Indeed, an increase in life expectancy exerts two opposite effects upon health-care expenditure. The reduction in the number of mortalities reduces health-care expenditure, as decedents are much more expensive than survivors in terms of health-care costs. On the other hand, the expansion of the population that a rise in life expectancy brings about increases health-care expenditure considerably. In our numerical simulations, however, the latter effect strongly dominates the former effect throughout most of the simulation period.

An improvement in health will lower expenditure on total health- and long-term care and pensions and will improve government finances by 0.7%. Living longer in better health finally has rather moderate effects upon total expenditure, and the sustainability gap in the living longer in better health scenario is more or less the same as in the base case scenario. The fiscal impact of better health is thus similar to that of a higher life expectancy. Nevertheless, the same does not hold true for health care and pension expenditures separately. Although expenditures on health care are expected to decline, expenditures on pensions are held to increase.

The ageing of the population will thus significantly increase expenditures on public health- and long-term care and pensions. The widespread belief that people may live longer, but are on average also healthier, will only marginally change the base case projections if the expected increase in life expectancy and health develops according to our premises. It has to be emphasised, however, that how both demography and health will develop in the future is very uncertain. Further, as we have seen, a larger than expected health improvement may have profound effects on the sectoral structure of a country as it can shift resources away from the health-care sector and reallocate them towards other sectors in the economy. A further increase in life expectancy will have the opposite effect.

Two final remarks are appropriate. Our calculations have emphasised the effect of population ageing. It is obvious that many more factors are relevant and possibly even more important than the ageing of the population itself. Thus the projections should not be misinterpreted as projections of the most likely future developments. Furthermore, all calculations were carried out in a policy-neutral environment. It can be argued that the projected effects will provoke important policy changes, but no account has been taken of possible reactions in this field.

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Appendix A.1

Table A1.1 Total population, base case scenario (millions of persons)

	2000	2010	2020	2030	2040	2050
Austria	8,1	8,1	8,2	8,1	7,9	7,6
Belgium	10,2	10,4	10,5	10,5	10,4	10,1
Denmark	5,3	5,5	5,6	5,6	5,6	5,6
Finland	5,2	5,3	5,3	5,3	5,1	4,9
France	59,2	61,4	62,9	63,6	63,5	62,1
Germany	82,1	83,4	83,3	82,0	79,6	76,0
Greece	10,5	10,8	10,8	10,7	10,6	10,2
Ireland	3,8	4,1	4,4	4,6	4,7	4,8
Italy	57,6	57,3	56,0	54,0	51,5	48,1
Luxembourg	0,4	0,5	0,5	0,5	0,5	0,6
Netherlands	16,0	16,7	17,3	17,6	17,7	17,6
Portugal	10,0	10,3	10,5	10,7	10,8	10,7
Spain	39,4	39,9	39,5	38,6	37,3	35,2
Sweden	8,9	9,0	9,1	9,3	9,2	9,2
United Kingdom	59,5	60,9	62,2	63,2	62,9	61,8
EU total	**376,3**	**383,4**	**386,0**	**384,5**	**377,4**	**364,4**

Source: Authors' calculations.

Table A1.2 Total population, living longer scenario (low) (millions of persons)

	2000	2010	2020	2030	2040	2050
Austria	8,1	8,2	8,2	8,2	8,0	7,7
Belgium	10,2	10,4	10,5	10,6	10,5	10,3
Denmark	5,3	5,5	5,6	5,7	5,7	5,6
Finland	5,2	5,3	5,3	5,3	5,2	5,0
France	59,2	61,4	63,0	64,0	64,0	62,9
Germany	82,1	83,5	83,6	82,6	80,6	77,3
Greece	10,5	10,8	10,8	10,8	10,7	10,4
Ireland	3,8	4,1	4,4	4,6	4,8	4,8
Italy	57,6	57,3	56,2	54,4	52,1	48,9
Luxembourg	0,4	0,5	0,5	0,5	0,5	0,6
Netherlands	16,0	16,7	17,3	17,8	17,9	17,9
Portugal	10,0	10,3	10,6	10,7	10,9	10,8
Spain	39,4	39,9	39,7	38,9	37,8	35,8
Sweden	8,9	9,0	9,1	9,3	9,3	9,3
United Kingdom	59,5	61,0	62,4	63,6	63,6	62,7
EU total	**376,3**	**383,9**	**387,4**	**387,1**	**381,6**	**370,0**

Source: Authors' calculations.

Table A1.3 Total population, living longer scenario (middle) (millions of persons)

	2000	2010	2020	2030	2040	2050
Austria	8,1	8,2	8,2	8,3	8,1	7,9
Belgium	10,2	10,4	10,6	10,7	10,7	10,5
Denmark	5,3	5,5	5,6	5,7	5,8	5,8
Finland	5,2	5,3	5,4	5,4	5,3	5,1
France	59,2	61,5	63,3	64,6	65,0	64,2
Germany	82,1	83,7	84,1	83,5	81,9	79,2
Greece	10,5	10,8	10,9	10,9	10,8	10,6
Ireland	3,8	4,2	4,5	4,7	4,8	4,9
Italy	57,6	57,4	56,5	55,0	53,0	50,1
Luxembourg	0,4	0,5	0,5	0,5	0,5	0,6
Netherlands	16,0	16,8	17,4	17,9	18,2	18,2
Portugal	10,0	10,3	10,6	10,8	11,0	11,1
Spain	39,4	40,0	39,9	39,2	38,4	36,7
Sweden	8,9	9,0	9,2	9,4	9,4	9,5
United Kingdom	59,5	61,1	62,7	64,2	64,5	64,1
EU total	**376,3**	**384,5**	**389,4**	**390,8**	**387,5**	**378,4**

Source: Authors' calculations.

Table A1.4 Total population, living longer scenario (high) (millions of persons)

	2000	2010	2020	2030	2040	2050
Austria	8,1	8,2	8,3	8,3	8,2	8,1
Belgium	10,2	10,4	10,6	10,8	10,8	10,7
Denmark	5,3	5,5	5,6	5,8	5,9	5,9
Finland	5,2	5,3	5,4	5,4	5,4	5,2
France	59,2	61,6	63,5	65,0	65,7	65,1
Germany	82,1	83,8	84,5	84,2	82,9	80,8
Greece	10,5	10,8	10,9	11,0	11,0	10,8
Ireland	3,8	4,2	4,5	4,7	4,9	5,0
Italy	57,6	57,5	56,7	55,4	53,7	51,1
Luxembourg	0,4	0,5	0,5	0,5	0,5	0,6
Netherlands	16,0	16,8	17,5	18,1	18,4	18,6
Portugal	10,0	10,4	10,7	10,9	11,2	11,2
Spain	39,4	40,0	40,0	39,5	38,9	37,4
Sweden	8,9	9,0	9,2	9,5	9,5	9,6
United Kingdom	59,5	61,1	62,9	64,6	65,3	65,2
EU total	**376,3**	**384,9**	**390,8**	**393,7**	**392,2**	**385,3**

Source: Authors' calculations.

Table A1.5 Life expectancy developments in the EU

Scenario	Base case		Living longer		
			Low	Middle	High
Life expectancy at age	0	0	0	0	0
Year	2000	2050	2050	2050	2050
Austria	78,0	83,4	84,5	86,4	87,9
Belgium	77,7	82,5	83,6	85,6	87,2
Denmark	76,5	80,9	82,3	84,4	86,2
Finland	77,4	82,4	83,6	85,6	87,3
France	78,7	83,3	84,4	86,5	88,0
Germany	77,8	82,4	83,6	85,7	87,3
Greece	78,2	82,9	84,1	86,1	87,7
Ireland	76,5	81,5	82,8	84,8	86,5
Italy	78,8	83,4	84,6	86,5	88,0
Luxembourg	77,8	82,7	83,8	85,8	87,4
Netherlands	78,1	81,0	82,3	84,4	86,2
Portugal	75,5	81,0	82,1	84,2	85,9
Spain	78,5	81,9	83,1	85,2	86,9
Sweden	79,6	83,9	85,0	86,7	88,2
United Kingdom	77,4	82,4	83,7	85,7	87,4
EU average	**78,0**	**82,6**	**83,8**	**85,8**	**87,4**

Scenario	Base case		Living longer		
			Low	Middle	High
Life expectancy at age	65	65	65	65	65
Year	2000	2050	2050	2050	2050
Austria	16,8	20,1	21,1	22,5	23,7
Belgium	16,5	19,5	20,5	21,9	23,2
Denmark	15,8	18,5	19,6	21,1	22,5
Finland	16,5	19,5	20,6	22,0	23,3
France	18,1	20,8	21,7	23,0	24,2
Germany	16,6	19,5	20,5	22,0	23,3
Greece	16,7	19,9	20,9	22,4	23,7
Ireland	15,2	18,5	19,6	21,1	22,5
Italy	17,4	20,3	21,3	22,7	23,9
Luxembourg	17,0	19,7	20,7	22,1	23,3
Netherlands	16,5	18,4	19,5	21,0	22,4
Portugal	15,3	18,5	19,5	21,0	22,3
Spain	17,5	19,5	20,6	22,0	23,3
Sweden	17,5	20,3	21,2	22,6	23,7
United Kingdom	15,9	19,2	20,3	21,9	23,3
EU average	**16,9**	**19,7**	**20,7**	**22,2**	**22,6**

Source: Authors' calculations.

Appendix A.2

Calculation of mortality rates by specific age category for the group aged 90+

As mentioned in chapter 3, the demographic data by Eurostat only give population and mortality data for the age categories of 0 to 90+. For an accurate prediction of health and pension expenditures, however, we are also interested in the specific breakdown of the age category 90+ into the ages of 90 to 99. To achieve this we used recent realised population and mortality figures for this group, which for most countries can be found in the Human Mortality Database and the Kannisto-Thatcher database from the Max Planck Institute. While this data would not give us information about the trend in these figures until 2050, it would give a good indication of what the population and mortality figures look like in the most recent years by specific age category and could serve as base figures. We then used this information and observable trends in mortality figures for the 90+ age group for those EU countries for which we did have the required age split until 2050, as well as observable trends in the age groups just under the age of 90 (ages 85 to 89), to project future mortality rates for other EU countries. Although the mortality rates differ by specific age category, we assumed that the change in the mortality rates in the period to 2050 was equal for the specified age groups for computational convenience. Using these mortality rates, population figures for the oldest old can be calculated in the manner that was presented in chapter 2. There we explained that the population in a given year can be calculated from the population in a previous year by adjusting this population figure for any mortality changes and net migration. As we have population figures in the base year and mortality figures for the whole projection period, future populations by age category can now easily be calculated. We abstracted from any migration flows as these can be expected to be close to zero at the higher ages.

Thus from the development of the mortality rates population figures can easily be deduced. As we did have original estimates from Eurostat for the total size of the population aged 90+, we adjusted the mortality figures for each country to enable the population figures we obtained to resemble the Eurostat population figures as much as possible and allowed an error margin of no more than 3%. While the mortality rates were adjusted on the basis of trial and error, we tried to keep the procedure as simple as possible by allowing no more than two different rates of adjustment from the realised figures we used as base figures. Depending on whether our population projections for these specific age categories were either higher or lower than the Eurostat prediction, mortality rates were increased or decreased by a respective percentage for a certain period to correct for this difference. Such an exercise could for instance lead to a 7% relative gradual decline in mortality rates during the first 10 years and a 10% relative gradual decline during the remaining years to correct for differences in population figures. The mortality rates obtained in this manner differ by country and by period.

One shortcoming of this approach is that no difference is made between changes in the gradual decline of mortality rates by respective age. As shown by the figures for the Netherlands for example, the expected decline in mortality rates do differ by age category and turn out to be higher for the group of those aged 98 than for the group of those aged 91. The application of uniform rates that reflect this decline may thus slightly underestimate the development of the population in the higher range, i.e. the group of those aged 95-98. Because these age groups comprise only a very small part of the population, however, they will only marginally affect calculations of health and pension expenditure in the projections in parts I and II.

Appendix A.3

Relevance of cost of mortality in projecting health-care expenditures

To see how relevant the concept of the cost of mortality and its variation over the different age categories is, two other scenarios were run with different costs of mortality. Recall that in our base case scenario the cost of mortality followed a u-shaped curve. In the first scenario it is assumed that the cost of mortality for all ages equals the costs for the group aged 35-64, which is equal to the benchmark cost of a person aged 95 years. This would imply a lower cost of mortality for all other ages compared with the base case scenario. The second scenario assumes no costs of mortality at all. This will tell us just how important the inclusion of the costs incurred during the last years of life is for the projections of health care for the different EU countries. These scenarios can therefore be thought of as a test to measure how sensitive the results of the projections of health-care expenditures are to the assumptions made in the base case scenario with regard to the cost of mortality. Table A3.1 shows the projected expenditure paths for health and long-term care until 2050 for the EU countries for both scenarios. For convenience, the first three columns show the results from the base case scenario as presented in Table 4.1.

Projections of health- and long-term care expenditures with lower costs of mortality

A lower cost of mortality for all age groups, except for those aged 35-64 (which stays the same), will lead to higher expenditures on total health and long-term care for all EU countries. The difference in percentage points in terms of GDP is small however; the increase in total expenditures varies between 0 and 0.3% of GDP. Both categories of expenditures contribute to this rise in total expenditures. The conclusion that a lowering of the cost of mortality increases expenditure on health care and long-term care may at first sight seem counterintuitive. Yet it can be explained by the fact that the costs of mortality are part of the average cost of health care per person and as explained in chapter 2 are subtracted from the respective health-care and long-term care components. A lowering of the cost of mortality thus leads to higher cost profiles for health care and long-term care for the survivors. As relatively few people die before the age of 85, a large number of persons make use of health care and long-term care services and a relative increase in these costs will offset a decline in mortality costs by which only a relatively small number of people are affected. We have also calculated how this lower cost of mortality would impact government finances and found that the sustainability gap for the average EU country would have to increase by 0.1% to keep government finances sustainable.

Likewise an increase in the cost of mortality (not shown in the table) will lead to a lowering of expenditures on health and long-term care, albeit at the same small percentages that were found when the costs of mortality were lowered. The level of the cost of mortality among age groups thus only marginally seems to influence total health- and long-term care expenditures. The impact will obviously increase the larger the deviation, i.e. a lower or higher cost of mortality based on the initial level of cost of mortality for the respective age group.

Table A3.1 Projection of public expenditures on health- and long-term care with various assumptions about the amount of the mortality costs

	Health care expenditure (% of GDP)						
	Base case			Death costs			
				Low		None	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*	2050	*extra incr.*
Austria	5,1	7,7	*2,5*	7,8	*0,1*	8,0	*0,4*
Belgium	5,2	6,9	*1,7*	7,0	*0,1*	7,2	*0,3*
Denmark	4,0	4,6	*0,6*	4,8	*0,2*	5,1	*0,5*
Finland	4,8	6,7	*1,9*	6,8	*0,2*	7,1	*0,4*
France	5,5	7,4	*1,9*	7,5	*0,1*	7,6	*0,2*
Germany	6,5	8,9	*2,4*	9,0	*0,1*	9,1	*0,2*
Greece	4,7	6,1	*1,4*	6,2	*0,0*	6,2	*0,1*
Ireland	5,6	6,6	*1,0*	6,7	*0,1*	6,9	*0,3*
Italy	5,5	7,7	*2,2*	7,7	*0,1*	7,8	*0,2*
Luxembourg	n.a	n.a		n.a	*n.a*	n.a	
Netherlands	4,7	5,5	*0,8*	5,6	*0,1*	5,7	*0,2*
Portugal	5,3	7,0	*1,7*	7,1	*0,0*	7,2	*0,1*
Spain	6,2	8,9	*2,7*	8,9	*0,0*	9,0	*0,1*
Sweden	5,1	6,0	*0,9*	6,2	*0,2*	6,5	*0,5*
United Kingdom	3,9	4,9	*0,9*	5,1	*0,2*	5,4	*0,5*
EU average	**5,4**	**7,1**	***1,7***	**7,2**	***0,1***	**7,4**	***0,3***

	Long term care expenditure (% of GDP)						
	Base case			Death costs			
				Low		None	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*	2050	*extra incr.*
Austria	0,6	1,6	*1,0*	1,7	*0,1*	1,8	*0,2*
Belgium	0,7	1,6	*0,9*	1,7	*0,1*	1,8	*0,2*
Denmark	2,2	4,1	*1,9*	4,1	*0,1*	4,2	*0,2*
Finland	1,5	3,3	*1,9*	3,4	*0,1*	3,5	*0,2*
France	0,7	1,5	*0,8*	1,6	*0,0*	1,6	*0,1*
Germany	0,3	0,6	*0,4*	0,7	*0,0*	0,7	*0,1*
Greece	n.a.	n.a.		n.a.	*n.a.*	n.a.	
Ireland	0,7	1,2	*0,6*	1,3	*0,0*	1,3	*0,1*
Italy	0,7	1,2	*0,5*	1,3	*0,0*	1,3	*0,1*
Luxembourg	n.a	n.a		n.a	*n.a*	n.a	
Netherlands	2,6	4,5	*1,9*	4,5	*0,0*	4,6	*0,1*
Portugal	n.a.	n.a.		n.a.	*n.a.*	n.a.	
Spain	n.a.	n.a.		n.a.	*n.a.*	n.a.	
Sweden	2,4	4,3	*2,0*	4,4	*0,1*	4,5	*0,2*
United Kingdom	1,7	3,4	*1,7*	3,5	*0,1*	3,6	*0,3*
EU average	**0,9**	**1,8**	***0,9***	**1,9**	***0,1***	**2,0**	***0,1***

	Total health and long-term care expenditure (% of GDP)						
	Base case			Death costs			
				Low		None	
	2002	2050	*% incr. Exp 2002-2050*	2050	*extra incr.*	2050	*extra incr.*
Austria	5,8	9,3	*3,5*	9,5	*0,2*	9,8	*0,5*
Belgium	5,9	8,5	*2,6*	8,7	*0,2*	9,0	*0,5*
Denmark	6,2	8,7	*2,5*	8,9	*0,2*	9,3	*0,6*
Finland	6,3	10,0	*3,7*	10,2	*0,2*	10,6	*0,6*
France	6,2	8,9	*2,7*	9,0	*0,1*	9,2	*0,3*
Germany	6,7	9,5	*2,8*	9,6	*0,1*	9,9	*0,4*
Greece	4,7	6,1	*1,4*	6,2	*0,0*	6,2	*0,1*
Ireland	6,3	7,9	*1,6*	8,0	*0,1*	8,3	*0,4*
Italy	6,2	8,9	*2,7*	9,0	*0,1*	9,1	*0,2*
Luxembourg	n.a	n.a		n.a	*n.a*	n.a	
Netherlands	7,3	10,0	*2,7*	10,1	*0,1*	10,3	*0,3*
Portugal	5,3	7,0	*1,7*	7,1	*0,0*	7,2	*0,1*
Spain	6,2	8,9	*2,7*	8,9	*0,0*	9,0	*0,1*
Sweden	7,5	10,4	*2,9*	10,6	*0,2*	11,0	*0,6*
United Kingdom	5,7	8,3	*2,6*	8,6	*0,3*	9,0	*0,8*
EU average	**6,2**	**8,9**	***2,7***	**9,1**	***0,2***	**9,3**	***0,4***

Source: Authors' calculations.

Projections of health- and long-term care expenditures without the inclusion of the cost of mortality

As outlined in chapter 1, other studies have highlighted the importance of including the costs of mortality for accurately projecting health-care expenditures. If the costs of mortality or costs incurred during the last years of life were included in the projections, expenditures were projected to be significantly lower than if these costs were calculated by using the standard approach. The last two columns in Table A3.1 show the results of not including the cost of mortality in this study for the individual countries of the EU. As one can see the projections that do not take account of the cost of mortality all lead to higher expenditures on health care and long-term care for each EU country, although at different magnitudes. The projections of health-care expenditure are most influenced in Denmark, Finland, Sweden and the UK where the inclusion of the cost of mortality will lead to lower expenditures on health care by 0.3%. On average, health-care expenditures are 0.2% lower for the EU if the mortality costs are included. The inclusion of the cost of mortality likewise leads to lower expenditures on long-term care; for the EU this will lead to a decline in expenditures of 0.1%. When looking at total health-care and long-term care expenditure, the inclusion of the cost of mortality will lead to declines in expenditures of 0.6% and more for Denmark, Finland, Sweden and the UK. Overall the inclusion of the cost of mortality seems very relevant for making accurate projections of health-care expenditures for the EU countries.

We have also calculated the sustainability gaps for the EU countries when mortality costs are not included in the health care projections and found that the sustainability gap would increase by 0.22% for the EU average. These changes in sustainability gaps are shown in Table A3.2. As could be concluded in the previous paragraph, the countries that benefit most in terms of sustainability are Denmark, Finland, Sweden and the UK.

Table A3.2 Change in the sustainability gaps if the cost of mortality argument was excluded (% of GDP)

Group A	Denmark	0,44	Group C	Ireland	0,33
	Sweden	0,40		Luxembourg	0,00
				Netherlands	0,23
				Portugal	0,09
				Spain	0,06
Group B	Belgium	0,33	Group D	France	0,21
	Austria	0,28		Germany	0,22
	Finland	0,39		Greece	0,07
	Italy	0,12			
	United Kingdom	0,53			
	EU average	**0,22**			

Source: Authors' calculations.

AGIR – Ageing, Health and Retirement in Europe

AGIR is the title of a major study on the process of population ageing in Europe and its future economic consequences. This project was motivated by an interest in verifying whether people are not only living longer but also in better health. It aims at analysing how the economic impact of population ageing could vary when not only demographic factors, but also health developments are taken into consideration. The project started in January 2002 for a period of three years.

The **principal objectives** of the study are to:

- document developments in the health of the elderly, ideally since 1950, based on a systematic collection of existing national data on the health and morbidity of different cohorts of the population;
- analyse retirement decisions and the demand for health care as a function of age, health and the utility of work and leisure;
- combine these results, and on that basis to elaborate scenarios for the future evolution of expenditure on health care and pensions; and
- analyse the potential macroeconomic consequences of different measures aiming at improving the sustainability of the European pension systems.

The **AGIR** project is carried out by a consortium of nine European research institutes, most of which are members of ENEPRI:

- **CEPS** (Centre for European Policy Studies), Brussels
- **CEPII** (Centre d'Etudes Prospectives et d'Informations Internationales), Paris
- **CPB** (Netherlands Bureau for Economic Policy Analysis), The Hague
- **DIW** (Deutsches Institut für Wirtschaftsforschung), Berlin
- **ETLA** (the Research Institute of the Finnish Economy), Helsinki
- **FEDEA** (Fundación de Estudios de Economía Aplicada), Madrid
- **FPB** (Belgian Federal Planning Bureau), Brussels
- **NIESR** (National Institute for Economic and Social Research), London
- **LEGOS** (Laboratoire d'Economie et de Gestion des Organisations de Santé, Université de Paris-Dauphine), Paris

It has received finance from the European Commission, under the Quality of Life Programme of the 5th EU Research Framework Programme. The project is coordinated by Jorgen Mortensen, Associate Senior Research Fellow at CEPS. For further information, contact him at: jorgen.mortensen@ceps.be.

About ENEPRI

The European Network of Economic Policy Research Institutes (**ENEPRI**) is composed of leading socio-economic research institutes in practically all EU member states and candidate countries that are committed to working together to develop and consolidate a European agenda of research. **ENEPRI** was launched in 2000 by the Brussels-based Centre for European Policy Studies (CEPS), which provides overall coordination for the initiative.

While the European construction has made gigantic steps forward in the recent past, the European dimension of research seems to have been overlooked. The provision of economic analysis at the European level, however, is a fundamental prerequisite to the successful understanding of the achievements and challenges that lie ahead. **ENEPRI** aims to fill this gap by pooling the research efforts of its different member institutes in their respective areas of specialisation and to encourage an explicit European-wide approach.

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CEPS	Centre for European Policy Studies, Brussels, Belgium
CERGE-EI	Centre for Economic Research and Graduated Education, Charles University, Prague, Czech Republic
CPB	Netherlands Bureau for Economic Policy Analysis, The Hague, The Netherlands
DIW	Deutsches Institut für Wirtschaftsforschung, Berlin, Germany
ESRI	Economic and Social Research Institute, Dublin, Ireland
ETLA	Research Institute for the Finnish Economy, Helsinki, Finland
FEDEA	Fundación de Estudios de Economía Aplicada, Madrid, Spain
FPB	Federal Planning Bureau, Brussels, Belgium
IE-BAS	Institute of Economics, Bulgarian Academy of Sciences, Sofia, Bulgaria
IER	Institute for Economic Research, Ljubljana, Slovenia
IHS	Institute for Advanced Studies, Vienna, Austria
ISAE	Istituto di Studi e Analisi Economica, Rome, Italy
ISWE-SAS	Institute for Slovak and World Economy, Bratislava, Slovakia
NIER	National Institute of Economic Research, Stockholm, Sweden
NIESR	National Institute of Economic and Social Research, London, UK
NOBE	Niezalezny Osrodek Bana Ekonomicznych, Lodz, Poland
PRAXIS	Center for Policy Studies, Tallinn, Estonia
RCEP	Romanian Centre for Economic Policies, Bucharest, Romania
TÁRKI	Social Research Centre Inc., Budapest, Hungary

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