OECD *Economic Studies* No. 43, 2006/2

THE DRIVERS OF PUBLIC EXPENDITURE ON HEALTH AND LONG-TERM CARE: AN INTEGRATED APPROACH

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The authors both work in the OECD Economics Department. Contact: Joaquim Oliveira Martins (joaquim.oliveira@oecd.org). Simen Bjørnerud from the Norwegian Ministry of Finance provided useful inputs at an earlier stage of this project during a secondment at the OECD Economics Department. We received useful comments from Jean-Philippe Cotis, Jørgen Elmeskov, Michael P. Feiner, Vincent Koen, Gaetan Lafortune, François Lequiller, Giuseppe Nicoletti, Peter Scherer and Hannes Suppanz as well as other OECD colleagues. The work also benefited from discussions in the context of the Ageing Working Group of the European Commission, in particular Henri Bogaert, Declan Costello, Michel Englert and Bartosz Przywara. We also would like to thank Irene Sinha for her excellent technical assistance. The views expressed are those of the authors and do not reflect those of the OECD or its member countries.

INTRODUCTION

Public expenditures on health and long-term care (hereafter, LTC) are a matter of concern for governments in most OECD countries. These expenditures have recently accelerated and are putting pressure on public budgets, adding to that arising from insufficiently reformed retirement schemes and other forms of social spending. The growth of public spending on health and long-term care in OECD countries has been limited for some time via the implementation of cost-containment policies. These policies acted essentially through wage moderation, price controls and postponement of investment in the case of health care. A large share of long-term care has been informally provided by families. However, the scope for containing health and LTC expenditures along these lines is narrowing.

In trying to foresee how much health care spending could increase in the future and what policy can do about it, the different drivers of expenditure can be broadly classified into demographic and non-demographic factors. D*emographic factors* will put upward pressure on health and long-term care costs since they tend to rise with age. Accordingly, previous projections of future health expenditures were mainly based on a given relation between health care spending and age (see Dang *et al.* 2001; EC-EPC, 2001; Health Canada, 2001). But this approach was essentially static, as it did not take into consideration a dynamic and positive link between health status and longevity gains, reflecting a "healthy ageing" process. This will lower the average cost per individual in older age groups, all the more so as major health costs tend to come at the end of life. Healthy ageing should also reduce the share of dependents per older age group, thereby mitigating future pressures on long-term care costs. On balance, however, ageing is expected to push health spending up.

N*on-demographic factors* will also push spending up. Empirical evidence on health care income elasticities is still inconclusive, though recent analysis (*e.g.* Dreger and Reimers, 2005) suggests that unit income elasticity for health care could be a reasonable approximation. Against this background, health care costs can grow faster than income for two main reasons. First, technological progress increases the variety and quality of products and treatments. Second, even when technological progress is cost-saving and reduces the relative price of health products and services, overall expenditures may still rise because of the high price elasticity of demand for health care. Because of lack of data, evidence concerning long-term care income elasticities is just not available, though these could be low. Still, long-term care expenditures as a share of GDP are likely to increase, due to a "cost disease". Limited scope for productivity gains, wage equalisation throughout the economy and low price elasticity could drive LTC expenditures up in line with relative price increases.

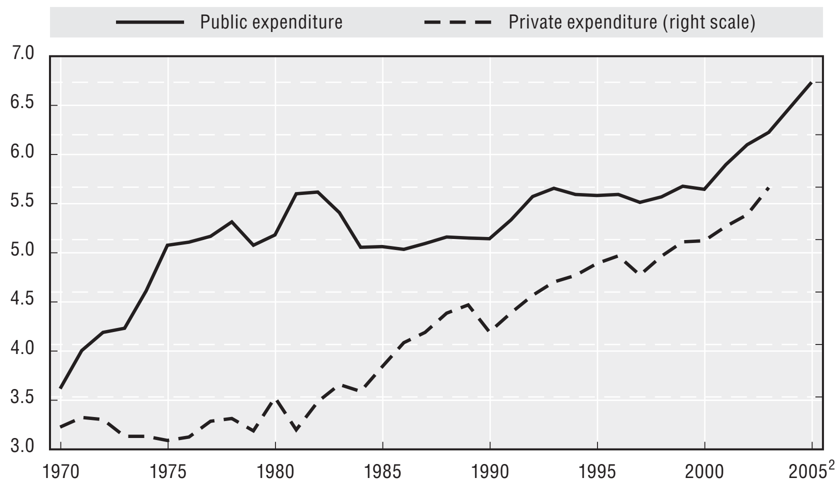
Along these lines, this paper explores two alternative scenarios for future public spending. In a "cost-pressure" scenario, non-demographic pressures on expenditures are assumed to remain fully operative, resulting in spending trends that correspond to observed trends over the recent past. In a "cost-containment" scenario, policy action is assumed to curb non-demographic drivers of expenditures. The paper begins with a short overview of spending trends over the past decades. Then it turns to the projection method of health care expenditure, decomposing demographic and non-demographic drivers and discussing the main mechanisms at work in each case. Alternative projection scenarios are presented, followed by a discussion of the sensitivity of the results to key assumptions. The same sequence of analysis applies to long-term care expenditures. The paper concludes with a summary of the results and some policy conclusions.

EXPENDITURE TRENDS OVER THE PERIOD 1970-2005

As a share of GDP, public spending of health and long-term care grew by some 50% between 1970 and the early 1980s (Figure 1). Governments started to react to these trends in the course of the 1980s by putting in place a number of cost-containment policies (see Docteur and Oxley, 2003). These policies acted mainly through macroeconomic mechanisms, such as wage moderation, price controls and postponement of investments. As a result, from mid-1980s to late 1990s, OECD public expenditure of health and long-term care remained roughly stable in per cent of GDP. Concomitantly, private health spending started to accelerate in the early 1980s.

Public cost-containment policies could not be sustained forever. It is difficult to contain wages and, at the same time, attract young and skilled workers in the health care sector. The replacement of retiring staff in public sectors, such as health care, will create strong demand pressures in the context of diminishing cohorts of younger workers entering the labour markets (see Høj and Toly, 2005). Controlling prices is not easy when technical progress is permanently creating new products and treatments. Equipments also need to be renovated, especially in presence of rapid technical progress. Thus, after a long period of cost contention, since 2000, the share of public health and long-term care expenditures to GDP is increasing at a rate of over 3% per year for the OECD. In this context, an important question is which factors will drive future expenditures, notably in relation to projected demographic trends.

Figure 1. **Evolution of public and private OECD total health spending**[1]
As a % of GDP



1. Unweighted average of available OECD countries.
2. OECD estimates.
Source: OECD Health Database (2005).

HEALTH CARE

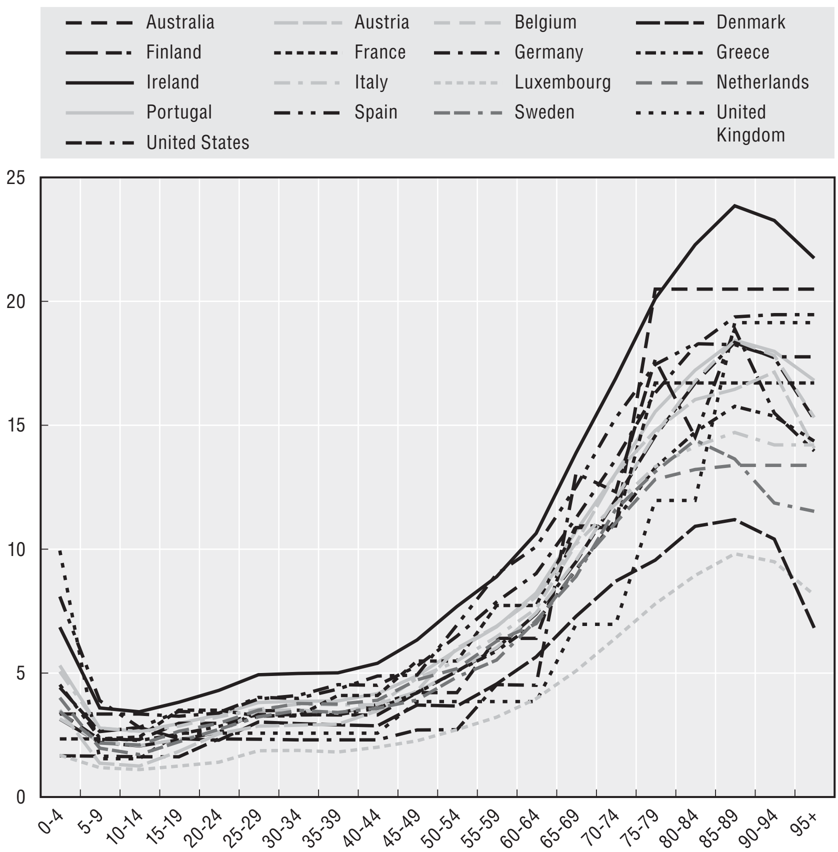
Demographic drivers of expenditure

While the effect of ageing on public health expenditures per capita has been weak in the past,[1] it is commonly expected that it will increase in the future. This assessment is based on the combined effect of the projected increase in the share of older people and the tendency for health expenditures per capita to increase with age.[2] The average expenditure profiles by age available for the year 1999 (Figure 2) are relatively high for young children, decrease and remain stable for most of the prime-age period and then start to increase rapidly at older ages.[3] On the basis of these expenditure profiles and population estimates, older people (age 65+) accounted for a significant share (around 35%) of public health care expenditures by 2005.

Major health expenditures occur in the proximity to death.[4] The shape of the average expenditure curves reflects the interaction between these "death-related costs" and mortality rates. While mortality rates increase with age, the costs of health care near death tend to be higher at young and prime age than for elderly people (April, 2004). This explains why expenditures first increase with age, then peak and after decline at very old ages. The little spike in health expenditures at

Figure 2. **Public health care expenditure by age groups**[1]

% of GDP per capita



1. Expenditure per capita in each age group for the year 1999 divided by GDP per capita.
Source: ENPRI-AGRI, national authorities and authors' calculations.

the beginning of the curve is just related to early infant mortality being higher than young and prime-age mortality.

For the purpose of projecting health expenditures it seems then convenient to disentangle the expenditures for survivors and non-survivors. The expenditures for the *non-survivors* can be estimated by multiplying the health costs near to death by the number of deaths per age group. Here, the proxy for the 'death-related costs' is the health expenditure per capita for the group 95+ years old (assuming that after 95 years, health expenditures are only related to death). This amount was then multiplied by a factor, equal to 4 for an individual from 0 to 59 years old[5] and declining linearly to 1 afterwards, to reflect the decline of the death-related costs with age. The *survivors*' cost curve can be derived from the difference between the total cost curve and the non-survivor curve (see Annex).

To be coherent, if health costs are mostly death-related, the projected increase in life expectancy must be accompanied by an equivalent gain in the numbers of years spent in good health. Otherwise, an increasing share of the population living in bad health would emerge and health care expenditures would then cease to be mainly driven by the death-related costs, as initially assumed (*q.e.d.*).

In such a scenario, the expenditure curve for *survivors* is allowed to shift rightwards in line with longevity gains, progressively postponing the age-related increases in expenditure.[6] This development tends to reduce costs compared with a situation in which life expectancy would not increase. The baseline projections presented in this paper follow this "healthy ageing" scenario, but the sensitivity of the results to alternative assumptions (Box 1) is also tested below.

Box 1. **Longevity and health status scenarios**

Different scenarios have been envisaged in the literature on the link between longevity and health expectancy. In an “expansion of morbidity” scenario (Grunenberg, 1977), the share of life spent in bad health would increase as life expectancy increases, while a “compression of morbidity" scenario (Fries, 1980) would mean the opposite. Manton (1982) put forward a "dynamic equilibrium” hypothesis where longevity gains are translated one-to-one into years in good health (or "healthy ageing"). Under this scenario, health care expenditures would be postponed over time in line with the increase in life expectancy. Michel and Robine (2004) proposed a general approach to explain why countries may shift from an expansion to a contraction of morbidity regime, or achieve a balanced equilibrium between longevity gains and the reduction of morbidity. They identified several factors at work: *i*) An increase in the survival rates of sick persons which would explain the expansion in morbidity; *ii*) a control of the progression of chronic diseases which would explain a subtle equilibrium between the fall in mortality and the increase in disability; *iii*) an improvement in the health status and health behaviour of the new cohorts of old people which would explain the compression of morbidity, and eventually; *iv*) the emergence of very old and frail populations which would explain a new expansion in morbidity. Depending on the relative size of each of these factors, countries could evolve from one morbidity regime to another.

As regards *non-survivors*, two different effects are at play. On the one hand, the number of deaths is set to rise due to the *transitory* effect of the post-war babyboom.

On the other hand, if mortality falls over time, due to a *permanent* increase in longevity, fewer will be at the very end of life in each given year, mitigating health care costs.[7] The total effect on public health care expenditures will depend on the relative size of these effects.

Non-demographic drivers of expenditure

Income growth is certainly the main non-demographic driver of expenditures. However, the vast literature on this topic is still somewhat inconclusive on the precise value for the income elasticity. First, income elasticity tends to increase with the level of aggregation, implying that health care could be both "an individual necessity and a national luxury" (Getzen, 2000). Second, the high income elasticities (above unity) often found in macro studies may result from the failure to control for true price effects (Dreger and Reimers, 2005). In this context, a reasonable approach seems to assume unitary income elasticity and, subsequently, to test the sensitivity of the projections to this assumption.[8]

After controlling for demographic effects and conditional to the income elasticity, a residual expenditure growth can be derived. Between 1981 and 2002 (Table 1), public health spending grew on average by 3.6% per year for OECD countries,[9] of which 0.3 percentage point was accounted by pure demographic effects[10] and 2.3 percentage points by income effects (with unitary income elasticity). Thus, the average residual growth can be estimated at around 1% per year.

The central expenditure projections assume this OECD average residual growth. There are at least two reasons for not using a country-specific residual in the context of long-run projections. First, in countries where cost-containment policies have resulted in a low or negative residual (*e.g.* Austria, Denmark, Ireland, Italy, Sweden) there could be a trend reversal, *e.g.* because new personnel has to be attracted or run-down facilities renewed. Second, in countries where the residual growth was very high (*e.g.* Portugal, Turkey, the United States) it may seem likely that cost-containment policies will be implemented in the future. These effects would lead to a certain cross-country convergence of the expenditure residual over time.

What are the factors underlying the residual expenditure growth? The main culprits are technology and relative prices.[11] Indeed, the gains in health status discussed above do not only arise from improvements in lifestyle (Sheehan, 2002; Cutler, 2001), but also from advances in medical treatment/technology. The latter do not come free of economic cost. Technical progress can be cost-saving and reduce the relative price of health products and services, but its impact on expenditure will depend on the price elasticity of the demand for health care. If it is high, a fall in prices will induce a more than proportionate rise in demand, increasing expenditures.[12] Even if prices do not fall, new technologies may increase

Table 1. **Decomposing growth in public health spending,[1] 1981-2002[2]**
Average annual per cent change

	Health spending	Age effect	Income effect[3]	Residual
Australia (1981-2001)	3.6	0.4	1.8	1.4
Austria	2.2	0.1	2.1	0.0
Belgium (1995-2002)	2.9	0.4	1.7	0.6
Canada	2.6	0.4	1.7	0.6
Czech Republic (1993-2002)	2.7	0.4	2.8	–0.4
Denmark	1.3	0.1	1.7	–0.5
Finland	2.6	0.3	2.1	0.2
France	2.8	0.2	1.6	1.0
Germany	2.2	0.2	1.2	1.0
Greece (1987-2002)	3.4	0.4	1.3	0.8
Hungary (1991-2002)	1.5	0.3	2.8	–1.5
Iceland	3.5	0.1	1.5	1.9
Ireland	3.9	0.1	4.9	–1.0
Italy (1988-2002)	2.1	0.7	1.7	–0.1
Japan (1981-2001)	3.8	0.4	2.2	1.1
Korea (1982-2002)	10.1	1.4	6.1	2.4
Luxembourg	3.8	0.0	3.9	–0.1
Mexico (1990-2002)	4.5	0.7	0.5	2.4
Netherlands	2.6	0.3	1.9	0.3
New Zealand	2.7	0.2	1.5	1.0
Norway	4.0	0.1	2.5	1.5
Poland (1990-2002)	3.1	0.5	3.2	–0.6
Portugal	5.9	0.4	2.6	2.8
Slovak Republic (1997-2002)	2.1	0.5	4.2	–1.5
Spain	3.4	0.3	2.3	0.8
Sweden	1.5	0.1	1.7	–0.4
Switzerland (1985-2002)	3.8	0.2	0.8	2.9
Turkey (1984-2002)	11.0	0.3	2.3	8.3
United Kingdom	3.4	0.2	2.3	1.0
United States	4.7	0.1	2.0	2.6
Average	3.6	0.3	2.3	1.0

1. Total public health spending per capita.
2. Or the longest overlapping period available.
3. Assuming an income elasticity of health expenditure equal to 1.
Source: OECD Health Database (2004), ENPRI-AGIR and authors' calculations.

demand by increasing the variety and quality of products,[13, 14] thus decreasing the "true" relative prices of health care products and services.[15] Finally, the particular incentives prevailing in health care, *i.e.* an insurance system on the basis of retrospective costs, tend to boost R&D, innovation and relative prices (Weisbrod, 1991).

Projection model for health care

Defining HE, Y and N as real health care expenditures, real income and population, respectively; and, ε the income elasticity of health expenditures and ONDF the other non-demographic factors, the growth of health expenditures can be decomposed as follows:

$$\Delta \log\left(\frac{HE}{N}\right) = \Delta \log(Adjusted\,age\,factor) + \varepsilon \cdot \Delta \log\left(\frac{Y}{N}\right) + \Delta \log(ONDF) \qquad [1]$$

or expressed in share of expenditure to GDP:

$$\Delta \log\left(\frac{HE}{Y}\right) = \Delta \log(Adjusted\,age\,factor) + (\varepsilon - 1) \cdot \Delta \log\left(\frac{Y}{N}\right) + \Delta \log(ONDF) \qquad [2]$$

Intuitively, the mechanical effect of population ageing on expenditures can be seen as moving up along the expenditure curve, assuming that the age profile of expenditures remains constant over time. This demographic effect is adjusted for the "healthy ageing" by shifting the expenditure curve rightwards, implying that older people still cost more than the young, but at progressively older ages. Finally, the cost curve shifts upwards due to non-demographic drivers (income and other non-demographic effects).

In order to make the projections less sensitive to the starting year and allow for some convergence of expenditures to GDP across countries,[16] the total logarithmic growth rates derived from equation [2] for each country are applied to the OECD average expenditure share to GDP in 2005 (a sort of "representative" OECD country). The changes in expenditure shares calculated from this common base are then added to the country-specific shares in 2005 to obtain the projected ratios of expenditure to GDP (see Annex).

Additional exogenous assumptions underlying the projections for both health and long term care are listed in Box 2 (more details are also provided in the Annex).

Alternative scenarios for **OECD** *countries*

The framework described above was used to project expenditures over the period 2005-50. In the main scenarios, the income elasticity is set to one, thus income effects are not creating additional pressures in terms of expenditure shares to GDP.

Demographic effects

As shown in Panel A of Figure 3, demographic effects can be decomposed into the health care spending for survivors, the adjustment for "healthy ageing" and the death-related costs. Pure ageing effects can be quite large for some countries, but they tend to be compensated by a better health status, as longevity increases. The death-related costs account only for a small fraction of the increase in expenditures as a share of GDP (to around 7% of total health care spending by 2050). The

Box 2. **Exogenous variables and assumptions underlying the projections**

The projections require a set of exogenous data, as follows:

1) Population projections (N). The population projections were gathered by the OECD Directorate on Employment, Labour and Social Affairs, directly from national sources. Given that the underlying assumptions on fertility and life expectancy are not necessarily uniform across countries (see Oliveira Martins *et al.*, 2005 for a discussion), this paper also uses a population maquette (Gonand, 2005) to test the sensitivity of the results to uniform longevity assumptions for a selected group of countries.

2) Labour force participation projections (L/N) rely on previous OECD work (Burniaux *et al.*, 2003). These projections are constructed on the basis of a, so-called, cohort approach. They correspond to a baseline scenario, *i.e.* the impact of current policies is assumed to influence labour participation over the next decades, but no additional assumptions are made concerning future policy changes.

3) Labour productivity (Y/L) growth is assumed to converge linearly from the initial rate (1995-2003) to 1.75% per year by 2030 in all countries, except former transition countries and Mexico where it converges only by 2050.

Summary statistics on the exogenous assumptions are provided in OECD (2006). The projected GDP per capita is directly derived from the above exogenous variables (Y/N = Y/L × L/N). This simple framework is not supposed to capture in the best way productivity differentials across countries, but to isolate, as far as possible, the effect of ageing and other demographic factors on the projections.

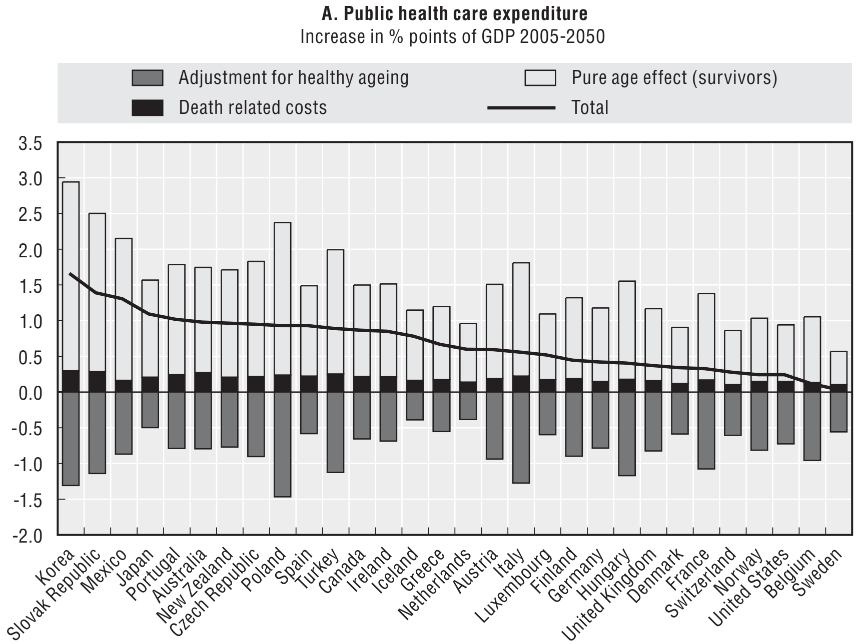
net effect of demographics on health care expenditures ranges from virtually zero in Sweden to 1.6 percentage points of GDP for Korea. This can be mapped to differences in evolving old-age dependency ratios (Panel B of Figure 3).

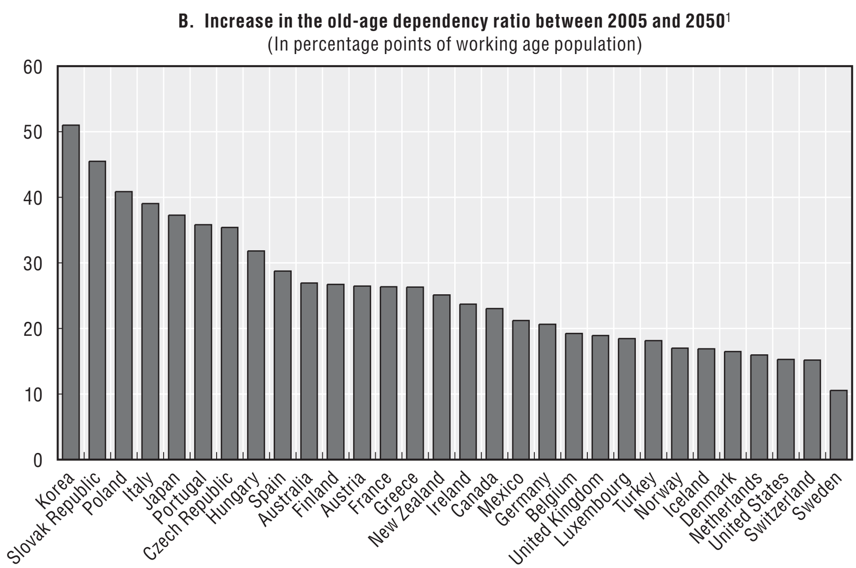
On average, demographic effects account for a small increase in expenditure, from 5.7% in 2005 to 6.3% by 2050, or 0.6 percentage points of GDP (Table 2). Admittedly, the "healthy ageing" assumption can be viewed as relatively optimistic, albeit in line with observed patterns of morbidity regimes in many OECD countries. The sensitivity of the results to this assumption was tested (see below.)

A *cost pressure scenario*

In this scenario it is assumed that, on top of the demographic effects and unitary income effects, the expenditure residual continues to grow at 1% per year over the projection period. This induces a substantial increase in the health expenditures, averaging nearly 4 percentage points of GDP from 2005 to 2050. In

Figure 3. **Demographic effects on health care expenditure**





1. Ratio of population aged 65 and over to population aged 15-64.
Source: Authors' calculations.

Table 2. **Projection scenarios for public health care expenditure, 2005-2050[1]**
In % of GDP

	2005[2]	Demographic effect	Cost-pressure	Cost-containment	Sensitivity analysis: Country-specific residuals	Sensitivity analysis: Income elasticity = 0.8	Sensitivity analysis: Income elasticity = 1.2	Sensitivity analysis: Residuals at 1.5%	Sensitivity analysis: Compression of morbidity	Sensitivity analysis: Expansion of morbidity
		2050								
Australia	5.6	6.5	9.7	7.9	8.5	7.1	8.9	8.7	7.1	8.7
Austria	3.8	4.4	7.6	5.7	4.4	5.0	6.6	6.6	5.0	6.7
Belgium	5.7	5.8	9.0	7.2	6.7	6.4	8.1	8.0	6.4	8.2
Canada	6.2	7.0	10.2	8.4	7.8	7.6	9.3	9.2	7.9	9.1
Czech Republic	7.0	8.0	11.2	9.4	7.5	8.9	9.9	10.2	8.5	10.3
Denmark	5.3	5.6	8.8	7.0	5.1	6.2	7.9	7.8	6.4	7.6
Finland	3.4	3.8	7.0	5.2	4.1	4.3	6.3	6.0	4.4	6.1
France	7.0	7.3	10.6	8.7	8.7	8.1	9.5	9.6	7.8	9.8
Germany	7.8	8.2	11.4	9.6	9.6	8.9	10.3	10.4	9.0	10.4
Greece	4.9	5.5	8.7	6.9	6.6	6.1	7.9	7.7	6.4	7.5
Hungary	6.7	7.1	10.3	8.5	5.4	7.5	9.6	9.3	7.6	9.6
Iceland	6.8	7.5	10.7	8.9	10.5	7.9	10.1	9.7	8.5	9.3
Ireland	5.9	6.8	10.0	8.2	5.6	6.9	9.8	9.0	7.7	8.8
Italy	6.0	6.5	9.7	7.9	6.4	7.3	8.6	8.7	6.8	9.2
Japan	6.0	7.1	10.3	8.5	8.7	7.9	9.1	9.3	7.9	9.0
Korea	3.0	4.6	7.8	6.0	8.6	5.3	6.9	6.8	4.8	7.3
Luxembourg	6.1	6.6	9.9	8.0	6.6	6.9	9.4	8.9	7.5	8.6
Mexico	3.0	4.3	7.5	5.7	8.3	4.4	7.3	6.5	4.9	6.5
Netherlands	5.1	5.7	8.9	7.0	6.1	6.3	8.0	7.9	6.8	7.4
New Zealand	6.0	6.9	10.1	8.3	8.4	7.6	9.1	9.1	7.7	9.1
Norway	7.3	7.5	10.7	8.9	9.6	8.1	9.8	9.7	8.1	9.7
Poland	4.4	5.3	8.5	6.7	4.6	5.5	8.2	7.5	5.5	8.2
Portugal	6.7	7.7	10.9	9.1	12.6	8.3	10.1	9.9	8.4	9.9
Slovak Republic	5.1	6.5	9.7	7.9	4.9	7.2	8.6	8.7	6.8	9.0
Spain	5.5	6.4	9.6	7.8	7.5	7.1	8.5	8.6	7.2	8.3

Table 2. **Projection scenarios for public health care expenditure, 2005-2050**[1] (*cont.*)

In % of GDP

	2005[2]	Demographic effect	Cost-pressure	Cost-containment	Sensitivity analysis: Country-specific residuals	Income elasticity = 0.8	Income elasticity = 1.2	Residuals at 1.5%	Compression of morbidity	Expansion of morbidity
		2050								
Sweden	5.3	5.3	8.5	6.7	4.9	5.9	7.7	7.5	6.3	7.3
Switzerland	6.2	6.4	9.6	7.8	11.4	7.1	8.6	8.6	7.4	8.4
Turkey	5.9	6.7	9.9	8.1	n.a	7.3	9.1	8.9	7.3	9.2
United Kingdom	6.1	6.5	9.7	7.9	7.9	7.1	8.8	8.7	7.1	8.7
United States	6.3	6.5	9.7	7.9	10.8	7.1	8.9	8.7	7.3	8.6
Average	**5.7**	**6.3**	**9.6**	**7.7**	**7.5**	**6.9**	**8.7**	**8.5**	**7.0**	**8.5**

1. For the definition of the different scenarios see Table A1.
2. Estimates, taking into account the observed expenditure growth between 2000 and 2003 (or 2002 if not available).

Source: Authors' calculations.

most countries, health care expenditures would then approach or exceed 10% of GDP by the end of the projection period. While these figures are a useful benchmark, it is unlikely that public health care expenditures to GDP could continue to grow at such constant rate, without limit.

A *cost-containment scenario*

In a voluntarily optimistic "cost-containment" scenario, the residual expenditure growth is assumed to converge to zero by 2050,[17] implicitly meaning that some policies in place are effective in controlling expenditure growth driven by some of the non-demographic factors. These policies could progressively rein in the expenditure residual, for example by ensuring that future technology improvements are mainly used in a cost-saving way. In the absence of additional ageing effects, this would imply that public health care expenditure and income would evolve in parallel over the very long-run.[18] It should be stressed, nevertheless, that a continuous cost-containment over such a long period would be rather challenging.

Under this scenario, public health care expenditures in the OECD area would still increase on average by two percentage points between 2005 and 2050, from 5.7% to 7.7% of GDP (*cf*. Table 2). Moreover, large increases (above 2.5 percentage points of GDP) by 2050 are found (in descending order) in Korea, the Slovak Republic, Mexico and Japan, which are experiencing a rapid demographic change.

Sensitivity analysis

To assess the robustness of the results, a number of parameters were changed compared with the "cost-containment scenario". These include the income elasticity, the magnitude of the residual, health status scenarios and demographic projections. Overall, these sensitivity tests do not change dramatically the overall picture, although country by country large differences may emerge. Moreover, combinations of a change in assumptions that influence the results in the same direction could alter significantly the results.

R*esiduals, income elasticity and different health status*

Applying country-specific expenditure residuals[19] significantly change the spending projections for individual OECD countries (*cf*. right columns Table 2). Korea, Mexico, Portugal, Switzerland and the United States record increases above 2 percentage points of GDP compared with the "cost-containment" scenario.[20] If anything, this illustrates how unsustainable are current health expenditure trends in some OECD countries. Conversely, in countries where cost-containment policies were successful, the projected expenditure shares would tend to be more moderate than in the cost-containment scenario (*e.g*. Denmark, Sweden). Other countries would display large decreases in expenditures because the effect of past residual growth resulting from idiosyncratic conditions, such as the scaling back of former welfare systems during economic transition (the Czech Republic, Hungary, Poland and the Slovak Republic), would be prolonged in the future.

Concerning income elasticities, projections were run with values below and above unity (0.8 and 1.2, respectively), while keeping the residual as in the cost-containment scenario.[21] Under these alternative scenarios, average OECD public health care expenditure shares would range from around 7% to 8.7% of GDP. The countries with the largest projected GDP per capita growth (*e.g.* Ireland, Mexico, Poland) are obviously the most affected by changes in income elasticity.

As discussed above, the residual was derived from trends observed over the two past decades, a period characterised by efforts to contain costs. Assuming a residual at 1.5% growth per year, in line with 1970-2002 average (but still declining to zero over the projection period) would induce an average increase of less than 1 percentage point of GDP compared with the cost-containment scenario.

Sensitivity to alternative health status was also explored. In a "compression of morbidity" scenario the shift in the cost curves is twice the adjustment applied in the "healthy ageing" regime. Alternatively, a regime of "expansion of morbidity" corresponds to a scenario where longevity gains are not translated into "healthy ageing". Under these scenarios, average health expenditures by 2050 range from 7 to 8.5% of GDP. This shows that alternative morbidity regimes matter for projecting future expenditure trends, but their impact appear to be smaller than non-demographic effects.

Alternative population projections

As noted in Box 2, national population projections are not based on harmonised assumptions across countries. In particular, projected longevity gains can differ widely and, on average, are also lower than observed in the past decades.

To test the effect of alternative demographic assumptions, longevity was assumed to increase in line with past trends (two years per decade).[22] The simulations were carried out for five large OECD countries (France, Germany, Italy, Japan and the United States). As it could be expected in a world of "healthy ageing", the implied deviations are small (taking the cost-containment scenario as a benchmark, see Table 3). But without this assumption, the results would be more sensitive to idiosyncrasies in national population projections. If an "expansion of morbidity" assumption is combined with higher longevity gains, the two effects reinforce each other and generate an increase in expenditures (around 1 percentage point, compared with the cost-containment scenario). This highlights the importance of the interaction effects.

Table 3. **Sensitivity analysis of health care expenditure to population projections**
Assuming longevity gains of 2 years per decade (In % of GDP)

		Healthy ageing	Expansion of morbidity	*Memo item*: Cost-containment scenario
	2005[1]	2050		
France	7.0	8.8	9.8	*8.7*
Germany	7.8	9.6	10.7	*9.6*
Italy	6.0	8.1	9.2	*7.9*
Japan	6.0	8.4	9.5	*8.5*
United States	6.3	7.7	8.6	*7.9*
Average	**6.6**	**8.5**	**9.6**	***8.5***

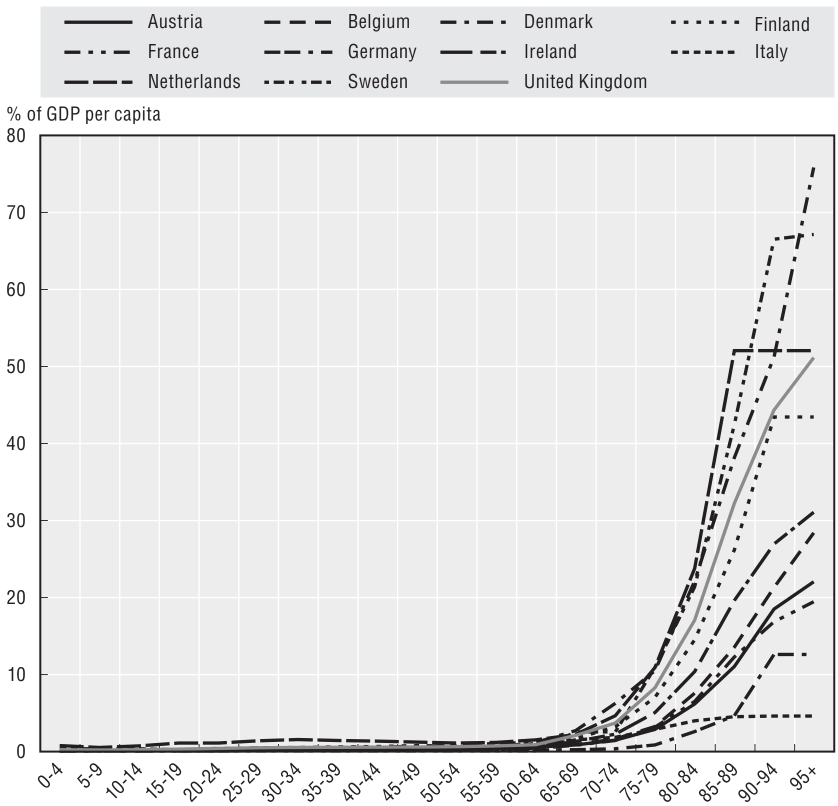
1. Estimates, taking into account the observed expenditure growth between 2000 and 2003 (or 2002 if not available).
Source: Authors' calculations.

LONG-TERM CARE

After analysing health care expenditures, a parallel projection method is used for long-term care (LTC). While health care services aim at changing a health condition (from unwell to well), long-term care merely aims at making the current condition (unwell) more bearable. Individuals may become dependent and need LTC due to disability, chronic condition, trauma, or illness, which limit their ability to carry out basic self care or personal tasks that must be performed every day. Such activities are defined as activities of daily living, ADLs (eating, dressing, bathing, getting in and out of bed, and incontinence) or instrumental activities of daily living, IADLs (preparing own meals, cleaning, laundry, taking medication, getting to places beyond walking distance, shopping, managing money affairs and using the telephone/Internet).

Compared with health care, the importance of current public LTC spending is still limited (only 1-2% of GDP). However, as LTC is heavily concentrated among the elderly (Wittenberg *et al.*, 2002), given projected demographic changes, its share in the economy is set to increase. LTC expenditure profiles by age groups are the foundation of the projection framework. In contrast with health care, these expenditure curves are basically close to zero up to age 60-65, and then increase sharply and monotonically, with different slopes across countries (Figure 4). These characteristics stem from different features, such as the mix between (expensive) formal and (inexpensive) informal care and the current prevalence of dependency (disability status).[22] On the basis of the LTC expenditure profiles and population estimates, older people (aged 65+) accounted for 82% of public LTC expenditures by 2005.

Figure 4. **Public long-term care expenditure by age group**[1]

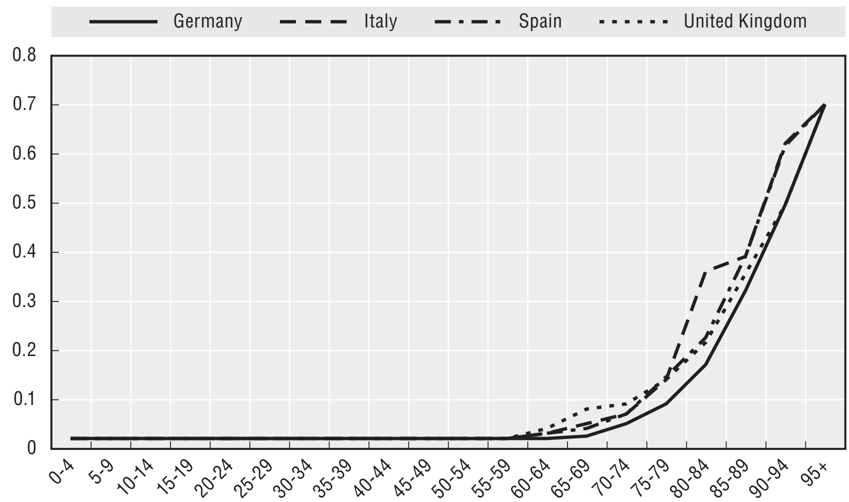


1. Expenditure per capita in each age group divided by GDP per capita, 1999.
Source: ENPRI-AGIR and authors' calculations.

Demographic drivers of expenditure

Whereas health care projections distinguished between survivors and non-survivors, the LTC projections split each age group into *dependants* and *non-dependants*.[24] Deriving the cost of LTC *per dependant* requires an estimate of the prevalence of dependency by age group. One of the most comprehensive studies in this area by Comas-Herrera *et al.* (2003) provides dependency figures only for Germany, Italy, Spain and the United Kingdom (Figure 5). As an approximation, it was assumed here that dependency ratios are uniform across countries and are equal to average of the four countries above (this has the advantage of making the projections less sensitive to initial conditions). By dividing the original expenditure profile by the average cross-country dependency ratio, the LTC expenditures per dependant person can be derived.

Figure 5. **Prevalence of dependency by age group**[1]



1. Dependency is defined as the inability to accomplish one or several Activities of Daily Living (see text).
Source: Comas-Herrera *et al.* (2003) and authors' calculations.

Box 3. **Has disability fallen over time?**

Consistent cross-country data on disability rates do not exist. Disability is usually measured through the inability of performing one or more Activities of Daily Living (ADL). Evidence for some OECD countries suggests that the share of the severely disabled has fallen over time, while no conclusion could be reached concerning the evolution of moderate disability. Studies on the United States, for which more data are available, show that disability rates may have declined somewhat among the oldest but have increased among younger age groups, a phenomenon that is often linked to obesity trends (*cf.* Rand Research Bulletin, 2004).

Nonetheless, downward trends in disability may not be accompanied by a lower pressure on expenditures. On the contrary, increased spending on health care is rather the precondition for lower disability (Lichtenberg and Virabhak, 2002; Lichtenberg, 2003; Jacobzone, 2003) and helping a chronically-ill person to be autonomous may require access to the high-cost bio-technologies and drugs.

Concerning disability regimes, there is a great deal of uncertainty (see Box 3). Internationally comparable data in this area are rather scarce (Lagergren and Batljan, 2000; Jacobzone *et al.* 2000; Wittenberg *et al.* 2001). Moreover, disability is not necessarily translated into dependency, as technical progress can help a disabled person to work and take part in everyday life. Given the lack of hard evidence on these phenomena, this paper adopts a conservative view by assuming that only *half* of the longevity gains are translated into a reduction in dependency. This limited "healthy ageing" scenario for LTC could be justified on the grounds that for the oldest old, where dependency is most prevalent, the potential for experiencing complete healthy longevity gains is decreasing.

Non-demographic drivers of expenditure

LTC expenditures are closely related to the shares of *formal* and *informal*[25] care and how they will evolve over time.[26] Currently, the bulk of LTC is provided informally (at explicit no-cost) throughout the OECD, and it is especially dominant in southern European countries. As labour force participation is projected to increase in the future, it is likely that less resources for informal care will be available and will have to be replaced by expensive formal care (OECD, 2005b; Comas-Herrera *et al.* 2005).[27]

Another major driver is labour costs of staff providing LTC. Data for the United Kingdom show that staff costs in public sector homes accounted for 85% of total unit costs (Netten *et al.*, 1998). Reinhold (2001) also found that staff costs accounted for 70% to 90% of total unit costs of nursing homes in Germany.

While LTC is highly labour-intensive, room for productivity gains is probably limited. This makes the ingredients for a potential "cost disease" (Baumol, 1967, 1993). Reflecting a negative productivity differential and equalisation of wages across sectors, it implies that relative prices of LTC *vis-à-vis* other goods and services in the economy will tend to rise. With a low price-elasticity of demand, the share of LTC expenditure in GDP will also increase over time. To capture this Baumol effect it is assumed here that unit costs rise in line with aggregate labour productivity, a proxy for wage growth of care staff (see Comas-Herrera *et al.*, 2003).

Turning to income effects, empirical evidence on the income elasticity of LTC expenditure is just not available. But, considering that LTC can be characterised as a necessity, the income elasticity is probably close to zero. This is another crude assumption because the future development of long-term care services could induce more demand for higher quality services; therefore, an alternative value for the income elasticity will be tested below.

To assess the impact of these drivers on observed differences of LTC expenditures per dependant across countries, the following simple econometric model was specified:[28]

$$Log\left(\frac{LTC}{ND}\right) = \alpha + \beta_1 \cdot Age + \beta_2 \cdot Z + \beta_3 \cdot W + u \qquad [3]$$

where LTC is total long-term care expenditure, ND, the number of dependants, *Age* is the central point in each age bracket (2, 7, 12,…, 97), Z a proxy capturing the provision of informal care and W a proxy for the other effects (relative prices and/or income). This equation was estimated in a panel of eleven EU countries by twenty age groups (Table 4). Following alternative specification tests (not reported here), the availability of informal care appeared to be best captured by the participation ratio of the population aged 50-64. The level of GDP per capita was included but it did not appear significant, suggesting that the income elasticity could indeed be small. Given the reduced size of the sample and co-linearity problems, it was not possible to test for relative price (or wage inflation) effects. The estimates of the age and old-age participation coefficients are robust across different specifications and display the expected sign.

Table 4. **Econometric estimates of long-term care costs per dependant**

Log of long-term care cost per dependant	Fixed effects	Robust OLS with age-invariant explanatory variables	
Age	0.0335***	0.0348***	0.0345***
	(0.0014)	(0.0025)	(0.0023)
Participation ratio of people		0.0394***	0.0378***
aged 50-64		(0.0054)	(0.0066)
GDP per capita			0.0748
			(0.0509)
Constant	6.433***	4.217***	2.356*
	(0.079)	(0.380)	(1.317)
Number of countries	11	11	11
Number of age groups	20	20	20
Number of observations	185	185	185
R-squared	0.77 (within)	0.62	0.62

Notes: *** significant at 1% and * significant at 10%. Standard errors in parentheses.
Source: Authors' estimates.

Projection model for long-term care

Combining the different drivers, the logarithmic growth of long-term care expenditures to GDP can be decomposed as follows:

$$\Delta \log\left(\frac{LTC}{Y}\right) = \Delta \log(Adjusted\ age\ factor) + (\varphi - 1)\cdot \Delta \log\left(\frac{Y}{N}\right) + \gamma \cdot \Delta \log(Baumol\ effect) + \omega \cdot \Delta \log(Share\ of\ informal\ care) \quad [4]$$

where Y and N are income and population, as defined previously; φ is the income elasticity of LTC expenditures and γ the elasticity characterising the "Baumol effect", *i.e.* the extent to which an increase of average labour productivity in the economy (a proxy for wage growth) is translated into an increase of LTC costs per dependant.

Using this framework, the drivers are allowed to operate in several ways (see Annex for further details). The demographic effect is adjusted in such a way that *half* of the projected longevity gains are translated into years with lower dependency, shifting dependency curve rightwards.[29]

On non-demographic factors, the expenditure curve per dependant shifts upwards due to the "cost-disease" effect. In most scenarios, the "Baumol elasticity" (γ) was assumed to be 0.5, probably a mild view on the extent to which the productivity of LTC services could under-perform relatively to the rest of the economy. The income elasticity was assumed in general to be zero, implying that income growth tends to drive down LTC expenditures as a share of GDP.

The second non-demographic effect aims at capturing the effect of a decreasing share of informal care in the total supply of LTC through the labour market participation rate of people aged 50-64. Using estimated equation [3], increasing labour market participation induces an upward shift in the LTC cost curve. The baseline projections on participation rates are derived from Burniaux *et al.* (2003). The latter rely on a cohort approach, but the last cohort used to project participation is the one entering the labour market in year 2000. The behaviour of subsequent cohorts remains unchanged thereafter. This simplification could lead to a downward bias in the projections, especially in countries where participation rates were well below the OECD average in 2000. Therefore, sensitivity analysis below will test for a more sanguine scenario on participation rates.

Alternative scenarios for **OECD** *countries*

Similar to the approach followed for the health care projections, LTC expenditures were projected under a range of scenarios over the period 2005-50.

Demographic effects

Because the prevalence of dependency increases sharply with age, demographic effects contribute to a relatively much larger increase in LTC expenditures than the one observed for health care. On average, LTC expenditures would reach 2.3% of GDP by 2050 or an increase of 1.2 percentage points of GDP compared with 2005 (Table 5). Very large increases (from around 2 to close to 4 percentage points of GDP) are found in fast-ageing countries, such as Korea, the Slovak Republic, Poland and Mexico.

Table 5. **Projection scenarios for public long-term care expenditure, 2005-2050**[1]

In % of GDP

	2005[2]	Demographic effect	Cost-pressure	Cost-containment	Sensitivity analysis				
					Unitary income elasticity	Compression of disability	Expansion of disability	Increase in dependency	Increased participation
		2050							
Australia	0.9	2.2	2.9	2.0	2.6	1.5	2.4	3.1	3.2
Austria	1.3	2.5	3.3	2.5	3.0	2.0	2.9	3.6	5.4
Belgium	1.5	2.4	3.4	2.6	3.2	2.2	3.1	3.7	5.9
Canada	1.2	2.3	3.2	2.4	3.0	1.9	2.9	3.6	2.9
Czech Republic	0.4	2.0	2.0	1.3	1.7	0.9	1.8	2.4	3.2
Denmark	2.6	3.3	4.1	3.3	3.9	2.9	3.7	4.2	3.5
Finland	2.9	4.3	5.2	4.2	4.8	3.7	4.6	5.4	4.9
France	1.1	2.3	2.8	2.0	2.5	1.6	2.4	3.0	3.7
Germany	1.0	1.9	2.9	2.2	2.7	1.7	2.7	3.4	3.2
Greece	0.2	1.0	2.8	2.0	2.6	1.4	2.6	3.5	3.0
Hungary	0.3	1.5	2.4	1.0	1.6	0.6	1.3	1.8	5.4
Iceland	2.9	3.5	4.4	3.4	4.1	3.1	3.8	4.3	3.5
Ireland	0.7	1.7	4.6	3.2	3.9	2.5	3.9	4.9	3.7
Italy	0.6	2.0	3.5	2.8	3.3	2.2	3.5	4.5	6.3
Japan	0.9	2.3	3.1	2.4	2.8	1.9	2.9	3.7	2.3
Korea	0.3	4.1	4.1	3.1	3.7	2.3	3.9	5.1	5.1
Luxembourg	0.7	1.6	3.8	2.6	3.3	2.0	3.1	4.0	4.9
Mexico	0.1	2.0	4.2	3.0	3.8	2.2	3.9	5.1	3.7
Netherlands	1.7	2.4	3.7	2.9	3.5	2.4	3.4	4.1	3.9
New Zealand	0.5	2.0	2.4	1.7	2.2	1.2	2.1	2.8	2.1
Norway	2.6	3.3	4.3	3.5	4.1	3.1	3.9	4.5	3.6
Poland	0.5	2.6	3.7	1.8	2.5	1.3	2.2	2.8	6.2
Portugal	0.2	1.3	2.2	1.3	1.9	0.8	1.8	2.4	2.1
Slovak Republic	0.3	2.6	2.6	1.5	2.0	1.1	2.0	2.6	6.6
Spain	0.2	1.0	2.6	1.9	2.3	1.3	2.4	3.3	3.0

Table 5. **Projection scenarios for public long-term care expenditure, 2005-2050**[1] (*cont.*)

In % of GDP

	2005[2]	Demographic effect	Cost-pressure	Cost-containment	Sensitivity analysis: Unitary income elasticity	Sensitivity analysis: Compression of disability	Sensitivity analysis: Expansion of disability	Sensitivity analysis: Increase in dependency	Sensitivity analysis: Increased participation
		2050							
Sweden	3.3	3.6	4.3	3.4	4.0	3.2	3.6	4.0	3.6
Switzerland	1.2	1.7	2.6	1.9	2.4	1.5	2.3	2.8	1.9
Turkey	0.1	1.8	1.8	0.8	1.4	0.5	1.2	1.7	6.8
United Kingdom	1.1	2.1	3.0	2.1	2.7	1.7	2.6	3.2	2.6
United States	0.9	1.8	2.7	1.8	2.4	1.4	2.2	2.8	1.9
Average	**1.1**	**2.3**	**3.3**	**2.4**	**2.9**	**1.9**	**2.8**	**3.5**	**3.9**

1. For the definition of the different scenarios see Table A2.
2. Estimates, taking into account the observed expenditure growth between 2000 and 2003 (or 2002 if not available).

Source: Authors' calculations

A *cost-pressure scenario*

With a "full Baumol" effect, LTC costs per dependant increase in line with average labour productivity in the economy. This induces a steady increase in relative prices, pushing LTC expenditures to 3.3% of GDP by 2050, or an increase of 2.2 percentage points of GDP compared with 2005.

A *cost-containment scenario*

Policies could "contain" the cost pressures associated with the Baumol effect, although it is difficult to give a clear content for such policy lever. In practical terms it would mean that governments deploy a continuous effort to generate productivity gains and/or contain upward pressures on wages of staff providing long-term care. In the scenario simulated here, the supply of informal care remains relatively abundant because mild baseline increases in the participation ratios are combined with an increase of the population in the group of 50-64 years old due to the ageing trends. Even under these optimistic assumptions, the average LTC expenditures more than double from the current base to reach 2.4% of GDP by 2050. The larger effects are found in countries where the 50-64 participation ratios are projected to increase significantly and demographic pressures are strong (Greece, Italy, Ireland and Spain).

Sensitivity analysis

Given the many uncertainties, sensitivity analysis is particularly important to test the robustness of LTC projections. A first simulation captures the possibility of stronger income effects. With unit income elasticity, LTC expenditure to GDP by 2050 would increase by around ½ percentage point compared with the cost-containment scenario.

A scenario of "compression of disability" was tested, where the dependency curve is shifted to the right twice as fast as in the cost-containment scenario. This reduces LTC expenditures by around ½ percentage point of GDP for the OECD group compared with "cost-containment" scenario. In an "expansion of disability" scenario, the dependency rates remain constant as life expectancy increases and the effect would be symmetrically opposite.

Another alternative scenario captures a possible estimate of the impact of the worrying obesity trends on dependency.[30] Indeed, between 1986 and 2000, the proportion of moderately obese individuals (those with a Body mass index of 30-35) merely doubled in the United States. In contrast, the proportion of individuals with a BMI of 40 or greater quadrupled. Sturm and Lakdawalla (2004) argue that if current trends in obesity continue, disability rates will increase by 1% a year more in the 50-59 age group than if there were no further weight gains. This effect was captured here by an autonomous increase in the dependency rate by 0.5% per year. On average LTC expenditures would reach 3.5% of GDP by 2050, a significant shift of above 1 percentage point of GDP compared with the cost-containment case.

In an "increased participation" scenario, the availability of informal care is dramatically reduced by assuming that all countries converge towards an old-age participation ratio of at least 70% by 2050 (countries having already a participation ratio above that level were supposed to follow their country-specific pattern). This is well above the baseline labour participation projections and would lead to average LTC costs roughly at 4% of GDP by 2050, or an additional expenditure of 1.5 percentage points of GDP compared with the cost-containment scenario. The most significant increases would occur in countries where old-age participation ratios are currently particularly low (*e.g.* Austria, France, Italy, Turkey and former transition countries).

The comparison between this scenario and the cost-containment one gives a sense of the trade-offs involved with policies aiming at increasing participation rates, on the one hand, and the objective of containing future LTC expenditures, on the other hand. In this context, competing demands on the age group 50-64 could be particularly strong.

The sensitivity to alternative population projections was also tested for five OECD countries (France, Germany, Italy, Japan and the United States). Under the "healthy ageing" assumption (*i.e.* the dependency curves are shifted by half of the increase in life expectancy), higher longevity gains (two years per decade) *per se* do not have a strong impact on expenditures (see Table 6). By contrast, a scenario where higher longevity gains are coupled with an 'expansion of disability' would push average LTC expenditures to above 4% of GDP by 2050.

Table 6. **Sensitivity analysis of long-term care expenditure to population projections**

Assuming longevity gains of 2 years per decade (In % of GDP)

		Healthy ageing	Expansion of disability	*Memo item*: Cost-containment scenario
	2005[1]	2050		
France	1.1	2.2	3.1	*2.0*
Germany	1.0	3.0	4.4	*2.2*
Italy	0.6	3.5	5.3	*2.8*
Japan	0.9	3.6	5.2	*2.4*
United States	0.9	1.7	2.6	*1.8*
Average	**0.9**	**2.8**	**4.1**	***2.3***

1. Estimates, taking into account the observed expenditure growth between 2000 and 2003 (or 2002 if not available).
Source: Authors' calculations.

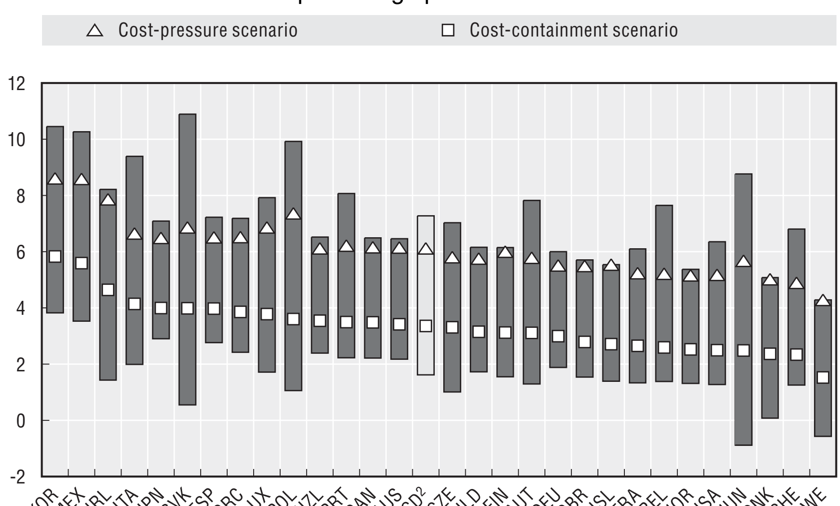
To sum-up, the sensitivity analysis showed that the long-term care projections presented here seem relatively robust to alternative specifications of the income elasticity, health status and longevity assumptions. In contrast, increased dependency associated with obesity trends or lower provision of informal care could have a much stronger impact on expenditures. A combination of these negative factors would obviously generate a rather gloomy perspective for public budgets.

AN OVERVIEW OF CROSS-COUNTRY RESULTS

Combining health and long-term care projections, together with sensitivity analysis generates striking differences across countries (Figure 6). A group of countries stands out with increases of total spending at or above four percentage points of GDP over the period 2005-50, even in the optimistic 'cost-containment' scenario. It includes rapidly ageing countries (Italy, Japan and Spain), countries that will experience a dramatic change in their population structure (Korea, Mexico and the Slovak Republic), and countries where labour participation is currently low and may face a substantial increase in the demand for *formal* long-term care (Ireland, Italy and Spain). In contrast, Sweden is in the lowest range with an increase below two

Figure 6. **Total increase in health and long-term care spending by country, 2005-2050**[1]

In percentage points of GDP



1. The vertical bars correspond to the range of the alternative scenarios, including sensitivity analysis. Countries are ranked by the increase of expenditures between 2005 and 2050 in the cost-containment scenario. Turkey was not included because data limitations made it impossible to calculate one of the scenarios.
2. OECD average excluding Turkey.

Source: Authors' calculations.

percentage points of GDP. This country is in a mature phase of its ageing process and already spends a relatively high share of GDP on health and long-term care.

CONCLUSIONS

This paper has shown that spending on health and long-term care is a first-order policy issue. Between now and 2050, public spending on health and long-term care could almost double as a share of GDP in the average OECD country in the absence of policy action to break with past trends in this area. And that estimate takes into account that as people live longer, they also remain in good health for longer. Even with containment measures, public spending on health and long-term care could rise from the current average level of 6-7% of GDP to around 10% by 2050. In some countries, the increase could be dramatic.

Yet, these projections may be on the low side. For example, an expansion of morbidity – *i.e.* a scenario in which increases in longevity would translate into a higher share of life in bad health, together with higher longevity gains, would produce a more pessimistic outlook. Likewise, technology could exert greater pressures on health care demand than assumed in the projections, while dependency rates could increase more than expected, reflecting *inter alia* a continuation of recent obesity trends and lower provision of informal care.

These heavy pressures on public finances call for policy action, which would involve curbing the impact of technology and prices on health care spending and mitigating the cost-disease effect in long-term care provision *via* productivity gains. These are not easy tasks. To improve cost-efficiency at the microeconomic level, reforms will have to be deeper and more sophisticated than those implemented so far. And in any event, policy makers will face difficult trade-offs. In particular, reining in the impact of technological progress on health care demand without foregoing the benefits it provides to patients will be challenging. Likewise, new ways will have to be found to minimise the pressures on long-term care expenditures that may arise from an increased participation of women and older workers in the labour force, which yet is much needed for the sustainability of old-age social spending.

Notes

1. See Culyer (1990), Gerdtham *et al.* 1992), Hitiris and Posnett (1992), Zewifel *et al.* (1999), Richardson and Roberston (1999), Moise and Jacobzone (2003), and Jönsson and Eckerlund (2003).
2. Across all health expenditure types, expenditures per capita of those aged over 65 are around four times higher than those under 65. The ratio rises to between six to nine times higher for the older groups (Productivity Commission, 2005; OECD Health Database, 2005a).
3. The data is based on the EU-AGIR Project; see Westerhout and Pellikaan (2005). The complete expenditure profiles were only available for a subset of OECD countries. A number of different adjustments and estimations were made in order to derive these curves for other OECD countries. Moreover, for some countries only total costs were available and thus health care had to be separated from long-term care. For 12 countries, the data were simply not available. In this case, the expenditure curves were estimated by adjusting expenditures as a spline function of age, based on available data and were calibrated on the basis of total health expenditures derived from OECD (2005a). These estimation procedures are described in detail in the Annex.
4. For a discussion and evidence on the "death-related costs", see Seshamani and Gray (2004), Batljan and Lagergren (2004).
5. This proportion is based on April (2006) and some evidence gathered by the EC-Ageing Working group (EC-EPC, 2005). The results are not very sensitive to the alternative assumptions, because mortality rates are rather low for young and prime-age people.
6. By contrast, in "pure demographic" projections, the expenditure curves would not shift rightwards with ageing, reflecting the implicit assumption of unchanged health status at any given age. When the cost curves stay put in presence of longevity gains, the share of life lived in "bad health" increases when life expectancy increases.
7. See for example Fuchs (1984), Zwiefel *et al.* (1999), Jacobzone (2003) and Gray (2004).
8. See OECD (2006) for a discussion of the empirical literature and econometric estimates of the income elasticity under alternative specifications for a panel of 30 OECD countries for the period 1970-2002.
9. This estimate was carried out for total health spending given that the split between health care and long-term care expenditures is not available in time series for historical data. Given the low share of public long-term care expenditure to GDP in 2000 (typically below 1% of GDP; OECD, 2005b), this approximation of the residual growth seems reasonable.

10. To simplify calculations, the effect of past ageing does not incorporate "healthy longevity" and "death-related costs" as is done in the projections. In any event, the ageing effect was small and would have been even smaller if a more sophisticated method had been applied. If anything, *ceteris paribus*, ignoring these past factors is likely to have lead to a downward bias in the estimated residual.

11. See Fuchs (1972), and Mushkin and Landefeld (1979). More recently, there has been a renewal of interest in this technology residual approach, see Newhouse (1992), KPMG Consulting (2001), Wanless (2001) and Productivity Commission (2005a-b).

12. For example, Dormont, Grignon and Huber (2006) found that in France the unit price of certain surgical treatments, such as cataract, decreased whereas the frequency of the treatments increased significantly. Such effects can explain much of the recent upward shift in the health care cost curves in France.

13. Some governments are attempting to introduce such quality adjustments in the measure of output (and hence prices) of public services. See Grice (2005) for a discussion on this point based on the Atkinson Review, prepared for the UK Office for National Statistics.

14. For a comprehensive overview of key studies that explicitly estimate price elasticity for health services, see Ringel *et al.* (2002).

15. This is equivalent to say that the "true" relative price of health care *vis-à-vis* all other goods in the economy decreases. Consider for example the case of a demand for variety model with a CES utility function: $U = \sum_i x_i^{(\sigma-1)/\sigma}$, where $\sigma > 1$ is the elasticity of substitution among products. To simplify, let us assume price symmetry ($p_i = p$, $\forall i$). The true composite price index is then equal to $P^* = n^{(1-\sigma)} \cdot p$. With two types of composite goods, say health (H) and all other goods (O), the true relative price would be: $P_H^* / P_O^* = (n_H / n_O)^{(1-\sigma)} \cdot (p_H / p_O)$. Thus, even if the usual price ratio (p_H / p_O) remains constant, the "true" relative price P_H^* / P_O^* would decrease when the pace of product creation in the health sector is much faster than in the rest of the economy.

16. Without this specification, spending patterns of countries with equivalent expenditure drivers would diverge in terms of share of expenditure to GDP merely due to different initial expenditure to GDP ratios. Such a divergent scenario is not very appealing in the context of long-term projections.

17. This is roughly equivalent to assuming that the residual grows at a constant rate of ½ per cent per year.

18. This convergence assumption (or transversality condition) may appear controversial in view of past experience. The assumption is justified by the fact that the expenditure growth has to be financed by the public purse. Under perfect health market conditions, a continuing increase in the share of income going to health care spending could reflect individual preferences. But the health care market is not perfect and governments are footing most of the bill. Thus, rapid growth of the share of health care spending in income would have to be compensated by reductions in other public spending items, which may be difficult to achieve and/or increased health care charges for individuals. Such cost sharing has already been introduced in most countries. Similar transversality conditions have also been imposed in other projection exercises. For example, Englert (2004) assumes that income elasticity ultimately converges to one. For symmetry, negative residuals are assumed to increase towards zero over the projection period, in the scenario with country-specific residuals.

19. Note that the technology residual is still assumed to converge towards zero over the projection period.

20. Given the very high historical growth rate of the residual for Turkey, this country was excluded from this simulation as it produced rather implausible shares of health care expenditures to GDP by 2050.

21. Note that when the chosen income elasticity is assumed to be changed both in the past and in the future, applying sub-unity elasticity would increase the residual when explaining past data. This means, when projecting, that the drag on expenditure growth from lower income elasticity would be offset by a higher residual, and *vice versa*. By construction, such scenarios would not produce very different results.

22. These alternative population projections were derived from a stylised demographic model, which mimics national projections (see Gonand, 2005).

23. For comprehensive discussions of long-term care, see for example OECD (2005b), Lundsgaard (2005), Karlsson *et al.* (2004), Comas-Herrera *et al.* (2003), Norton (2000) and Wittenberg *et al.* (1998). Interesting UK case studies are Davies *et al.* (1990) and Evandrou *et al.* (1998). As an indication of the potential spending pressures, the average cost per year of institutional long-term care for old persons in France is currently at EUR 35 000 per dependant, and in the range of $40 000-75 000 per dependant for the United States (Taleyson, 2003).

24. Indeed, even if the unit costs of long-term care per dependant are equal in, say, countries A and B, the expenditure curves by age group would still differ if the share of dependants in each age group is different in each country.

25. Most informal care is provided by partners or children. To be considered informal, the provision of care cannot be paid for as if purchasing a service. However, an informal care giver may receive income transfers conditioned on his/her provision of informal care and possibly, in practice, some informal payment from the person receiving care. On the other hand, formal care is provided by care assistants who are paid for providing care under some form of employment contract. It includes care provided in institutions as well as care provided at home. The difference between formal and informal care is first of all not about the type of care, but who provides it (Lundsgaard, 2005).

26. Due to lack of sufficiently comparable information across countries, this paper does not incorporate another important distinction, which is the subdivision of formal care into institutional care and care delivered to the patient's home. There are indeed fundamental differences between countries in the way they organise their formal LTC. Institutional LTC is particularly widespread in the Nordic countries. Norway and Sweden stand out with substantially higher LTC spending than any other country due to generous services (single rooms and well-equipped housing infrastructure) provided for residents in nursing homes (OECD, 2005b). Whether this organisation is adopted by other countries or a (cheaper) ambulatory help-at-home strategy is pursued could have important consequences for public expenditures.

27. There are indications that the proportion of older people living alone increased up to the early 1990s, although trends appear to have changed since (Tomassini *et al.*, 2004 and Borsch-Suppan, 2005).

28. Given that the shape of the expenditure curves by age is close to an exponential function, a log-level specification was used.

29. Note that this method differs somewhat from what was presented earlier for health care expenditures, where the cost profile for survivors was shifted directly in line with projected longevity gains. Here the cost profile is shifted indirectly through the shift in dependency rates.
30. See also Olshansky *et al.* (2005) for a discussion on the effect of obesity trends on life expectancy.

Annex

Data Sources and Methods

Estimating death-related costs

The primary data for 18 OECD countries are drawn from the AGIR data set (Westerhout and Pellikaan, 2005, based on EC-EPC, 2001) for EU15 countries and from national sources for Australia, Canada and the United States.

The cost of death for the oldest group (95+) is assumed to be the lowest and was proxied by their observed health expenditure per person when available. For France, Germany, Italy, the United Kingdom, Spain, the Netherlands and Australia for which the expenditure for the oldest group were not available, the cost of people aged 75-79 was taken as a proxy. In fact, when available, expenditure at age 95+ is roughly equal to the level of expenditure at age 75-79. For the countries where no cost expenditures were available, the cost of death for the oldest group was estimated by taking three times the average health expenditure per capita.

The costs of death for other age groups are then derived by multiplying this estimate by an adjustment factor equal to four between ages 0-4 to 55-59, gradually decreasing to 1 afterwards. Multiplying these costs of death by the estimated number of deaths by age group (using mortality data) gives the death-related cost (DRC) curve.

Estimating the survivors' expenditure curves

The cost curve for *survivors* can be simply derived by subtracting the death-related costs just described from the total expenditure curves, when available (18 OECD countries). Given the uncertainties surrounding these data, it seemed preferable to estimate an average expenditure curve for survivors and then calibrate this curve for each country (see below). In this way, the projections are less sensitive to initial conditions and to country-specific data idiosyncrasies.

This average expenditure curve for *survivors* was estimated econometrically in a panel of 18 countries by 20 age groups, using a spline function, as follows:

$$\left.\frac{\text{Health Exp.}}{\text{Population}}\right|_{age\ group} = -137.8 \cdot age + 9.94 \cdot age^2 - 0.29 \cdot age^3 + 0.004 \cdot age^4 - 0.00002 \cdot age^5 + 1222.6$$

where *age* is the central point in each age bracket (*e.g.* 2, 7, 12,…, 97). All the estimated coefficients are significant.

Calibration of the expenditure curves on the OECD health database

The cost curves derived for the year 2000 were first calibrated in order to fit with levels of 2005, the starting point of the projections. The total health and long-term care expenditures for 2005 being not yet available in the OECD Health Data (2005a), an estimate was made by applying the observed growth rate in expenditures 2000-03 (or 2002, depending on the countries) for the whole period 2000-05. A second step was to split the total spending into health and long-term care. The details of this split are provided below and involved an estimate of the shares of long-term care expenditures using OECD (2005b).

The costs of death by age group for 2005 were derived by applying the same growth rate as the total health expenditures between 2000 and 2005. The total death-related costs in 2005 were computed as the product of the cost of death by the projected number of deaths by age group in that year. The total survivor expenditures were then derived by subtracting the total death-related costs from the total health spending. Using this information, the survivor cost curve was calibrated proportionally for each age group.

Projecting the demographic effects under a "healthy ageing" scenario

Shifting the survivor cost curve according to longevity gains involves two steps:

- The survivor expenditure curve by five-year age groups is interpolated in order to derive a profile by individual age. In this way, the cost curve can be shifted smoothly over time in line with life expectancy gains.
- An "effective age" is calculated by subtracting the increase in life expectancy at birth according to national projections from current age. For example, a 70-year old person in Germany is projected to have an effective age of 67 by 2025 and 64 by 2050.

The death-related cost curve remains constant over time (to isolate the demographic effect) and the total costs of death are projected according to the number of deaths.

Deriving expenditure curves for long-term care (LTC)

Expenditure curves for 11 EU-countries were obtained from the AGIR data set (Westerhout and Pellikaan, 2005, based on EC-EPC, 2001). An average dependency ratio (prevalence of dependency by age group) was derived from Comas-Herrera (2003) study for four countries (the United Kingdom, Spain, Italy and Germany). As the Comas-Herrera study only provides dependency ratios for old ages, this ratio was assumed to start at 2% for younger ages.

More precisely, the LTC expenditures per dependant were derived as follows:

$$\left.\frac{LTC}{dependant}\right|_{age\ group} = \left.\frac{LTC}{population}\right|_{age\ group} \times \left.\frac{1}{dependency\ ratio}\right|_{age\ group}$$

where $dependency\ ratio = \left.\frac{number\ of\ dependants}{total\ population}\right|_{age\ group}$

An average LTC expenditure curve per dependant and age group was estimated using the following equation (see Table 4, in the main text):

$$Log\left(\frac{LTC}{dependant}\right) = 4.217 + 0.0348 \cdot age + 0.0394 \cdot (Labour\ Force\ participation\ ratio\ of\ 50\text{–}64)$$

This equation was used to derive the shift in the LTC expenditure curve associated with changes in the participation ratios. Having the expenditure curves per dependant in each age group, the total LTC costs can be calculated as follows:

$$Total\ \ LTC = \sum_i \left[\left. \frac{LTC}{dependant} \right|_{age\,group\,i} \cdot number\ of\ \ dependants \big|_{age\ group\ i} \right]$$

The total LTC expenditure in percentage of GDP in 2000 was calibrated to fit the estimates of the OECD Long-term Care study (OECD, 2005b), when available. Data for the countries not available in this study were obtained by applying the ratios of LTC to GDP observed in "similar" benchmark countries, as indicated in the table below:

Country estimated	Benchmark countries
Belgium	Netherlands
Czech Republic	*Average* (Hungary, Poland)
Slovak Republic	*Average* (Hungary, Poland)
Denmark	*Average* (Norway, Sweden)
Finland	*Average* (Norway, Sweden)
Iceland	*Average* (Norway, Sweden)
France	Germany
Greece	Spain
Italy	*Average* (Germany, Spain)
Portugal	Spain
Switzerland	Germany
Turkey	Mexico

The starting point of the projections

The projected changes in spending expressed in percentage of GDP were calculated from a common base applied to all OECD countries. This base was taken as the OECD average of expenditure in 2005. These changes were added to the initial level of expenditures in each country. This approach makes the projected changes (expressed in per cent of GDP) less dependent from the base year levels and also allows for a certain catch-up of expenditure ratios across countries. More precisely, the variation of the share of expenditure to GDP in country *j* between, say, 2005 and 2050, is calculated as:

$$\Delta\left(\left. \frac{Expenditure}{GDP} \right|_{\substack{country\,j \\ 2050-2005}} \right) = \exp\left[\Delta \log(Drivers)\Big|_{\substack{country\,j \\ 2050-2005}} + \log\left(\left. \frac{Expenditure}{GDP} \right|_{\substack{OECD\,average \\ year=2005}} \right) \right] - \left(\left. \frac{Expenditure}{GDP} \right|_{\substack{OECD\ \ average \\ year=2005}} \right)$$

Table A1. **Assumptions underlying the alternative projection scenarios: Health care**

Scenarios	Health Status	Income elasticity	Expenditure residual
Demographic effect	Healthy ageing: Longevity gains are translated into equivalent additional years in good health	Income elasticity is equal to 1	n.a.
Cost-pressure scenario	Healthy ageing: Longevity gains are translated into equivalent additional years in good health	Income elasticity is equal to 1	**The expenditure residual grows at 1% per year over the projection period**
Cost-containment scenario	Healthy ageing: Longevity gains are translated into equivalent additional years in good health	Income elasticity is equal to 1	Residual growth is equal to 1% in 2005 and converges to 0 by 2050 (transversality condition)
Country-specific residuals	Healthy ageing: Longevity gains are translated into equivalent additional years in good health	Income elasticity is equal to 1	**Residual growth is country-specific and converges to 0 by 2050 (transversality condition)**
Income elasticity = 0.8	Healthy ageing: Longevity gains are translated into equivalent additional years in good health	**Income elasticity is equal to 0.8**	Residual growth is equal to 1% in 2005 and converges to 0 by 2050 (transversality condition)
Income elasticity = 1.2	Healthy ageing: Longevity gains are translated into equivalent additional years in good health	**Income elasticity is equal to 1.2**	Residual growth is equal to 1% in 2005 and converges to 0 by 2050 (transversality condition)
Residuals at 1.5%	Healthy ageing: Longevity gains are translated into equivalent additional years in good health	Income elasticity is equal to 1	**Residual growth is equal to 1.5% in 2005 and converges to 0 by 2050 (transversality condition)**
Compression of morbidity	**Longevity gains are doubled into additional years in good health**	Income elasticity is equal to 1	Residual growth is equal to 1% in 2005 and converges to 0 by 2050 (transversality condition)
Expansion of morbidity	**No healthy ageing adjustment, *i.e.* longevity gains do not translate into additional years in good health**	Income elasticity is equal to 1	Residual growth is equal to 1% in 2005 and converges to 0 by 2050 (transversality condition)

Note: The key assumption changed in each scenario is in bold.

Table A2. **Assumptions underlying the alternative projection scenarios: Long-term care**

Scenarios	Health Status	Participation rates (proxy for availability of informal care)	Income and "cost disease" effects
Demographic effect	Healthy ageing: The prevalence of dependency per age is shifted by ½ year every 10 years (approximately half of the projected longevity gains)	n.a.	Long-term care costs per dependent increase by *half* of average labour productivity (partial Baumol effect) Income elasticity equal to zero
Cost-pressure scenario	Healthy ageing: The prevalence of dependency per age is shifted by ½ year every 10 years	Participation rates of people aged 50-64 increase in line with baseline labour force projections	**Long-term care costs per dependent increase in line with average labour productivity (full Baumol effect)** Income elasticity equal to zero
Cost-containment scenario	Healthy ageing: The prevalence of dependency per age is shifted by ½ year every 10 years	Participation rates of people aged 50-64 increase in line with baseline labour force projections	Long-term care costs per dependent increase by *half* of average labour productivity (partial Baumol effect) Income elasticity equal to zero
Unitary income elasticity	Healthy ageing: The prevalence of dependency per age is shifted by ½ year every 10 years	Participation rates of people aged 50-64 increase in line with baseline labour force projections	Long-term care costs per dependent increase by *half* of average labour productivity (partial Baumol effect) **Income elasticity equal to one**
Compression of disability	**The prevalence of dependency per age is shifted by 1 year every 10 years**	Participation rates of people aged 50-64 increase in line with baseline labour force projections	Long-term care costs per dependent increase by *half* of average labour productivity (partial Baumol effect) Income elasticity equal to zero
Expansion of disability	**No healthy ageing adjustment, *i.e.* the prevalence of dependency remains constant over time**	Participation rates of people aged 50-64 increase in line with baseline labour force projections	Long-term care costs per dependent increase by *half* of average labour productivity (partial Baumol effect) Income elasticity equal to zero
Increase in dependency	Healthy ageing: The prevalence of dependency per age is shifted by ½ year every 10 years, but **dependency rates are assumed to increase by 0.5% per year**	Participation rates of people aged 50-64 increase in line with baseline labour force projections	Long-term care costs per dependent increase by *half* of average labour productivity (partial Baumol effect) Income elasticity equal to zero
Increased participation	Healthy ageing: The prevalence of dependency per age is shifted by ½ year every 10 years	**Participation rates of people aged 50-64 converge to at least 70% by 2050 in all countries**	Long-term care costs per dependent increase by *half* of average labour productivity (partial Baumol effect) Income elasticity equal to zero

Note: The key assumption changed in each scenario is in bold.

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