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CAN WE AFFORD TO LIVE LONGER IN BETTER HEALTH?

ED WESTERHOUT AND FRANK PELLIKAAN

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ED WESTERHOUT AND FRANK PELLIKAAN*

Abstract

This research report analyses the effects of ageing populations upon public finances. More specifically, it focuses on the implications of population ageing for acute health care, long-term care and public pension expenditures for 15 EU countries. It pays particular attention to three novel insights: i) a large proportion of health-care spending relates to time to mortality rather than to age; ii) life expectancy may increase much faster than current demographic projections suggest; and, iii) average health status may continue to improve in the future. It adopts a generational accounting model that incorporates health-care costs during the last years of life, decomposed into an acute health-care component and a long-term care component.

The projections show that gains in life expectancy increase age-related expenditure, while improved health has the opposite effect. Combined, these trends reduce health-care costs and increase pension expenditures. Their joint effect upon public finances is rather modest, however. Hence, the assessment of public finances in most EU-15 countries does not change: even if a more rapid increase in life expectancy combines with an improvement in health, current fiscal and social security institutions will be unsustainable.

Key words: ageing populations, fiscal sustainability

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Preface

It is quite well known nowadays that ageing populations threaten the sustainability of fiscal policies. However, there are questions. Some of them are fundamental. And there are uncertainties. These are particularly large due to the long horizons involved.

This research report analyses the effects of ageing for acute health care, long-term care, public pensions and public finances for the countries that belong to the EU-15 area. It pays particular attention to three novel insights: i) a large part of health-care spending relates to time to mortality rather than to age; ii) life expectancy may increase much faster than current demographic projections suggest; and, iii) the average health status may continue to improve in the future. It adopts a generational accounting model that incorporates health-care costs during the last years of life, decomposed into an acute health-care component and a long-term care component.

The analysis has been carried out as part of the Ageing, Health and Retirement in Europe (AGIR) project, Work Package 4, being carried out by the EU-financed European Network of Economic Policy Research Institutes (ENEPRI).

An earlier research report on this theme was published as ENEPRI Research Report No. 8, *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* by Frank Pellikaan and Ed Westerhout. That report contains more technical details about the analysis. This document updates part of the earlier analysis and includes some comments on policy implications.

Thanks are due to Rudy Douven, Peter Kooiman, Esther Mot and Harry ter Rele for their helpful suggestions and comments on earlier drafts. Thanks for comments are also due to the participants of various AGIR workshops, a seminar at CPB, the EC/OECD/AWG workshop Understanding Trends in Disability among Elderly Populations and the Implications of Demographic and Non-Demographic Factors for Future Health and Long-Term Care Costs in Brussels on 21-22 February 2005 and the final AGIR conference in Brussels on 10 March 2005, and in particular to Axel Börsch-Supan and Bartosz Przywara (the discussants). Thanks are also due to Peter Dekker, André Nibbelink and Richard Rosenbrand for computational assistance and to Jannie Droog and Annemarie Spaans for typing assistance. The authors acknowledge funding from the European Commission under the AGIR project.

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Director, CPB

Summary

It is well known by now that population ageing jeopardises the sustainability of public finances in a number of countries. The gradual retiring of the baby-boom generations, low fertility rates and ongoing reductions in mortality rates portend dramatic changes in the age structure of populations. In many countries, old-age dependency ratios may more or less double within a period of 40 years. By themselves, these changes would not be problematic, except for the pay-as-you-go (PAYG) nature of many social security institutions. Population ageing unbalances the relation between pension expenditures and pension contributions because of its PAYG financing mode. This unbalance will be reflected in increasing fiscal deficits, which cannot be expected to disappear if policies are left unchanged.

A number of studies address the problem of quantifying the fiscal impact of population ageing. Especially important are the studies by the EU and the OECD, which do so for a large number of countries (Economic Policy Committee or EPC, 2001 and Dang et al., 2001, respectively). Unfortunately, these studies rely on assumptions that are difficult to accept in the light of recent empirical evidence. This also holds true for the assumptions these studies make on mortality-related costs, the future evolution of mortality rates and the health status of the population. In particular, these studies neglect mortality-related costs, assume a slowing down of the process of increasing longevity and postulate that the health status of the population will, apart from the impact of ageing, remain unchanged. Several arguments call into doubt the usefulness of these assumptions.

Three critical assumptions

The view that health-care expenditure is a function of age alone is heavily debated nowadays. First, evidence abounds that health-care expenditures by people in the last year of their lives is substantially larger than those of survivors of the same age. Focusing on the last year of life, the costs of decedents can be higher than those of survivors by a factor of 6. The share of expenditures during the last year of life of total health-care spending on the elderly is more than a quarter. Furthermore, this share is surprisingly stable over time. Calculations that neglect this type of evidence produce estimates of expenditure growth that are way too high. The errors involved may be 20% or higher.

Second, many studies take the view that there will be fewer gains in life expectancy because of biological limits. The idea that life expectancy gains in the near future will be modest because life expectancy is close to a biological limit has some intuitive appeal. Yet it conflicts with more recent historical evidence. White (2002) concludes from empirical evidence for a number of countries that life expectancy increases by one year every five years. Over the last 40 years, the rate of growth in life expectancy has not declined at all; it even shows a slight acceleration. Furthermore, Vaupel (1998) presents a number of historical examples in which the reductions in mortality rates were highest for the oldest old, contrary to the argument of a biological limit to life expectancy, which would suggest smaller life expectancy gains for the older age cohorts. Similarly, according to the biological limit argument, one would expect to observe smaller life expectancy gains for women, as on average they live longer than men. Nevertheless, Kannisto et al. (1994) show that in the 1980s, in contrast to the convergence argument, the gap between the mortality rates of women and men did not decrease at all and even grew further. To be sure, there is no reason to assume that the future is a mere extrapolation of recent history. But it is also true that it is difficult to consider a continuation of historical trends an unlikely scenario.

A third assumption that may be questioned concerns the health status of the population. Most projection exercises that calculate the impact of changing age structures assume constancy of

the health status of the population per age group. Historical evidence casts doubt on the validity of this assumption, however. Manton et al. (1997), Jacobzone et al. (2000) and Cutler (2001) document that disability rates among the elderly have declined and that the health status of elderly persons has in general been improving. Even if the more recent trend of worsening health as a result of overweight and obesity continues, it is not to be expected that the historical trend of improving health will halt within a few years time.

The future of fiscal deficits and debt positions

The obvious question arises of what will be the impact of alternative assumptions on these three aspects for the future development of budget deficits. Health-care spending may be seriously affected – not only the spending on acute health-care services, but also the spending on long-term care services. Projections for pension expenditure may be importantly altered as well. But the projections for labour market participation and thus tax and social security revenues may also change on account of alternative assumptions about the health development of the population. Ultimately, alternative insights may then change our assessment of the fiscal sustainability problem.

This report explores the impact of alternative assumptions on the determinants of medical spending, the development of life expectancy and the development of health. It covers the public sector in a broad sense, i.e. it analyses health expenditures, pension expenditures, social security expenditures and tax and social security revenues. It makes calculations for the group of EU-15 countries. It assesses the impact of life expectancy and health status separately and simultaneously, giving rise to three alternative scenarios: 'living longer', 'living in better health' and 'living longer in better health'.

Yet a caveat is in order before presenting the results. It would be tempting to interpret the calculations as projections of the most likely future developments of important variables. We warn against such an interpretation. The reason is that our calculations are kept deliberately simple and omit several aspects that are important in real life in order to focus on the contribution of the elements of mortality-related costs, life expectancy and health improvements. Our study is hopefully able to say something useful on the contribution of these three variables but nothing on the contribution of all other variables one can think of that will be relevant for fiscal sustainability projections. In order to avoid any misunderstanding we do not present the base case scenario but focus on the differences that relate to the trends in demography and health.

Our base case scenario does however reflect some of the things we learned from earlier projection exercises. During the next four decades, medical spending on acute health-care services and long-term care services will increase, in absolute terms and as a percentage of GDP. Pension expenditure will also increase, even faster than medical spending. The increase in pension expenditure will peak somewhere around 2035, starting to decline when the baby-boom generations gradually pass away. But the increase in health expenditure will continue to reflect the ongoing increase in life expectancy. This illustrates once again that population ageing is not a temporary issue, which will be resolved once the baby-boom generations have disappeared. The combination of an ongoing increase in life expectancy with a fixed age of retirement implies a permanent increase in the ratio of retirees to workers.

We use the sustainability gap to measure the size of the fiscal sustainability problem. To understand the sustainability gap, note that population ageing implies a debt that does not show up in official statistics. Summing the explicit debt and implicit debt gives the total public debt. The sustainability gap is the annuity value of this total public debt figure. We express the sustainability gap in terms of GDP, as is usual for debt figures. Hence, the sustainability gap is the immediate and permanent change in the primary surplus-to-GDP ratio required to restore fiscal sustainability.

Why future prospects may be brighter or duller

In terms of fiscal sustainability, the impact of mortality-related costs is relatively modest. The sustainability gap that corresponds to a scenario that does not take into account mortality-related costs (and that is identical in all other respects to the base case scenario) is only 0.2 percentage points higher than that of the base case scenario. Despite its importance, health-care expenditure is only one of the budgetary items affected by population ageing. Pension expenditure, social security expenditure and taxes and social security revenues do not change when mortality-related costs are included in the analysis. Focussing on health-care costs only, the difference is about 15%, which is in line with a number of other studies that simulate the impact of mortality-related costs for the future growth of health-care spending.

Compared with this, the impact of a stronger increase in life expectancy is much larger. Our living longer scenario assumes an increase of eight years, to be compared with a five-year increase in the base case scenario. Note that this corresponds more closely with historical evidence, which has shown a one-year increase in life expectancy every five years for a number of countries. The sustainability gap for the EU-15-average is now 1.0 percentage points of GDP larger than in the base case scenario, because the expansion of longevity increases pension and health expenditure. It is noteworthy that the reduction in mortality rates, which drives the increase in longevity, also reduces health spending in a very direct way, namely by lowering mortality-related costs. This effect is so small, however, that it is dominated by the boost in health spending resulting from the expansion of longevity.

The impact of an alternative assumption on the development of health is of similar importance. Assuming an improvement of health, the sustainability gap falls by 0.8 percentage points of GDP for the average EU-15 country. That the effect of a health improvement is so large has to do with its multiple impacts. Better health not only reduces health expenditure, but also delays retirement, thereby increasing participation in the labour market and reducing social security expenditure.

Given that the impact of both a stronger increase in life expectancy and a steady improvement in the health of the population is relatively large, it is interesting to see the impact on fiscal sustainability of the combination of these two trends. This effect turns out to be rather small, however: the sustainability gap for the living longer in better health scenario is almost similar to that in the base case scenario. The drop in public spending related to healthier lives neutralises the boost in public spending on account of longer lives. Yet on a lower aggregate level, the combined scenario does not work out to be neutral. Pension expenditure and expenditure on long-term care services increase faster than in the base case, whereas acute health-care expenditure increases at a slower pace. Moreover, the uncertainties are particularly large in the combined scenario.

A warning signal

The calculated sustainability gaps deviate significantly from zero and the conclusion that current fiscal policies in many EU-15 countries are unsustainable is pretty robust. Obviously, exogenous developments may help to make the future look brighter. A substantial increase in labour market participation would help to reduce fiscal sustainability problems to a large extent, for example. In particular, if the future increase in life expectancy is accompanied by a rise in the (actual) retirement age, the extent of fiscal problems will decrease. On the other hand, there are adverse risks as well. The prospects of an improvement in the health status of the population may fail to materialise and health spending may increase much faster than is assumed in our calculations. Indeed, there is ample evidence that economic factors play an important role in health expenditure projections and in the assessment of the sustainability of fiscal policies as well. Sustainability gaps would then be much higher than those that follow from our calculations. Assuming some risk aversion on the part of policy-makers, i.e. that they are more concerned with the pessimistic scenarios than the more optimistic ones, this only strengthens the case for policy reforms that help to close fiscal sustainability gaps. Which policies should be reformed is a question that we cannot answer and clearly falls beyond the scope of our analysis. What our analysis offers is only a signal. The signal is that living longer in better health will not relieve the fiscal sustainability problems in the EU-15 countries.

1. Introduction

As is well known by now, population ageing jeopardises the sustainability of public finances in a number of countries. The doubling of old-age dependency ratios (the number of persons aged 65+ over persons aged 20-64) implies huge public deficits if current fiscal and social security institutions are maintained.

A number of studies address the problem of quantifying the fiscal impact of population ageing. Especially important are the studies by the EU and the OECD, which do so for a large number of countries (Economic Policy Committee, 2001 and Dang et al., 2001 respectively). Inevitably, in order to be able to produce such calculations, assumptions have to be made on things about which knowledge is typically scarce. On a few points, however, a case can be made for adjusting specific assumptions. Notably, the assumptions that these official projections make on the cost of mortality, the future evolution of mortality rates and the health status of the population seem difficult to accept on the basis of current empirical evidence.

First, the view that health-care expenditure is a function of age alone is adhered to by very few people nowadays. There is a great deal of evidence that the health-care expenditure of people in the last year of their lives is substantially larger than that of survivors of the same age. Focusing on the last year of life, the costs of decedents can be six times higher than those of survivors (Hogan et al., 2001). The share of expenditures during the last year of life of total health-care spending on the elderly is more than a quarter. Furthermore, this share is surprisingly stable over time (Lubitz & Riley, 1993 and Hogan et al., 2001). Calculations that neglect this type of evidence produce estimates of expenditure growth that are way too high. The errors involved may be as large as 20% or more (Westerhout, 2004).

Second, there is the argument that the gains in life expectancy may become smaller in the future, perhaps because of biological limits to human life expectancy. This idea of an upper limit to life expectancy was quite popular in the 1960s and 1970s and, indeed, has some intuitive appeal (Fogel, 1994). Moreover, it underlies many of today's projections, including those of the EU and the OECD. Nevertheless, it conflicts with more recent historical evidence. Life expectancy increases almost linearly over time (Oeppen & Vaupel, 2002). Using data from more than 20 countries, White (2002) finds that life expectancy increases by one year every five years. Over the last 40 years, the rate of growth in life expectancy has not declined at all; it even shows a slight acceleration. This suggests that if there is a biological limit to human life, life expectancy is not quite close to this limit or the limit itself evolves over time.

Furthermore, Vaupel (1998) offers another argument against stabilisation. If the argument of the biological limit were true, one would expect to observe smaller life expectancy gains for the age cohorts with the shortest life expectancies, i.e. the older age cohorts. Vaupel presents, however, a number of historical examples in which the reductions in mortality rates were highest for the oldest age cohorts. Similarly, because of the biological limit argument, one would expect to observe smaller life expectancy gains for women, as women on average live longer than men. Nevertheless, Kannisto et al. (1994) show that in the 1980s, in contrast to this convergence argument, the gap between the mortality rates of women and men did not reduce, but instead widened further.

A third issue concerns the health status of the population. Official projections assume that the health status of the population, apart from the impact of ageing, will remain unchanged. But historical evidence casts doubt on the validity of this assumption. Cutler (2001) and Jacobzone et al. (2000) document that disability rates among the elderly have declined in the past, as the health status of elderly has in general been improving. More recently, research has become available that focuses on the increasing prevalence of overweight and obesity (Sturm, 2002 and Finkelstein et al., 2003). If this trend continues, at some point in the future we might see a deterioration rather than an improvement of health status (Sturm et al., 2004). Yet it is still unlikely that the population will not become healthier during the next decades.

This report explores the impact of life expectancy and health status for the sustainability of public finances. It does so for the EU-15 countries separately and for the EU-15 as a whole. It focuses on expenditure for acute health care, long-term care, social security and tax revenues. It assesses the impact of life expectancy and health status separately and simultaneously, giving rise to three alternative scenarios: 'living longer', 'living in better health' and 'living longer in better health'.

Certainly this paper is not the first to focus on the effects of life expectancy and health status. In particular, Jacobzone et al. (2000) and Cutler & Sheiner (2001) are important forerunners. Compared with these two studies, our research is broader since it also examines the implications for pension expenditures and labour market participation. Moreover, the three reports apply to different areas. The study by Jacobzone et al. (2000) relates to the OECD area and that by Cutler & Sheiner (2001) to the US; our analysis pertains to the EU-15 area.

Our calculations should not be interpreted as projections of the most likely future developments of important variables. The calculations are kept deliberately simple and omit several aspects that are important in real life in order to focus on the contribution of mortality-related costs, life expectancy and health improvements. This report aims at assessing the implications of only three assumptions in the field of demography and health for estimations of the sustainability of current fiscal policies.

An earlier report (Pellikaan & Westerhout, 2005) also discusses our findings, focusing more on technical details and presenting a sensitivity analysis. This document updates part of the earlier study and includes some comments on policy implications. In particular, the update concerns the assumed age profiles of decedents with regard to health-care spending. This update has no implications for our results, however, as can be seen by simple comparison.

The structure of this report is as follows. Section 2 summarises arguments against the standard approach for projecting health-care expenditure, which does not take into account mortality-related costs. Section 3 explains how we include mortality-related costs in our framework. Section 4 presents projections of an increase in life expectancy on the development of health and pension expenditures and public finances. It pays particular attention to (the relevance of) the mortality-related cost argument. Sections 5 and 6 focus upon the effects of health improvements and the combination of the two trends. In each case, we calculate the correction in primary surpluses that is needed to keep public finances sustainable, the so-called 'sustainability gap'. Section 7 is devoted to policy implications.

2. Projecting health-care spending

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 for this trend are the fall in fertility rates, the gradual retirement of the baby-boom generations and the ongoing increase of life expectancies. This process of population ageing will have profound effects on the health-care sector and on pension schemes. Furthermore, labour market participation is expected to decline. This 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-related cost argument, i.e. the fact that expenditure increases very fast in the last years before mortality, for projections of health expenditure. It thereby distinguishes between acute health- and long-term care. In addition, it 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 ones. To the extent that they are true, these two arguments respectively imply that health expenditure may rise at a much faster or slower pace in the future than anticipated thus far.

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

2.1 Standard projection method

Most simulation studies apply a rather mechanical method to calculate the effect of population ageing on public expenditures. This method, which has its roots in generational accounting studies, calculates the effect of changes in the age structure of the population under the assumption that in the future the age profiles of public expenditure categories will remain unchanged. The procedure is as follows. First, current expenditure per age cohort is decomposed into the expenditure per capita and the size of that age cohort. Second, 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.

This analysis adopts this standard extrapolation method when it comes to projecting pension expenditure, spending on public goods and tax revenues. In projecting the development of acute health-care expenditure and long-term care expenditure, however, it pursues a different strategy. Indeed, by distinguishing between survivors and decedents, it allows the age profile of health expenditure to change endogenously through time.

Actually, there are several reasons why the assumption that the age profile of health expenditure will remain the same in the future may be wrong. A first reason relates to women giving birth. If population ageing is the result of declining fertility rates, one may expect health expenditure 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 on average women outlive men. 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 giving care at home, thereby diminishing the demand for formal long-term care (Lakdawalla & 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 & Meara (1999) show that the age profile of health expenditure by Medicare beneficiaries in the US has grown higher and argue that this does not reflect changes in the health status of these people. Instead, they find that the disability status of the eldest elderly (85+) is falling more rapidly than that of the youngest elderly (65-85).

Most relevant in this report is that the age profile may also change in 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 the age profile of medical spending. This shift may be parallel or more local if the health improvement occurs for particular ages.

An increase in life expectancy may change the age profile of medical spending as well. In particular, increases in life expectancy may imply higher health-care costs. Indeed, this holds if the rise in longevity is 'produced' by new costly medical technologies. Jones (2002) describes a model in which longevity-increasing technological progress accounts for a large part of health expenditure growth. Empirically, however, the issue is unresolved. On a cross-country level, there is very little correlation between changes in life expectancy and changes in health expenditure.

2.2 The mortality-related costs argument

A major argument against the standard projection method relates to health spending in the last years of life. There is widespread empirical evidence now that medical spending in the last years of life relates to time to mortality (Lubitz & Riley, 1993, Zweifel et al., 1999 and Cutler & Meara, 1999). First, medical consumption of persons in the last year of life is considerably higher than that of persons of the same age who survive. Roos et al. (1987) demonstrate this for hospital services and nursing-home services. McGrail et al. (2000), Hogan et al. (2001) and Batljan & Lagergren (2004) provide similar evidence for health-care costs. According to these analyses, the costs of persons in the last year of their life can be six times higher than the costs of survivors. As a share of medical expenditure on the elderly, spending during the last year of life is found to be more than a quarter. Second, this feature is quite robust. It applies to different types of medical services and is observed in various countries. In addition, the share of mortality-related costs of total health-care costs of the elderly is surprisingly stable over time (Lubitz & Riley, 1993 and Hogan et al., 2001). Third, mortality-related costs are not restricted to the last year of life. Health-care costs are higher several years before mortality. The typical pattern is that health-care consumption increases as mortality approaches. Roos et al. (1987) demonstrate this for hospital and nursing-home usage. Stooker et al. (2001), Batljan & Lagergren (2004), Seshamani & Gray (2004) and Lubitz et al. (1995) respectively illustrate a negative relationship between health-care costs and time to mortality up to 2, 6, 15 and 17 years before mortality. Furthermore, Lubitz & Riley (1993), Stooker et al. (2001) and Levinsky et al. (2001) show that a negative relationship applies during the last year of life as well. Moreover, Seshamani & Gray (2004) find the effect of time to mortality upon health-care costs to be stable over time.

Based on this evidence, we must conclude that older persons consume more overall health-care services not only because they are older, but also because they are closer to their mortality. Hence, time to mortality adds to age as a factor determining health-care spending. It is obvious that accounting for this mortality-related cost argument may change the predicted effects of population ageing. In particular, if population ageing is driven by the increase of life expectancies, one may expect age profiles to decline for those ages for which mortality rates decrease.

Zweifel et al. (1999) suggest that health expenditure is completely independent of age, not only for people in the last years of their lives, but also for people of younger ages. Note that if this were true, health expenditure per capita may decline because of ageing. If health expenditure per capita increases as mortality approaches, health expenditure per capita decreases with time to mortality. The effect of ageing or, put better, increasing life expectancy, would then be to reduce health expenditure per capita (Westerhout, 2004).

In this context, the time-to-mortality argument may be somewhat unrealistic. Much more plausible is a weaker form of the time-to-mortality argument, holding that time to mortality and age both explain health expenditure. Time to mortality can be the major driver of health expenditure for persons in the last years of their lives; for the majority of younger people, age may continue to be a very relevant explanatory variable. The effect of ageing upon health expenditure in this weak form of the time-to-mortality approach is then ambiguous. Nevertheless, what unambiguously holds true is that the ageing effect upon health expenditure is less strong under the time-to-mortality approach than under the standard projection approach.

2.3 Implications for numerical simulation exercises

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 amount to 64% rather than 73%, which would apply if the projection was made using the standard approach. The Van Ewijk et al. (2000) study for the Netherlands calculated that health 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 Economic Policy Committee (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%. Stearns & Norton (2004) calculated that Medicare expenditure as projected for 2020 could be between 9 and 15% lower if adjustments were made for mortality-related costs. Batljan & Lagergren (2004) find a somewhat larger reduction in the health expenditure effect of ageing if the standard extrapolation method is replaced with the mortality-related cost approach: this effect would drop from 18 to 11%. Finally, Miller (2001) uses a time-until-mortality method to project the ageing-related shift in the age profile of health expenditure. This method does not decompose the population into survivors and decedents, but links the aggregate health expenditure profile to time until mortality rather than age. An increase in life expectancy then shifts the age profile of health expenditure to the right. As in the case of the other studies, Miller (2001) also finds significantly lower cost forecasts.

This overview suggests that accounting for mortality-related costs may be important. Moreover, there is reason to believe that the above figures underestimate the significance of accounting for mortality-related costs. The point is that the significance of mortality-related costs depends on the strength of population ageing. Indeed, in a non-population ageing economy with a constant age structure, the issue of mortality-related costs would be irrelevant. As the trend of future population ageing is stronger than that in the past, figures based on previous demographic behaviour may underestimate the role of mortality-related costs.

3. Mortality-related costs

3.1 Methodological issues

Given that health-care expenditure is decomposed into a part that can be attributed to survivors and another part that can be attributed to decedents, one can separately project the development of health-care expenditures of survivors and decedents. Upon aggregation, total health-care expenditure can be calculated. Equivalently, one can calculate the age profile of aggregate health-care expenditure, which is a weighted average of the age profiles of survivors and decedents. On the basis of the age profile of aggregate health-care expenditure, one can project the development of health-care expenditure through time. As in the standard approach, the development of health expenditure is calculated by combining demographic prospects with the age profile of health expenditure per capita. The difference between the mortality-related cost approach and the standard approach (which does not take into account the cost of dying) is that the age profile of health-care expenditure in the former approach is not exogenous, but endogenously related to the projected developments in mortality rates.

Ideally, microeconomic data are used to assess the cost of dying. Indeed, most of the studies that apply the improved methodology pursue this route. These data often allow relating the cost of dying to gender and age. Sometimes, they even allow distinguishing between the costs in the last year of life, the next-to-last year of life and so on. This study does not employ microeconomic data, however. The reason is that we do not have such data available. We argue nonetheless that this may be less worrisome for our analysis than may seem at first sight. The reason is that our analysis focuses on the behaviour of macroeconomic aggregates rather than that of individuals. On this level, it may be more important to distinguish between the costs of survivors and decedents than to put in the most realistic estimates of the cost of dying, as long as the estimates of the cost of dying used in the simulations are not too distant from the real data.

An important innovation of our study is that it applies the methodology of mortality-related costs separately for acute health- and long-term care. This may be crucial at the level of predicting the development of acute health-care expenditure and that of long-term care expenditure, since the age profiles for decedents differ quite a lot for these two spending categories. Given the distinction between acute health- and long-term care, we also have to split the cost of dying into two parts: one that corresponds to acute health-care expenditure and the remainder that corresponds to expenditure on long-term care.

Let us now formally define survivors as those persons who live during the whole year and non-survivors as those who die during the year. The number of survivors by age category *j* can be calculated as the fraction of people who live during the whole year $(1-\sigma_{(j,t)})$, i.e. one minus the age-specific mortality rate, which varies by time *t*, multiplied by the size of the population in that age category at the beginning of the year. Likewise, the number of decedents can be calculated as the fraction of people 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 the beginning of the year. Death-related costs per capita are allowed to differ with age and year. Let us use $D_{(j,0)}$ to define the level of death-related costs in the base year (indexed 0).

We decompose the cost of death *D* into an acute health- and long-term care component. The decomposition is age-specific. Formally,

$$D_{(j,0,H)} = \varepsilon_{(j)} D_{(j,0)} \quad (1)$$

$$D_{(j,0,L)} = (1-\varepsilon_{(j)}) D_{(j,0)} \quad (2)$$

where H and L refer to the acute health- and long-term care component respectively and $\varepsilon_{(j)}$ is the age-dependent fraction of death-related costs that is spent on acute health care.

By definition, expenditure per capita of the aggregate of survivors and decedents is a weighted average of the expenditure per survivor and the expenditure per decedent, where the mortality and survival rates act as weighting coefficients. This applies both to acute health- and long-term care.

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

$$k \in (H, L)$$

Here, U denotes health-care expenditure per survivor and T denotes health expenditure per capita for the whole of survivors and decedents. Given the assumptions made with respect to death-related costs and the information on total health expenditure per capita, we can calculate expenditure per capita of survivors as follows:

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

$$U_{(j,0,L)} = \frac{T_{L_j} - \sigma_{(j,0)} D_{(j,0,L)}}{1 - \sigma_{(j,0)}} \tag{4}$$

3.2 Aggregate age profiles

The age profiles for public acute health-care expenditure and long-term care expenditure were taken from the EPC (2001) study mentioned earlier, which gives these age profiles for five-year age cohorts for most EU-15 countries.[1] Acute health-care expenditure refers to the costs associated with cure activities; long-term care expenditure refers to 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 subdivided into the respective age groups within those five years on an equal basis to obtain age profiles by age category.

For those countries on which we do not have age profiles but do have aggregate information on acute health- and long-term care expenditures, we use the average acute health- and long-term care profiles of the countries for which we do have such information.[3] 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. For Germany we use figures provided by the DIW. For this purpose, these figures were constructed to closely match the definitions for acute health- and long-term care costs as postulated by the Economic Policy Committee.

Figures 1 and 2 show the age profiles of acute health- and long-term care for the EU-15 countries for which this information is available. As can be expected, both categories of costs rise with age. While acute 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. Furthermore, we can see that differences between countries are quite large, especially at higher ages.

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[1] We would like to thank Declan Costello of the EPC for supplying us with this information.

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

[3] See also Pellikaan & Westerhout (2005).

Figure 1. Health-care expenditures by age profile

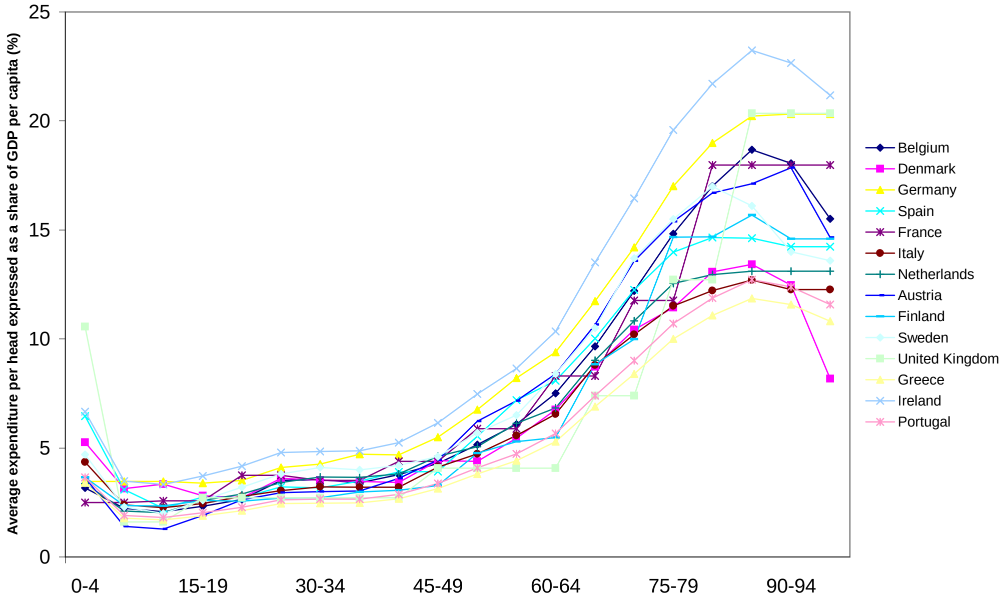
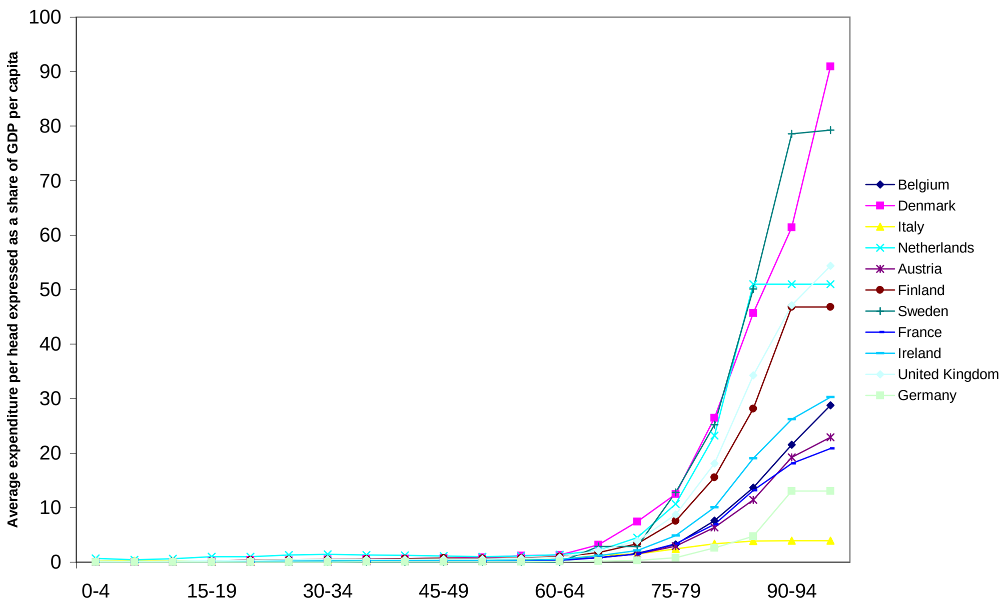


Figure 2. Long-term care expenditures by age profile



3.3 Age profiles of survivors and decedents

As previously discussed, we need a measure of the cost of mortality. Two aspects of this variable are important here: its level and its relationship with age. The studies mentioned in section 2 have either used hospital or insurance records to calculate mortality costs by specific age category, sometimes by gender and race. Owing to the difficulty of relating the precise outcomes in these studies to the health-care profiles we have,[4] as shown in Figures 1 and 2, we use the general implications that follow from these studies. Below we discuss some of the analyses that have investigated the pattern of the cost of mortality.

Roos et al. (1987) investigate the difference in health costs between survivors and non-survivors during the last four years before mortality. They include hospital usage, nursing-home usage and visits to physicians in their study on 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 to mortality becomes shorter), they also find that total health costs among decedents increase with age. This can be mainly attributed to the increase in mean days of residence in nursing homes, which rises rapidly with age. For example, they found that while male decedents aged 45-64 stay on average 7.2 days in nursing homes in the last year before dying, men above 85 years old stay on average 110.8 days in nursing homes in the last year before dying. Similar results apply to women. Overall, they find that the costs in the last 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. A similar conclusion was reached in a more recent study by Spillman & Lubitz (2000).

Serup-Hansen et al. (2002) 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 in-patient services. Owing to data limitations, they did not include long-term care costs. They found that the costs of non-survivors, i.e. the cost of mortality, are substantially higher than the costs of survivors for both health-care categories, although the differences are more marked for in-patient 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 in-patient services is that people at younger ages might 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.

Based on these studies, we have decided to model the cost of mortality as a U-shaped function of age. At young ages, the cost of mortality is relatively high because of the expensive high-tech medical treatments that are at that age often 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 this will result in an upward rise in total mortality costs by age.

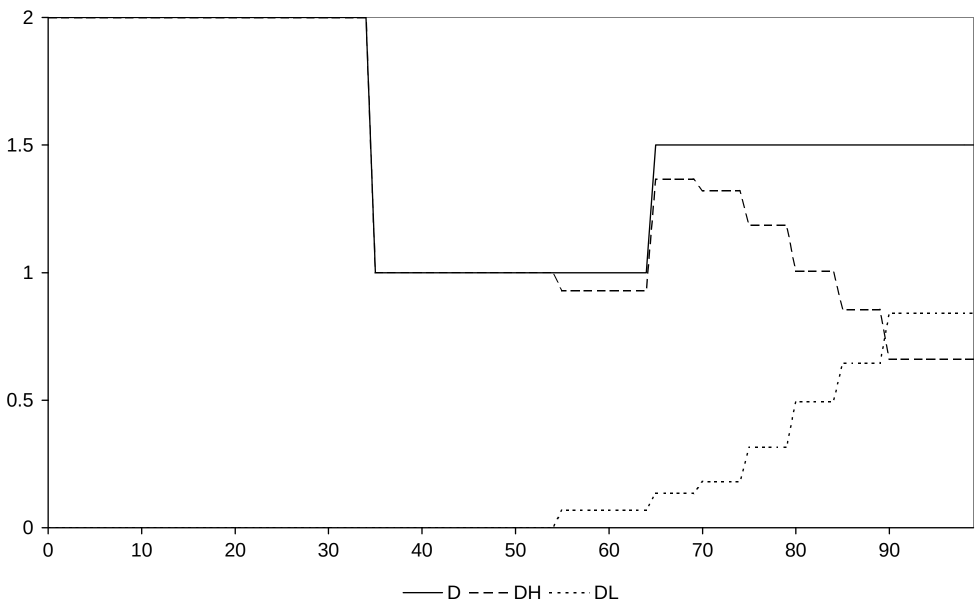
In particular, we divide the population into three broad age groups, those aged 0-34, 35-64 and 65+, to respectively reflect the young, the middle-aged and the old-age categories. The cost of mortality may differ between these three age groups but is the same within each one. Second, we assume a constant cost of mortality as a benchmark that equals the highest average total cost of acute health- and long-term care, i.e. that of a person aged 95 and above. The implication of this approach is that the costs of non-survivors will be higher than the costs 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 U-shaped curve. In the earlier analysis (Pellikaan

[4] Among other reasons, this is caused by fact that the specific health- and long-term care services investigated in the various studies do not always match the health- and long-term care services that are incorporated in our EPC profiles.

& Westerhout, 2005) we explored the sensitivity of this assumption by using either lower or higher mortality costs for certain age categories and found it to be relatively robust.

Figure 3 illustrates that our projections assume that the per-capita costs of mortality for people in the 0-34 age group are equal to twice our benchmark cost of mortality (average health-care costs for a person aged 95); for those aged 35-64 they are assumed to be equal to this benchmark and for those aged 65 and older the costs they are assumed to be 1.5 times the benchmark. This approach obviously has its shortcomings in that it may not adequately represent real mortality costs; it is no more than an indication. This holds with respect to both the level and age structure of mortality-related costs and to its timing. Indeed, many studies have found that mortality-related costs spread out over many years, whereas our model assumes that the health-care spending of survivors and decedents differs in the last year of life only.

Figure 3. Mortality-related costs, decomposed into acute health care and long-term care



As mortality-related costs are composed of both acute health- and long-term care expenditures and the composition of total expenditure in these two categories varies by age, the costs of death are subtracted from these respective components by different percentages at different ages. Table 1 shows our decomposition of D, based on findings by the Dutch WRR (1997).[5] The division into health- and long-term care components can easily be made by grouping the various types of expenditures in the categories mentioned. At young ages (0-54), the cost of mortality is thus in its total made up by health-care costs, while at higher ages a larger part of the cost of mortality is made up by long-term care costs. The observed pattern of the cost of mortality by age and health-care component also corresponds with the general findings of Roos et al. (1987) and Spillman & Lubitz (2000). We apply this allocation of mortality-related costs to each country, except when the data show that such a division would be meaningless. Figure 3 shows the decomposition of mortality-related costs into the acute health-care component and the long-

[5] 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 relative 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.

term care component. D_H and D_L represent the acute health- and long-term care components of death-related costs. It can be seen that as age increases, D_H declines and D_L increases. As noted, this pattern of increase was also found in some other studies.

Table 1. Division of the costs of mortality by age category over health- and long-term care components (%)

	Health care (ε_j)	Long-term care $(1-\varepsilon_j)$
Age	%	%
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: Authors' calculations.

Figures 4 and 5 show that the *T* and *U* curves diverge, particularly at higher ages. The reason is that as a result of rising mortality rates, an increasing part of total spending on acute health- and long-term care is made up of mortality-related costs.

Figure 4. Acute health-care costs, decomposed into the costs of survivors and decedents, in terms of benchmark costs of mortality

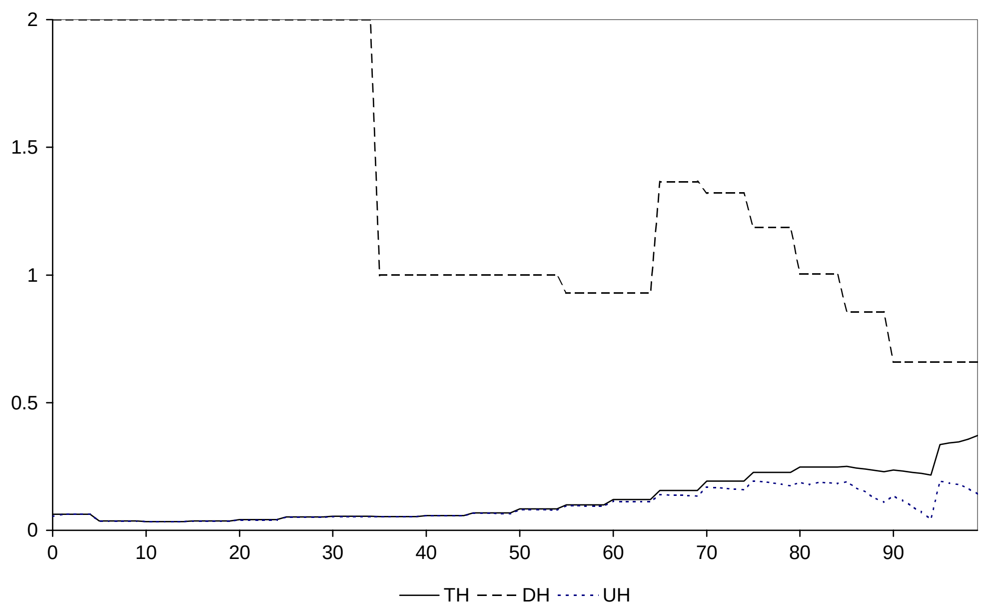
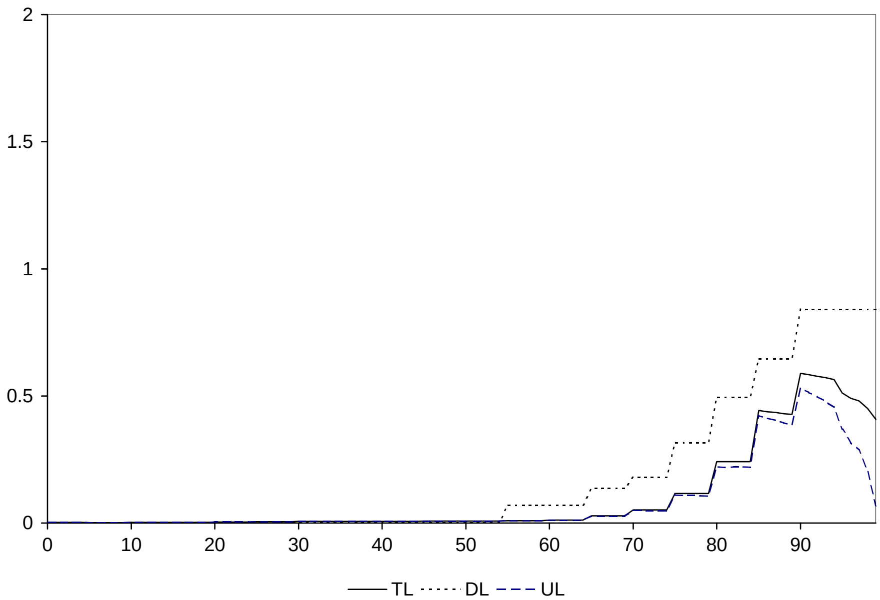


Figure 5. Long-term care costs, decomposed into the costs of survivors and decedents, in terms of benchmark costs of mortality



4. Living longer

The projections in this and the following sections concern the period from 2002-50. They use demographic projections from Eurostat and a bunch of other macroeconomic assumptions (regarding, among others, labour market participation, the interest rate, the rate of productivity growth and the income elasticity of health-care expenditure). Appendix A gives more information about the data we have used. Appendix B describes the model we have used in our calculations.

No account is taken of many other factors that are known to influence health-care expenditures, such as the introduction of new medical technologies or the price development in medicines. The reason is that our analysis focuses on the implications of longevity and health status and does not aim at sketching a picture of the most likely future developments.

Before presenting the living longer scenario, this section gives some information about the base case scenario. This scenario broadly coincides with the projections made for pension and health-care expenditure in the EPC (2001) study. Our projections of health-care expenditure differ from the EPC study, however, owing to the inclusion of mortality-related costs.

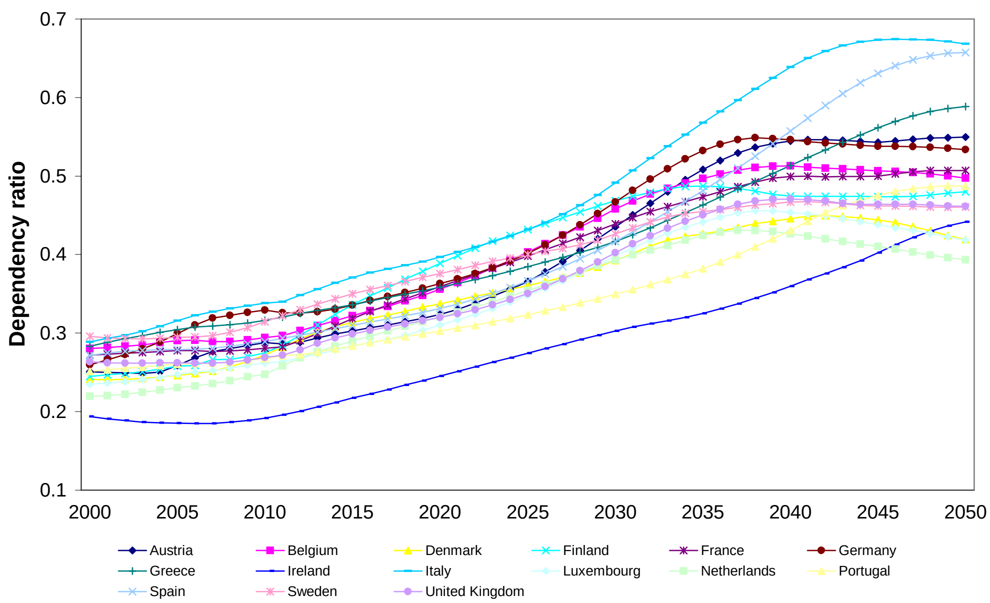
4.1 Demographic developments in the EU-15 area

This section describes some of the demographic developments awaiting the EU-15 countries in the next 50 years. First, the ageing of the population, caused both by an increase in life expectancy and 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. This will put pressure on the growth capacities of economies in the future as it reduces labour supply.

Old-age dependency ratios

Figure 6 shows the development of the old-age dependency ratio in the EU, where the old-age dependency ratio is defined as the ratio of elderly persons (65 and over) to the working age population (20-64). For all countries of the EU-15 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 percentage points respectively. On the other hand, the old-age dependency ratio in countries such as Sweden, the Netherlands, Denmark and Luxembourg compares favourably to the average trend seen in the other EU countries, with respective increases of 16, 17, 18 and 18 percentage points. 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.

Figure 6. The development of the old-age dependency ratios in the EU



4.2 Assumptions in the base case scenario

All our calculations aim at quantifying the extent to which current public institutions are unsustainable. Therefore, they sort of freeze current policy rules and deliberately exclude all kinds of possible future policy changes. This makes the simulations look a bit mechanical. But not doing so would severely hinder the task of assessing the sustainability of current public institutions.

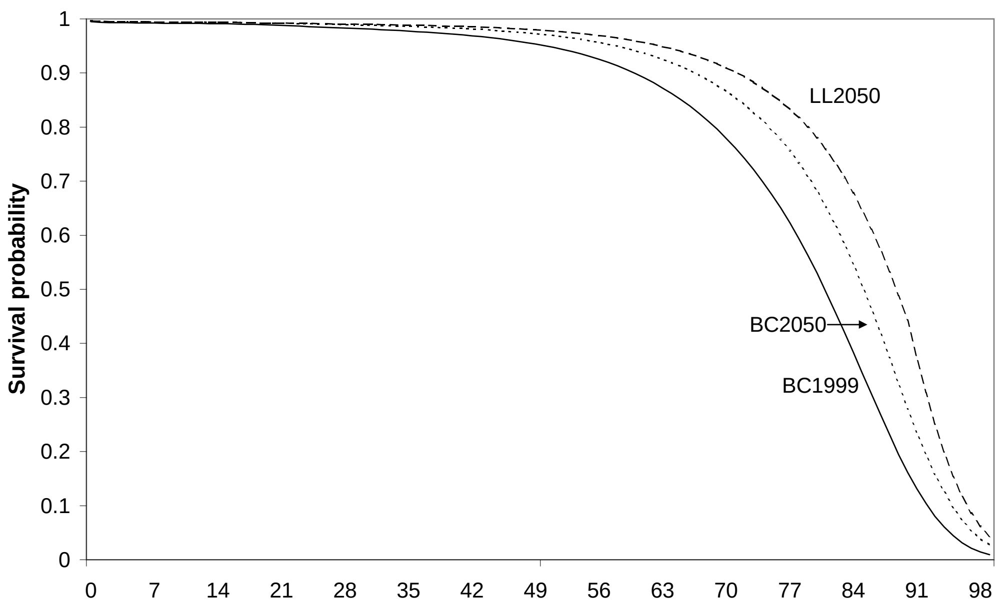
The labour productivity of all age groups is assumed to grow at an annual rate of 1.75% in all countries. The projections of labour force participation rates for the base case scenario are based on estimates used by the EPC of the European Community as prepared by the Ageing Working Group. These are 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 real interest rate is set at 3.75% and inflation at 2%. This gives a nominal interest rate of 5.75%. The government finance figures for the years 2001 to

2004 were taken from the OECD 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.

4.3 Assumptions in the living longer scenario

In order to quantify the impact of a further increase in life expectancy, the mortality rates of persons in different age categories are reduced on top of the reductions already inherent in the Eurostat projections that were used in the base case scenario. In the current scenario we assume that mortality rates will decline by 35.7% in the projection period,[6] in gradual equal steps each year, for those aged 20 to 90. This scenario corresponds to the idea that life expectancy may significantly increase in the future and that the mortality rates at older ages, i.e. those between 80 and 90, may decline at the same rate as those observed for young people.[7] Figure 7 shows the effect of this assumption on the survival probability of the EU population for the different demographic scenarios, where BC refers to the base case scenario and LL to the living-longer scenario.

Figure 7. Survival probability of the EU population under different demographic scenarios



[6] In Pellikaan & Westerhout (2005), we distinguished between three living longer scenarios, i.e. a low, middle and high scenario. The respective reduction in mortality rates in these scenarios was lower and higher than in the current living longer scenario, which corresponds to the middle living longer scenario in Pellikaan & Westerhout. Qualitatively, the other two scenarios are equivalent to the one presented here.

[7] This scenario follows the line of thinking of Vaupel (1998). He argues, however, that the decline in mortality rates for persons older than 80 years 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 persons 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 the living longer scenario may therefore underestimate the growth of the population of those aged 90 and older, or the oldest old. Given the relatively small number of people aged 80 and older, the impact of this error upon the predictions for macroeconomic aggregates may be modest.

From Figure 7 it can be concluded that a further reduction in mortality rates leads to an outward shift of the survival probability curve. The initiated decline in the mortality rate in our living longer scenario corresponds to an extra increase in life expectancy of respectively 3.2 years at birth when compared with the increase in life expectancy projected in the base case scenario in 2050. That is, the projected life expectancy at birth of a person born in 2050, which is 82.6 years in the base case scenario, increases to 85.8 years in the living longer scenario.

Table 2 compares the projected increases in expenditure on acute health care, long-term care and pensions in the living longer scenario with their counterparts in the base case scenario. The figures in the three right-hand columns reflect the additional increase or decrease in these expenditure categories in the living longer scenario.

Table 2. Change in public expenditures in the living longer scenario (% of GDP)

	Additional increase in living longer scenario		
	Acute health care	Long-term care	Pensions
Austria	0.5	0.3	1.7
Belgium	0.4	0.3	1.3
Denmark	– 0.1	0.9	1.5
Finland	0.3	0.7	1.5
France	0.4	0.2	1.3
Germany	0.6	0.1	1.9
Greece	0.4	–	2.5
Ireland	0.3	0.2	0.9
Italy	0.5	0.1	1.5
Luxembourg	–	–	0.9
Netherlands	0.1	1.0	1.7
Portugal	0.5	–	1.4
Spain	0.6	–	1.8
Sweden	0.0	1.0	1.0
United Kingdom	0.1	0.7	0.5
EU average	0.4	0.4	1.4

Source: Authors' calculations.

4.4 Projections of acute health- and long-term care expenditures

4.4.1 Acute health-care expenditures

A further increase in life expectancy will in all countries, except Denmark, lead to an increase in acute health-care expenditure. The impact on this expenditure category will be largest for Spain and Germany, where it rises by an additional 0.6% of GDP when compared with the base case scenario (the second column of Table 2). For the EU, acute health-care expenditure will on average increase by 0.4% of GDP. The outcome that an increase in life expectancy leads to an increase in acute health-care expenditures is not as straightforward as it seems, however. A decline in mortality rates has two opposite effects. On the one hand, the reduction of mortality rates decreases health-care expenditure because it postpones some of the costs made in the last years of life. This effect is stronger the higher the costs of decedents are relative to survivors. On the other hand, an increase in life expectancy will expand the number of people who consume health for a longer period of time.

The balance between the two effects eventually determines whether an increase in life expectancy will decrease or increase health-care costs. The earlier study (Pellikaan & Westerhout, 2005) demonstrates that the former effect dominates in the first few years of the projection. After some time, however, the effect that relates to the expansion of the population becomes dominant. Eventually, an increase in life expectancy boosts health-care expenditure.

4.4.2 Long-term care expenditures

Long-term care expenditure is expected to increase on the same scale as health-care expenditure. Here, the results differ much more widely across countries. For example, while the projected increase in life expectancy only marginally influences long-term care expenditures in Germany and Italy, it significantly influences these expenditures in the Scandinavian countries and the Netherlands – countries that spend larger amounts on long-term care. In the latter group of countries, long-term care costs will increase approximately by an additional 1% of GDP. Long-term care costs are more sensitive to the ageing process than those on acute health care.

4.4.3 Health-care expenditures

Compared with the base case scenario, health-care expenditure (the sum of expenditure on acute health- and long-term care) will increase on average by an additional 0.8% of GDP for the EU, ranging from 0.4% in Greece to 1.1% in the Netherlands. Despite the fact that a reduction in mortality rates directly reduces the strain that the process of dying puts on health-care expenditure, an increase in life expectancy significantly increases the total acute health- and long-term care expenditures.

4.5 Projection of public pension expenditures

A decline in mortality rates will lead to an increase in pension expenditures in all countries as the number of people who are eligible for pension benefits increases and they 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 are important elements of pension schemes in some countries. The postulated decline in mortality rates will have the greatest impact on pension expenditure in Germany, Greece and Spain, with respective additional increases of 1.9%, 2.5% and 1.8% of GDP if life expectancy should 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 increase in life expectancy will lead to an additional increase of 1.4% of GDP in pension expenditure for the average EU country.

4.6 Public finances

Combining the three columns of Table 2, we notice that the increase in life expectancy of 3.2 years will on average lead to a 2.2% increase of GDP in public expenditure. 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 largest 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 health care, i.e. 1.4% compared with 0.8%. This result should partly be ascribed to the fact that a decline in mortality rates has two opposite effects on health-care expenditure, but not on pension expenditure. An increase in life expectancy will lead to more years of pensions to be paid and thus an increase in total expenditure.

Table 5 in section 6.3 shows the change in the sustainability gaps caused by the projected increase in life expectancy when compared with the sustainability gaps found in the base case scenario. To keep government finances sustainable in this alternative demographic scenario, primary surpluses have to be increased by an additional 0.94% for the average EU country. If we look at the individual countries we see that the Netherlands, Greece and Germany would have to increase their primary surpluses the most to keep their government finances sustainable. This corresponds to the findings in Table 2, where the same countries showed the highest increase in public expenditure in the living longer scenario. As explained, the largest part of the change in the sustainability gaps can be attributed to the change in pension expenditure. The UK is the country that is least affected by a further increase in life expectancy.[8] In the UK the required adjustment in primary surpluses can be mainly explained by the increase in health-care expenditure.

5. Living in better health

In this section we investigate how an improvement in health will impact on the projections of health and pension expenditures and public finances. Continuous improvements in the health status of the population have at least two effects. First, healthier people can be assumed to need less medical attention. Increases in the average health status of a population can thus help to economise on health-care expenditure. Second, an increase in health may postpone early retirement and reduce the inflow into disability schemes, thus increasing labour market participation and reducing the number of persons aged 55 and over living on social security.

This section quantifies the impact of health improvements. Quantification may be even more interesting than sketching the sign of the effects of better health. In particular, quantification helps us to answer the question of whether the effect is sufficiently large to counteract the effect resulting from population ageing (see also Jacobzone et al., 2000).

5.1 Projections of acute health- and long-term care expenditures

This section assumes that health status improves according to the variable ‘life expectancy in good health’, of which the development is shown in Table A.1 in Appendix A. As reported above, we assume the elasticity guiding the relation between health expenditure and health status to be –0.3 for the ages 0-64 and –0.2 for the ages 65 and over. Yet health-care expenditure does not necessarily decline because of an improvement in health, since an improvement in health increases labour supply and thus GDP. Following extensive literature that shows a clear link between health expenditure and income, we assume that health-care expenditure increases on account of an increase in GDP. Table 3 shows the projections of health and long-term care expenditures when the above-mentioned features are incorporated in the projections.

5.1.1 Acute health care expenditures

An improvement in health decreases acute health-care expenditure when compared with the base case scenario. On average, expenditure will decrease by 0.8% of GDP for this category for the EU. The effect differs by country and the reduction in expenditures will be largest in those countries with the largest expected health improvement, which are Germany, Italy and Portugal. In all countries, expenditure on acute health care declines. Hence, the increase in this type of

[8] The figures for Luxembourg are not very reliable because of the lack of essential information on the development of acute health- and long-term care expenditure.

expenditure on account of additional income growth only partly offsets the reduction that is due to improved medical conditions.

Table 3. Change in public expenditures in the living in better health scenario (% of GDP)

	Additional increase in living in better-health scenario		
	Acute health care	Long-term care	Pensions
Austria	– 0.8	– 0.2	– 0.9
Belgium	– 0.5	– 0.1	– 0.8
Denmark	– 0.3	– 0.3	– 0.7
Finland	– 0.6	– 0.4	– 1.1
France	– 0.7	– 0.2	– 1.2
Germany	– 1.3	– 0.1	– 1.1
Greece	– 0.5	-	– 1.0
Ireland	– 0.4	– 0.1	– 0.4
Italy	– 1.0	– 0.2	– 0.7
Luxembourg	-	-	– 1.0
Netherlands	– 0.3	– 0.3	– 1.0
Portugal	– 1.5	-	– 1.6
Spain	– 0.6	-	– 0.7
Sweden	– 0.6	– 0.6	– 0.7
United Kingdom	– 0.3	– 0.3	– 0.4
EU average	– 0.8	– 0.2	– 0.9

Source: Authors' calculations.

5.1.2 Long-term care expenditures

An improvement in health likewise reduces the expenditure on long-term care. For the EU average, Table 3 shows that expenditure in the living in better health scenario will be 0.2% of GDP lower than those in the base case scenario. The savings on long-term care expenditure are less than those on acute health-care expenditure for two reasons. First, countries spend less on long-term care than on acute health care. Hence, savings on long-term care can be expected to be less. Second, long-term care services are consumed more heavily by older people. As we have assumed expenditure on long-term care to be less dependent on health status for the group aged 65+, the reduction in long-term care expenditure is also smaller. Still, for individual countries the savings on long-term care expenditure can be substantial, as is the case in the Scandinavian countries, the Netherlands and the UK.

5.1.3 Health-care expenditures

The total of acute health- and long-term care expenditure will on average decline by 1.0% of GDP for the EU when compared with the base case scenario. Thus, the expected improvement in health leads to a rosier picture on the development of expenditure.

5.2 Projection of public pension expenditures

Table 3 also shows the projected change in pension expenditure in the living in better health scenario. An improvement in health will as explained lead to a decline in the number of recipients and thus less expenditure on pension benefits – a reduction 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. The size of the projected decline in expenditure is similar to that of the projected reduction in expenditure on health care.

5.3 Public finances

The improvement in health reduces expenditure on health care and pensions by 1.9% of GDP, but there are substantial differences across countries. Compared with the base case scenario, the living in better health scenario features less pressure on public finances. Table 5 in section 6.3 shows the corresponding change in sustainability gaps. All countries show more favourable government finances and on average the sustainability gap for the EU will decline by 0.8%. In the living in better health scenario, four countries would not have any sustainability problems. Denmark, Sweden, Finland and Belgium would not have to increase their primary surpluses in order to make their policies sustainable. Notwithstanding this improvement, the sustainability of government finances would remain a serious problem at the EU-15 level.

6. Living longer in better health

In this section we combine the scenarios we have run in sections 4 and 5 into a living longer in better health scenario. We will thus assume that life expectancy increases as postulated in the living longer scenario (section 4) and that the health status of the population improves according to the assumptions made in the living in better health scenario (section 5).

6.1 Projections of health- and long-term care expenditures

Table 4 shows the change in acute health- and long-term care expenditure in the living longer in better health scenario, as compared with the base case scenario.

Table 4. Change in public expenditure in the living longer in better health scenario (% of GDP)

	Additional increase in living longer in better health scenario		
	Acute health care	Long-term care	Pensions
Austria	– 0.4	0.0	0.7
Belgium	– 0.2	0.1	0.4
Denmark	– 0.4	0.5	0.8
Finland	– 0.4	0.2	0.3
France	– 0.4	0.0	0.0
Germany	– 0.8	– 0.1	0.7
Greece	– 0.1	-	1.4
Ireland	– 0.2	0.1	0.4
Italy	– 0.6	– 0.1	0.7
Luxembourg	-	-	– 0.1
Netherlands	– 0.2	0.6	0.5
Portugal	– 1.2	-	– 0.4
Spain	0.0	-	1.0
Sweden	– 0.5	0.2	0.3
United Kingdom	– 0.2	0.4	0.0
EU average	– 0.4	0.1	0.4

Source: Authors' calculations.

6.1.1 Acute health-care expenditures

Living longer in better health reduces expenditure on acute health care when compared with the base case scenario. The reason is that the savings that are the result of health improvements dominate the expenditure increase that results from a lengthening of lives. In particular, the improvement in health reduces expenditure by 0.8% of GDP, whereas the increase in life expectancy increases expenditure by 0.4% of GDP.

6.1.2 Long-term care expenditures

For long-term care expenditures, the picture is the opposite of that above: long-term care expenditure will increase in the living longer in better health scenario, although only by a very small margin, i.e. 0.1% of GDP for the average EU-15 country. Now, the living longer effect dominates the health effect. The living longer effect increases expenditure by 0.4% of GDP, while the expected health change leads to a spending decline of 0.2% of GDP. Again, the results differ widely among countries. In some countries, living longer in better health reduces long-term care expenditure; in other countries, it increases long-term care expenditure.

6.1.3 Health-care expenditures

Living longer in better health reduces the expenditure on health care if compared with the base case scenario. For the EU as a whole, the positive effect from living in better health dominates the negative effect from a longer life expectancy. For most countries, living longer in better health reduces expenditure on health care. For some countries, however, health-care expenditure does not change or even increases as an effect of the combination of better health and longer life expectancy.

6.2 Projections of public pension expenditures

Table 4 shows that for the average EU-15 country, living longer in better health will lead to a 0.4% increase in expenditures on pensions when compared with the base case scenario. The effect of living longer thus outweighs the effect of better health. Results again differ from country to country, even on a qualitative basis.

6.3 Public finances

The effect of living longer in better health upon public expenditure is relatively small. The increase in health expenditure is smaller than in the base case scenario, whereas that of pension expenditure is larger. On average, a modest effect results of 0.1% of GDP.

Table 5 shows the change in sustainability gaps in this scenario. Compared with the base case scenario, the sustainability gap for the average EU country will increase by 0.1% of GDP (the sustainability gap declined by 0.8% in our living in better health scenario while it increased by 1.0% of GDP in the living longer scenario).

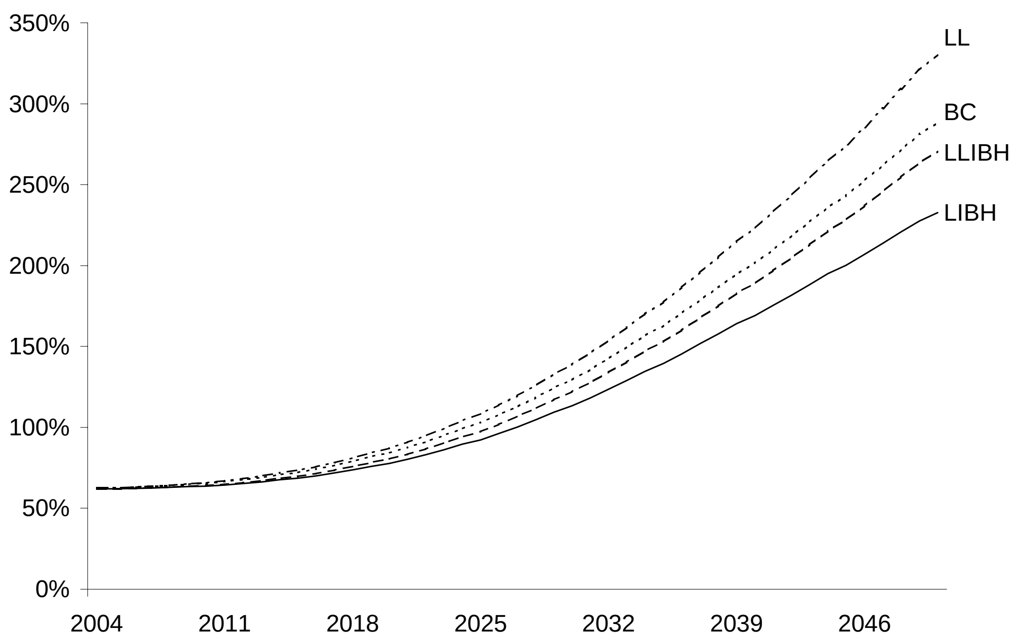
Table 5. Sustainability gaps in the three scenarios

	Differences with base case scenario		
	Living longer scenario	Better-health scenario	Living longer in better health scenario
Denmark	1.1	– 0.4	0.6
Sweden	0.9	– 0.7	0.2
Belgium	0.9	– 0.7	0.1
Austria	1.2	– 0.9	0.1
Finland	1.1	– 1.1	0.0
Italy	0.8	– 1.0	– 0.3
United Kingdom	0.5	– 0.1	0.3
Ireland	0.7	– 0.3	0.4
Luxembourg	0.4	0.1	0.4
Netherlands	1.4	– 0.8	0.5
Portugal	0.9	– 0.9	– 0.2
Spain	1.0	– 0.6	0.4
France	0.9	– 0.9	– 0.1
Germany	1.2	– 1.4	– 0.3
Greece	1.4	– 0.7	0.6
EU average	1.0	– 0.8	0.1

Source: Authors' calculations.

Figure 8 shows the debt development for the average EU country in the four scenarios we have discussed so far, where BC refers to the base case, LL to living longer, LLIB to living in better health and LLIBH to living longer in better health.

Figure 8. Debt developments – the EU average in four scenarios



The debt developments are most unstable and the sustainability problems most severe in the living longer scenario. On the other side of the spectrum is the living in better health scenario. Interestingly, the debt development in the LLIBH scenario is slightly less unstable than in the BC scenario, whereas the calculated sustainability gap is a little larger. The explanation is that the graph runs until 2050; however, our calculation of the sustainability gap takes account of the developments in primary deficits until infinity. Somewhere beyond 2050, the curve that describes the debt development in the living longer in better health scenario will cross the curve that corresponds to the base case scenario. Yet irrespective of the criteria one uses to evaluate the debt development in the two scenarios, the conclusion is that living longer in better health does not overturn the analysis that is implicit in our base case scenario for the average EU country and the whole of public finances.

7. Policy options

This section reviews some policy options that governments have to improve the sustainability of public finances. Each of these options is analysed on its merits and specifically with regard to how it affects economic efficiency and solidarity both within and between generations. We stress that the overview of available options is in no way meant to be exhaustive. Nor does it imply a preference for any specific option. We concentrate on four sets of policy instruments at the disposal of governments. These are respectively taxation policies, labour force participation policies, reforms of pension schemes and reforms of the health-care sector. In addition, the timing is relevant: should policy reforms be adopted as soon as possible or should they be delayed for some period of time? We first focus on this timing issue.

7.1 The timing of policy reforms

In plain language, our calculations of the sustainability gap indicate how much money a government is short of. In particular, the calculations indicate the amounts of money that should be raised in order to prevent the government from becoming insolvent in the end. The calculations do not tell us when policy reforms should be started, however. This could be now, five or ten years from now or any other time. Obviously, the different options are not equivalent. In general, the longer policy reforms are postponed, the larger are the policy changes that will be needed. In addition, different options have different consequences for intergenerational distribution. Generally, the longer policy reforms are delayed, the greater will be the burden for future generations and the smaller that for current generations. If we adopt the principle of concave utility, it is easy to show that spreading the burden across several generations is superior to putting the burden on a small group of generations. This principle implies that it would be better not to put off policy reforms.

If the policy change takes the form of a tax increase, considerations of efficiency play an important role. Assuming that lump-sum taxes are unavailable, the government has to resort to distortionary tax instruments. Economic theory tells us that distortionary effects are smaller, the lower the intertemporal variability in tax rates is. As the required increase in tax rates will be smaller if the policy of increasing tax rates is implemented sooner, tax rates are intertemporally more stable, which provides a second argument for the rapid implementation of policy changes.

An argument against fast implementation of policy changes that is frequently heard is that current generations would pay twice. First, they would pay for their own social security, health care and pensions. Second, they would pay to solve the sustainability problems that are the result of population ageing. That the proposal to start policy changes as soon as possible makes some generations pay twice is of course true. Nevertheless, that does not mean this is a bad policy. Some generations have to pay twice anyhow; otherwise, the sustainability problem cannot be solved. It is important to recognise that the ageing problem is general, i.e. not caused by specific generations and it is therefore not obvious that specific generations should finance the fiscal deficit. Therefore, a case can be made for letting all generations, current and future, contribute to solving the financial problems that stem from population ageing.

Another argument against fast implementation is that of ongoing economic growth. Ongoing economic growth makes future generations richer than current generations and makes it easier for future generations to carry the burden of higher taxes. This argument does not hold if utility does not expand in line with income, however. Indeed, intergenerational equity calls for equalisation of marginal utility, not marginal income. Unfortunately, there is very little empirical research on this theme that allows for further operationalisation.

7.2 Tax policies

In comparing different types of tax instruments, at least three criteria play a role. These are economic efficiency, intergenerational equity and intragenerational equity. Economic efficiency is maximised if the tax instrument chosen is that which would least distort labour/leisure and investment/savings decisions. In this respect, indirect taxation (e.g. consumption taxes) is superior to direct taxation (e.g. labour income taxes) if indirect taxes have a larger tax base. Intergenerational equity may also be achieved more easily by choosing indirect taxation as the elderly do pay consumption taxes, but not labour income taxes. Yet intragenerational equity may be reduced more if consumption taxes are increased.

The list of possible tax instruments is much longer that the criteria listed above. Next to consumption and labour income taxes, most countries levy taxes on capital income, wealth, profits of firms, bequests, etc. Moreover, taxes often include differentiated rates, thresholds, ceilings, exemptions and variations in all these aspects, which may have an impact on economic efficiency and intergenerational or intragenerational equity. Further, the effects of tax policies depend on a number of factors that may differ from country to country. Without further analysis, it is difficult to say anything about the kind of tax policies one could think of in order to restore fiscal sustainability.

7.3 Expenditure policies in general

Another way to restore fiscal sustainability is to cut public expenditures. The government can for example allow certain expenditure categories, for certain time periods, to grow at a lower rate than that of GDP. A direct cut in expenditures on health care and pensions would benefit young and future generations, while it would hurt the current generations (which use these services most intensively) if these cuts lead to deterioration in the quantity or quality of these services.

Here the comment that was made in the discussion on tax policies applies as well. In a general sense, we cannot point to a particular expenditure item that should be adjusted in order to achieve fiscal sustainability without further research. The same can be said about the trade-off between tax increases and public expenditure cuts. In particular, in order to be able to compare specific tax changes with changes in specific types of public spending, more information is needed on the way the tax and expenditure category affect economic efficiency and equity, both in an intergenerational and in an intragenerational sense. If the tax under consideration is highly distortionary and the expenditure category does not affect economic behaviour of any kind, the tax option will obviously be less attractive from an efficiency point of view (although not necessarily from an equity point of view). But whether this is the case, is *a priori* unclear.

7.4 Labour force participation policies

An increase in labour force participation can significantly improve public finances. As can be concluded from EPC (2001), labour force participation rates are expected to increase in the period between 2000 and 2050. This can be especially attributed to the expected increase in the labour force participation of women. If this occurs without government intervention, this is good news from the perspective of the population ageing problem. Indeed, increased levels of labour market participation have effects opposite to those of an ageing population: they raise tax revenues and social security contributions and reduce public spending on social security. If higher levels of labour market participation can be achieved by only subsidising it (explicit subsidies or specific tax reliefs), the message is somewhat different. For example, the government may have to revise tax rules or support and possibly subsidise the availability of childcare in order to increase the labour market participation of female workers. Then, other taxes have to be raised again (or additional expenditure cuts have to be made) in order to pay for these policies. Whether the fiscal situation improves then depends on the relation between the amount of subsidisation and the induced changes in labour market participation.

Policies aimed at increasing the participation of elderly persons differ importantly from policies that focus on women's labour participation. The labour force participation rates for persons aged 55 and over are pretty low. The high levels of non-participation of these age groups can be attributed to a significant degree to the financial incentives that are implicit in early retirement schemes. These incentives are often such that participation in early retirement schemes is 'an offer you cannot refuse'. In this case, governments could reduce subsidies to increase participation. This is very different from the case of female workers, which calls for more subsidies. Obviously, apart from these fiscal effects, the distributional effects of policies focused on female workers and older workers are also different. Again, such aspects should be taken into account before coming to a final verdict.

7.5 Pension policies

Another measure one could think of is to reduce the generosity of PAYG pensions or to increase the retirement age. Both policy measures would help restore the sustainability of fiscal policies, but would hurt the generations that are currently retired or close to retirement.

Countries that have privately funded pensions may face sustainability problems as well. Although population ageing has no direct effect upon the public budget through private pensions, it may indirectly affect the budget, particularly, if the principle of deferred taxation applies, as the increase in the number of retired people brings in tax revenues. One way of reforming pension schemes is to remove the subsidisation of these schemes. This would make the pension system more actuarially fair, which would induce people to retire at later ages. People would still be able to retire at earlier ages, but this would not come at the expense of public resources. Both policy options would jeopardise intergenerational solidarity however, as the price to be paid for the achievement of fiscal sustainability would rest on the shoulders of particular generations.

Another option is to index pension benefits negatively to life expectancy. The result of such an option may be very similar to that of blunt cuts in the levels of pension benefits. Because of the slow changes in life expectancy, changes could also occur very gradually. This strategy would spread losses over more generations and would allow people to anticipate future policy changes, adding to the political attractiveness of policy reforms.

7.6 Health-care policies

To mitigate the effect of population ageing on health-care expenditures, several options are available. Health-care budgets may be frozen for several years or expenditures cut so that health-care expenditures grow at a slower rate than GDP for a number of years. This would come at the expense of those persons who are dependent on the provision of health-care services and do not have the resources to buy private insurance. These policies would hurt current generations and benefit future generations and thus affect intergenerational solidarity. Yet, privatisation policies would also affect solidarity within generations. In particular, privatisation would hurt those who rely to a relatively large extent on the health-care sector.

Policies that would help to restore fiscal sustainability without directly affecting intergenerational solidarity could be those that enhance the level of competition in health-care markets. In particular, policies of managed competition may be successful to drive down the level of aggregate health-care expenditure when private insurers are induced to bargain aggressively with health-care providers about the price, the quality and the volume of medical services. The price to be paid now is that insurers may adopt not only bargaining policies to lower their costs, but also risk-selection policies. This approach would reduce the degree of solidarity, not so much between generations, but more within generations, between the good and bad risks.

7.7 Strengthening the economy

An increase in productivity does not necessarily improve public finances if, as we assumed, all expenditure categories and most notably expenditures on health care and pensions are related to wage increases. Still, targeted investments in both physical and human capital may increase society's capacity to cope with the population ageing problem. It could make it easier for example to induce reforms in the pension and health-care systems, from public provision to private provision. In this indirect sense, policies that boost productivity could be very welcome. Obviously, combining policies that raise productivity with policies that unlink expenditure levels with private-sector wage rates will also be helpful. Ultimately, the attractiveness of policies that raise productivity is determined by the benefits in terms of higher tax revenues and lower levels of public expenditure and the costs in terms of tax facilities or explicit subsidies.

7.8 Concluding remarks

As often noted in the report, we cannot tell which policy options are most preferable. All or most of the policy options one can think of to restore fiscal solvency have effects not only on economic efficiency, but also on different forms of equity. In case of contrary effects, it is policy-makers who should weigh the different objectives of the social welfare function and come to a decision.

Another element of importance is the variability that surrounds calculations. Calculations of the fiscal impact of population ageing are uncertain, owing to among others the uncertainty of different variables that are relevant to this issue – demographic and economic. Calculations of the impact of policies are surrounded by uncertainty as well. This caveat warns against an overly literal interpretation of the results of our analysis.

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Appendix A. Data

In this section we first briefly give attention to the demographic developments in the EU-15 area in the period until 2050 and then explore in more detail the data that we have used.

Demography

Population, mortality, migration and fertility figures were based on Eurostat 2000 figures, the central variant.[9] These figures are projections to 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 Pellikaan & Westerhout (2005), a description is given of how this desired split was obtained.

Pellikaan & Westerhout (2005) also report on the development of the mortality rates as expected in the period between 2002 and 2050. Mortality rates decline, although somewhat less for higher ages. Nevertheless, the declines are still quite substantial for the oldest old.

Pension expenditure

Aggregate figures for pension expenditures are taken from the EPC (2001) study. Public pension expenditure, including most public replacement revenues, is given for 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.[10] Thus both the figures in 2002 and 2050 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.

We equate the number of beneficiaries aged 65 and older to the number of persons aged 65 and over. For the persons aged 55 to 64 we use data from wave 7 of the European Community Household Panel (ECHP) to obtain the percentage of persons in this age category who receive either a pre-retirement pension, disability or unemployment benefit. We used the ECHP questions on income to derive the respective percentages of persons who are unemployed, disabled or who have retired early by age category.

The number of people who are eligible for a benefit may be overestimated in our model and the per capita benefits underestimated. 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 people out of the labour force who receive no entitlements. Nevertheless, this should not have any consequences for our projections of aggregate pension expenditure.

Health status indicator

It is difficult to measure the health status of the population and to predict the change in this status through time. Self-assessed health data usually lack reliability (see Ahn et al., 2004b and Bound, 1991).

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[9] See Pellikaan & Westerhout (2005) for an overview of the data.

[10] Ibid.

A more objective measure for the change in health through time may be life expectancy in good health. FEDEA has projected the future development of this indicator as part of the AGIR project. Life expectancy in good health is given both at 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 project changes in labour force participation and in health expenditure. Table A.1 shows the evolution of these indicators to 2025 and the implied percentage change in health status, which can be derived from these developments, i.e. between 1996 and 2025. As we perform projections to 2050, we assume that health will develop at the same annual rate in the period between 2026 and 2050 as in the period between 1996 and 2025. For the countries for which this information is not available, we have assumed that their health change corresponds to that of the average EU country. This is the case for Austria, Finland, Luxembourg and Sweden.

Table A.1 Remaining life expectancy in good health at ages 15 and 65 (in years)

	Age 15		% change	Age 65		% change
	1996	2025	1996-2025	1996	2025	1996-2025
Austria	n.a.	n.a.	10.2	n.a.	n.a.	54.3
Belgium	44.6	49.1	10.1	7.6	10.5	37.5
Denmark	46.2	50.3	8.9	8.2	10.7	29.9
Finland	n.a.	n.a.	10.2	n.a.	n.a.	54.3
France	36.6	40.8	11.7	5.3	7.8	47.8
Germany	28.6	33.9	18.2	3.0	5.9	101.0
Greece	47.4	50.1	5.8	5.8	8.0	37.8
Ireland	48.4	52.7	8.8	8.3	11.3	35.5
Italy	35.9	39.8	10.8	3.4	6.2	80.4
Luxembourg	n.a.	n.a.	10.2	n.a.	n.a.	54.3
Netherlands	45.0	48.6	7.9	7.7	10.4	34.3
Portugal	29.3	33.4	13.7	1.7	4.0	135.2
Spain	40.7	43.0	5.6	5.4	7.1	31.7
Sweden	n.a.	n.a.	10.2	n.a.	n.a.	54.3
United Kingdom	42.9	47.3	10.0	9.3	11.8	26.5

Source: Ahn et al. (2004b).

Relation between health status and labour market participation

As many studies have shown,[11] better health is positively correlated with actively being at work, especially at later ages. People with bad health are more likely to retire at earlier ages either through disability or unemployment schemes. Next to financial incentives,[12] health is the most important variable explaining the transition out of work before the legal retirement age. McGarry (2004) even finds poor health to have a substantially larger effect upon retirement expectations than financial variables.

For our projections, we are especially interested in the impact of health upon the decision to leave the labour force. For this purpose, we use existing studies on this subject to calculate elasticities that present this relation. From the analysis by Börsch-Supan (2000) we derive an elasticity of 0.8. A 1% increase in average health would thus lead to 0.8% fewer people quitting

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

[12] See Piekkola & Leijola (2004) and Gruber & Wise (2002).

the labour force. By varying the health changes in the simulations we tested the sensitivity of this relation and found that it was robust for different changes and ages. This elasticity has been applied in a uniform manner in all EU countries.

Relation between health status and health expenditure

Healthier people may be assumed to consume health-care services to a lesser degree than people with a worse health status. An improvement in health over time would thus lead to a decline in health expenditures for the average person. Note that this assumes that this health improvement is a genuine exogenous improvement in health without any associated increase in medical treatment and likewise expenditures, for example owing to changed health behaviour in the past. Obviously, this assumption may be overly optimistic, but we lack a better alternative. As we do not have country-specific information about the relation between health status and expenditure, we apply the results from the literature uniformly to all EU-15 countries.

Lubitz et al. (2003) investigate the relation between health, life expectancy and health care for Medicare-insured persons aged 70 and over in the US. This study concentrates on the difference in lifetime expenditures between people with various health states,[13] but average health-care expenditures by health status and broad age group are also reported. As we have already incorporated demographic developments in our model it is precisely the annual difference in expenditures between various health states that we are looking for. Lubitz et al. find that active persons with no limitations spend on average $4,600 per year on health care, while people with a Nagi limitation[14] in the same age group spend on average $5,800 per year on health care. Healthier people thus spend on average 20% less on health care than people with a Nagi limitation.

We use this relation to link health changes to health expenditures for those persons aged 65 and over. For example, a positive average health change of 5% per year will then lead to a 1% reduction in total expenditures. For persons below that age we have no specific information. We assume that the corresponding elasticity equals -0.3 for this age category.

Government statistics

Total government revenues, expenditures and debt figures for the years 2001-04 are taken from the OECD 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, which gives the percentages of GDP spent on public social expenditures. Pension and health expenditures follow from our own calculations. Education expenditures as a percentage of GDP are taken from the EPC study in 2003.

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

[14] A Nagi limitation was defined as 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).

Appendix B. The Simulation Model

This appendix summarises the model that is used to calculate the developments in health expenditures, pension expenditures and public finances under different scenarios. It describes the model for a particular country. For brevity, we omit the country index.

Demographics

To simulate demographic changes, the total population is decomposed into its three respective segments. First, net migration – that is immigration minus emigration; second, mortality; and third, fertility. Population in year *t* with age *j* can, aside for those that are aged 0,[15] be calculated as the sum of the population in the previous year plus any net migration and mortality that occurred during the year itself. Or

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

with s representing gender, *NMIGR* representing net migration and σ denoting the mortality rate. After reaching age 99, all persons are assumed to die. By changing mortality rates, we can derive other demographic scenarios, which can either represent an increase or decrease in life expectancy.

Health-care expenditures

We assume all types of health-, acute and long-term care expenditures by survivors and decedents to grow at the rate of labour productivity growth *p*, which we will take to be a constant. In addition, health expenditure per capita may fall owing to improvements in the health status (see below).

$$U_{(j,t,k)} = U_{(j,0,k)} (1+p)^t (1 - \varepsilon_{h(j)} \theta_{(j,t,s)})^t \qquad k \in (H, L) \quad \text{(A.1)}$$

$$D_{(j,t,k)} = D_{(j,0,k)} (1+p)^t (1 - \varepsilon_{h(j)} \theta_{(j,t,s)})^t \qquad k \in (H, L) \quad \text{(A.2)}$$

Here, *H* and *L* refer to acute health- and long-term care respectively. Aggregate health-care expenditures, T, can be derived by summing the expenditures of survivors and those of decedents:

$$T_{(j,t,k)} = (1 - \sigma_{(j,t)}) U_{(j,t,k)} + \sigma_{(j,t)} D_{(j,t,k)} \qquad k \in (H, L) \quad \text{(A.3)}$$

Health-care expenditure and its components do not distinguish between men and women. Hence, the mortality rates in equation A.4 denote the averages of the corresponding mortality rates for men and women.

The aggregates of acute health-care expenditures, *AHCEXP*, long-term care expenditures, *LTCEXP* and health-care expenditures, *HCEXP*, follow upon multiplying the per capita variables with the corresponding population sizes and adding up:

$$AHCEXP_{(t)} = \sum_j T_{(j,t,H)} POP_{(j,t)} \quad \text{(A.4)}$$

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

$$LTCEXP_{(t)} = \sum_{j} T_{(j,t,L)} POP_{(j,t)} \tag{A.5}$$

$$HCEXP_{(t)} = AHCEXP_{(t)} + LTCEXP_{(t)} \tag{A.6}$$

The population variable *POP* sums the populations of men and women.

Pension expenditures

Pension expenditures are calculated in a straightforward manner. In the base year the aggregate amount of public replacement revenues[16] 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 increases through time at a rate βp; β is an indexation factor, which differs across EU countries. Annual labour productivity growth p is uniform across countries. The development of pension expenditures by age category can then be calculated by multiplying the average pension benefit per person PB with the number of persons who are eligible for a pension in each respective year, E:

$$PEXP_{(j,t,s)} = PB_{(t)}\, E_{(j,t,s)} \tag{A.7}$$

$$PB_{(t)} = PB_{(0)}\, (1+\beta p)^{\,t} \tag{A.8}$$

$$E_{(j,t,s)} = POP_{(j,t,s)}\, (1 - LFP_{(j,t,s)}) \qquad \text{for } 55 \le j \le 64 \tag{A.9}$$

$$E_{(j,t,s)} = POP_{(j,t,s)} \;\; \text{for } \; j \ge 65 \tag{A.10}$$

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

$$TPEXP_{(t)} = \sum_{j} \sum_{s} PEXP_{(j,t,s)} \tag{A.11}$$

Relation between 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:

$$LFP_{(j,t,s)} = L\hat{F}P_{(j,t,s)} \left[1 - \mu_{(j,s)}\, \varepsilon_{o}\, \theta_{(j,t,s)}\right]^{-1} \tag{A.12}$$

where

[16] 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.

$$\mu_{(j,s)} = \frac{ER_{(j,s)} + DI_{(j,s)}}{OUTFLOW_{(j,s)}}$$

$$\theta_{(j,t,s)} = \frac{HEALTH_{(j,t,s)} - HEALTH_{(j,t-1,s)}}{HEALTH_{(j,t-1,s)}}$$

With ER, DI, and $OUTFLOW$ respectively presenting early retirement, disability inflow and the yearly outflow from the labour market. Equation A.13 implicitly assumes that only persons who make use of early retirement or disability schemes are likely to change their exit decision if their health improves, i.e. persons who make use of unemployment schemes will not be affected by any health changes.[17] The average health change that occurs in the respective year by respective age and gender is given by θ. The elasticity ε_o guides the relation between the number of persons who exit the labour force and health status. This elasticity 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 eligible for pension expenditures at ages 55 to 64.

Public finances: Revenues

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 sales, seignorage and so on). Direct tax revenues and other revenues grow at the same rate as GDP. These revenue categories are closely related to the level of output. Output equals labour productivity *h* times the labour force participation *LFP*. Hence, direct tax revenues relate to the size of the working population, while indirect tax revenues are more related to the level of consumption. This corresponds better to the size of the whole population rather than the working population. In particular, in an aging economy consumption may grow faster than output, making it useful to account explicitly for consumption-related tax revenues. We thus have:

$$DTREV_{(t)} = dtrv\, GDP_{(t)} = dtrv\, h_{(t)}\, LFP_{(t)} \tag{A.13}$$

$$ITREV_{(t)} = itrev\, h_{(t)}\, POP_{(t)} \tag{A.14}$$

$$OTHREV_{(t)} = otrev\, GDP_{(t)} \tag{A.15}$$

$$TOTREV_{(t)} = DTREV_{(t)} + ITREV_{(t)} + OTHREV_{(t)} \tag{A.16}$$

Public finances: Expenditure

On the expenditure side, total primary expenditures $TOTPEXP$ are divided into five expenditure categories. These are health expenditures $HCEXP$, pension expenditures $TPEXP$, expenditures

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

on social security benefits $SSEXP$, other expenditures $OTHEXP$ (including expenditures on infrastructure, defence and so on) and education expenditures $EDEXP$. Health expenditures develop according to equation A.7 with θ equal to zero if no health improvement takes place. Pension expenditures develop according to equation A.12. Expenditures on social security benefits rise in line with economic and population growth. 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 people, i.e. those aged 5-24. We thus have:

$$SSEXP_t = SSEXP_{(t-1)}\,(1+p)\,\frac{POP_t}{POP_{(t-1)}} \tag{A.17}$$

$$OTHEXP_t = OTHEXP_{(t-1)}\,(1+p) \tag{A.18}$$

$$EDEXP_t = EDEXP_{(t-1)}\,(1+p)\,\frac{POP_{t_{5-24}}}{POP_{(t-1)_{5-24}}} \tag{A.19}$$

$$TOTPEXP_t = HCEXP_t + TPEXP_t + SSEXP_t + OTHEXP_t + EDEXP_t \tag{A.20}$$

Public finances: Deficit and debt

From the development in government revenues and expenditures the development of the primary government deficit pt and the debt B can be deducted in the usual manner.

$$pt_t = TOTPEXP_t - TOTREV_t \tag{A.21}$$

$$B_t = (1+r_t)B_{t-1} + pt_t \tag{A.22}$$

As a measure of the sustainability of public finances we use the so-called 'sustainability gap'.[18] This sustainability gap measures the difference between the primary surplus in the starting year of the projection period and the primary surplus that corresponds with sustainable public finances. A positive sustainability gap indicates that current fiscal policies are not sustainable and policies have to increase primary surpluses (or reduce primary deficits) in order to finance the costs of population ageing. In case of a negative sustainability gap, primary surpluses can be reduced (primary deficits increased) without jeopardising the sustainability of government finances.

The sustainability gap can be calculated as follows:

$$S = \frac{1}{X}\left[B_0 + \sum_{t=1}^{49} pt_t \prod_{\tau=1}^{t}(1+r_\tau)^{-1} + pt_{49}\prod_{\tau=1}^{49}(1+r_\tau)^{-1}\frac{1}{(r-g)}\right] \tag{A.23}$$

where

$$X = GDP_0\left[\sum_{t=1}^{49}\prod_{\tau=1}^{t}\frac{(1+g_\tau)}{(1+r_\tau)} + \prod_{\tau=1}^{49}\frac{(1+g_\tau)}{(1+r_\tau)}\frac{1}{(r-g)}\right]$$

18 For an overview of different indicators of the sustainability of government finances, see Jägers & Raffelhüschen (1999).

Here, S denotes the sustainability gap (as defined for the start of the projection period), r the nominal interest rate, g the nominal rate of economic growth, B_0 the level of public debt in the starting year and pt_t the primary deficit in year t. Both the debt and the primary deficit flows are in terms of GDP. The same holds true for the sustainability gap measure S. The second term in the bracket represents the present value of primary deficits to 2050 (our projection period starts in 2004). The third term is the equivalent for the period from 2050 onwards. The expression reflects our assumption that beyond 2050 the interest rate and the rate of growth of GDP will have stabilised at values r and g respectively.

Total public debt, an alternative measure of fiscal sustainability, emerges from equation A.24 if X is taken to be equal to GDP_0. It can easily be seen that the ranking of countries according to this alternative measure coincides with the ranking according to the sustainability gap measure, as long as interest rates and rates of GDP growth do not differ between countries.

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.

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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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FPB	Federal Planning Bureau, Brussels, Belgium
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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
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