THE IMPACT OF AGEING ON HEALTH AND LONG-TERM CARE: THE CASE OF ITALY

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1 Introduction

Health and Long-term Care (LTC) expenditures are foreseen to be heavily affected by the demographic changes forecast for almost all developed countries. This is because of both further increases in life expectancy and the transition of the baby boom generations from the working age population to old age. Several studies, dealing with the analysis of the effects of ageing on public expenditures, agreed on considering the demographic factors as the main drivers of health and LTC expenditures for the next decades (Economic Policy Committee, 2001, 2003; Economic Policy Committee – European Commission 2006; OECD, 1998, 2003; World Bank, 1994). Such effects are basically brought about by the interaction between the age structure of the population, which will become increasingly older, and the health and LTC consumption profiles, which are greatly increasing according to the age.

Starting from a useful decomposition of the dynamics of health and LTC expenditures (paragraph 2), three groups of expenditure drivers are identified depending on whether they refer to changes in demographic structure, age consumption (or disability rate) profile or unit cost.

Besides the effects directly brought about by demographic changes, which are always incorporated in mid-long term forecasting models, the analysis is mainly based on the possible shift of the age consumption (or disability rate) profile generated by a modification of health status. As known, it is quite difficult and somehow arbitrary to try to foresee health improvements in the future, as they depend on a series of factors related to behaviour, new medical therapies, prevention of illnesses and so on. However, on the basis of past experience, it has been noted that increases in life expectancy have always been accompanied by health improvement. Acting on such evidence, the article provides an in-depth analysis of the methodologies aimed at reproducing the containing effects of the costs of ageing somehow correlated to changes in life expectancy. In this regard, major attention is paid to the forecasting activity of the Department of General Accounts (Ragioneria Generale dello Stato – RGS) in this field.

The evidence of a positive correlation between longer and healthier has two major implications. The first one is that maintaining unchanged the age consumption (or disability rate) profile is an extremely conservative assumption, when life expectancy is expected to rise. In fact, in a context of declining mortality, this hypothesis tends to overestimate the effects of ageing on health and LTC expenditures insofar as it excludes any correlated improvements in health status. Secondly, it has been considered quite fruitful to concentrate the analytical effort on studying health improvements caused by the interaction with changes in life expectancy, leaving aside those due to non-demographic factors. In this context, two theoretical approaches have been developed referred to as "*death-related costs*" and "*dynamic equilibrium*", respectively.

As for the former theory, it has been noticed that health-care consumption rises dramatically in the last few years of life independently of age and sex (Batljan and Lagergren, 2004; Cislaghi *et al.*, 2002; Zweifel *et al.*, 1999; Lubitz and Riley, 1993; Roos *et al.*, 1987). This means that age consumption profile is destined to modify its shape in function of both the number of

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deaths and the difference in the health-care consumption related to the proximity of death. Death-related costs methodology will be discussed in paragraph 3. The technical solution presented in this context is that actually applied by the RGS models (Aprile and Palombi, 2006) and also adopted by the Ageing Working Group attached to the Economic Policy Committee of the Ecofin Council (EPC-WGA), in view of the second round of common projections (Economic Policy Committee – European Commission, 2006).

The *dynamic equilibrium* theory postulates that the postponement of death to higher ages due to falling mortality is accompanied by a parallel postponement of illness status or disability. The basic idea is that increases in life expectancy are possible as long as the average health status improves at each age and sex, making the age consumption (or age disability rate) profile lower (Gruenberg, 1977; Verbrugge, 1984; Olshansky *et al.*, 1991; Guralnik, 1991; Manton *et al.*, 1995; Fries, 1993; Robine *et al.*, 2005). On the contrary, assuming no change in health conditions would mean that living longer would result in a corresponding greater period spent in bad health.

However, the traditional approach to implement the *dynamic equilibrium* theory in projecting models suffers from two shortcomings: i) the application of cross section life expectancies, instead of cohort ones, and ii) the implicit assumption that improvements of health condition, owing to changes in life expectancy, affect the whole population including the quota already disabled. Acting on these two shortcomings, a new methodological solution is proposed to project the age profile of disability rates, which will be taken on board in the next update of the RGS models (paragraph 4).

As for non-demographic drivers discussed in literature, according to which health and LTC unit costs may grow faster than GDP per capita, the technological progress is the only one briefly analysed in the paper. In this regard, a few comments on the recent proposal by OECD (OECD, 2006a) are provided in paragraph 5.

Finally, paragraph 6 will be entirely devoted to illustrating the latest projections of mid-long term trends of health and LTC in Italy. Such projections have been made with the RGS models updated to 2007 and issued in the last annual report by RGS (Ministero dell'economia e delle finanze – RGS, 2007). In this ambit, besides the *pure ageing scenario* approach, measuring only the effects brought about by changes in the population structure, a particular combination of different methodological assumptions, labelled as "*reference scenario*", is analysed in terms of projection results.

2 The core structure of a projection model

For each typology of health and LTC provision (j), the expenditure (S) can be expressed as a sum, by age (x) and sex (s), of the product of the health and LTC consumption (ψ), distributed by age and sex, and the corresponding levels of population. Analytically, for each year t, the following expression is valid:

$$S_t^j = \sum_s \sum_x \psi_{t,s,x}^j \, B_{t,s,x} = c_t^j \, B_t \sum_s \sum_x \psi_{t,s,x}^j \, b_{t,s,x} \tag{1}$$

where b indicates the incidence of the population belonging to a given age and sex in terms of the total population (B) and c the unit cost of the expenditure item j. Equation (1) may be usefully rearranged as follows:

$$S_{\tau}^{j} = B_t \frac{\sum_s \sum_x \psi_{t,s,x}^{j}\, b_{t,s,x}}{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t,s,x}} \frac{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t,s,x}}{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t_0,s,x}} \underbrace{c_t^{j} \sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t_0,s,x}}_{CPS} \tag{2}$$

where t_0 indicates the base year. As can be seen, the evolution of the last factor on the right hand side of equation (2), referred to as *standardised per capita consumption* (Consumo Pro capite Standardizzato - CPS) only depends on unit cost changes, *i.e.*, the dynamics of costs which are not correlated with age and sex. Obviously, the starting level of the unit cost is conventional and it may be set equal to 1.[1]

The expenditure item j, in terms of GDP (σ), becomes:

$$\sigma_t^{j} = \sigma_{t_0}^{j} \frac{\sum_s \sum_x \psi_{t,s,x}^{j}\, b_{t,s,x}}{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t,s,x}} \frac{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t,s,x}}{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t_0,s,x}} \frac{c_{t/t_0}^{j}}{h_{t/t_0}} \tag{3}$$

where h stands for GDP per capita while t/t_0 denotes the variation factor of the variable concerned, from year t_0 to year t.

According to the equation (3), the dynamics of the expenditure item j to GDP ratio may be decomposed as a product of three factors, as shown by the following equation:

$$\frac{\sigma_t^{j}}{\sigma_{t_0}^{j}} = \frac{\sum_s \sum_x \psi_{t,s,x}^{j}\, b_{t,s,x}}{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t,s,x}} \frac{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t,s,x}}{\sum_s \sum_x \psi_{t_0,s,x}^{j}\, b_{t_0,s,x}} \frac{c_{t/t_0}^{j}}{h_{t/t_0}} \tag{4}$$

The first factor of equation (4) measures the effects to the expenditure item j, as a share of GDP, brought about by changes in the age and sex consumption profile. In other wards, it reflects changes in the structure of demand of provisions or, alternatively, in the number of recipients, due to modifications in health status. The second factor measures the effects brought about by changes in age and sex structure of the population. Such and indicator is generally referred to as "*weighted population*", *i.e.*, the population weighted with the consumption profile in the base year. Finally, the third factor expresses the effects stemming from the diverse dynamics of unit cost and GDP per capita. It should be noted that the total population does not appear amongst the explanatory variables.

The decomposition shown in equation (4) is quite interesting, because it allows us to single out the effects directly attributable to changes in the demographic structure by age and sex (second factor) and those due to non-demographic factors. Furthermore, it proves that health-care expenditure as a percentage of GDP would depend only on demographic changes if the first and the last factors on the right hand side of equation (4) were kept constant during the whole forecasting period, which means: i) no change in the cohort profile of consumption by age and sex; ii) the unit cost evolves in line with GDP per capita. These two assumptions, jointly taken, feature the so-called "*pure ageing scenario*" insofar as the dynamics of the expenditure item to GDP ratio only depend on changes in the population structure.

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[1] A different value would imply just a compensative change in the level of consumption profile, by an equivalent percentage for each age and sex, without producing any alteration in projection results. It can be seen that in the base year the CPS equals per capita expenditure of item j.

As known, the demographic component is always embodied by mid-long term projection models and, sometimes, is the only one driving force taken into consideration. The reasons for that may be found in the following:

- the ageing expected for the next decades is quite strong, mainly because of the transition of the baby boom generations, besides the likely increase in life expectancy;
- the ageing is a phenomenon relatively certain since it greatly depends on the current structure of population;
- the pressure on health and LTC consumption brought about by the ageing is due to an increase of people in the upper age classes, characterised by higher health and LTC needs without involving any improvement in quality and effectiveness of medical treatments and services. This means that to curb the increase of the expenditure to GDP ratio, due to ageing, a stepping up of efficiency and effectiveness is required to avoid a worsening of the health well-being already achieved.

However, it has been argued that the component of the ageing stemming from the increase in life expectancy, underlying the demographic projections, may result in a right hand shift of age consumption profile, through an improvement of health status. According to the equation (4), this means that living longer, which contributes to the increase of weighted population, causes also a reduction in the consumption of elderly people because of a containment of the incidence of recipients in each age class compared to the base year (first factor). In this regard, two methodological approaches will be analysed in paragraphs 3 and 4 referred to as "*death related costs*" and "*dynamic equilibrium*", respectively.

As for the last factor of equation (4), the assumption of a dynamics of the unit cost in line with GDP per capita is generally preferred for several reasons, the most important of which may be summarised as follows:

- the impact of non-demographic drivers on the unit cost is difficult to be detected and estimated, mainly because of their interaction with the effects of policy changes. In this regard, the degree of arbitrariness is huge and the mechanical extrapolation of past trends over a quite long period leads to unreliable results;
- generally, an increase of the unit cost faster than per capita GDP implies an improvement of medical treatment or quality of services. In this case, the corresponding increase in health and LTC expenditures to GDP ratio is due to more costly provisions provided to each recipient, regardless of the class of needs. This makes quite a difference in terms of policies devoted to containing the dynamics of health and LTC expenditures. In fact, in the case of ageing, health and LTC costs are boosted by an increasingly larger number of recipients, keeping unchanged the resources destined to finance each class of needs;
- referring only to the public health and LTC, it is reasonable to suppose that the unit cost will not be allowed to grow faster than GDP per capita, especially considering the further costs brought about by ageing.

However, some alternative assumptions have been considered in literature, which postulate that the evolution of health and LTC unit costs may be faster than that of GDP per capita, causing this way a further increase in health and LTC expenditures. In this regard, the following theoretical approaches are worthwhile mentioning: i) the unit cost should be linked to the dynamics of productivity rather than those of GDP per capita; ii) prices of health goods and services grow faster than those of the economy as a whole; iii) demand for health goods and services has an elasticity to income higher than unity, as for luxury goods; iv) the effect of technological progress. These alternatives will not be analysed in this paper, with the exception of a brief comment on the recent proposal by OECD concerning how to incorporated the technological progress effects in projecting models (paragraph 5).

3 Death-related costs theory

3.1 The projection methodology

Some empirical studies have demonstrated that the state of health gets a great deal worse in the few years before death or, alternatively, health-care consumption becomes much more costly. This means that a very different health-care consumption could be attributed to people of the same age and sex as long as they are assumed to survive for quite a different period. Therefore, it is possible to take somehow account of the differences in the state of health by grouping people of the same age and sex in function of the number of life years prior to death.

The relevance of death-related costs in explaining health-care consumption emerges quite clearly from the empirical analyses carried out at the national and international levels. The outcome of these studies, mainly based on hospital expenditure databases, seems to be surprisingly consistent amongst countries[2] or different regions within the same country, as in the case of Italy,[3] notwithstanding the differences in the legal-institutional frameworks.

The strong evidence supporting *death-related costs* theory together with the fact that it is based on demographic parameters, such as the probabilities of surviving, has recently led several scholars and research institutions to consider death-related costs effects when projecting health-care expenditure.[4]

The methodology actually incorporated in the RGS projection models, may be described as follows.[5] People of the same age and sex may be divided into two groups: the first including those who are supposed to die within a year, the second comprising all other people.[6] Each group is provided with a different health-care consumption, which will be indicated with $\psi^{death}_{t,s,x}$, for the former (age profile of "*death-related*" costs), and $\psi^{surv}_{t,s,x}$, for the latter (age profile of "*normal*" costs). Setting $\pi_{t,s,x}$ the probability of death by age and sex, we can write:

$$\psi_{t,s,x} = \psi^{surv}_{t,s,x}\left(1-\pi_{t,s,x}\right)+\psi^{death}_{t,s,x}\ \pi_{t,s,x} = \psi^{surv}_{t,s,x}\left[\left(1-\pi_{t,s,x}\right)+k_{t,s,x}\ \pi_{t,s,x}\right] \tag{5}$$

where $k_{t,s,x} = \psi^{death}_{t,s,x} \big/ \psi^{surv}_{t,s,x}$ expresses, for a given age and sex, how many times the health-care consumption of a person who is bound to die within a year exceeds, on average, that of all other

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2 See Raitano (2005). In the ambit of the EPC-WGA activities, some countries provided data on death related costs to be incorporated in health care projection models. Almost all the data provided referred to hospital health care. See Economic Policy Committee – European Commission (2006).

3 ISAE (2005) and Gabriele *et al.* (2005)

4 See: Breyer and Felder (2004); Madsen (2004); Polder and Achterberg (2004); Serup-Hansen *et al.* (2002); Seshamani (2004); and Stearns and Norton (2004).

5 For details, see Aprile and Palombi, (2006). Such an approach was also discussed in the EPC-WGA in view of the second round of age-related expenditure projections, see Economic Policy Committee – European Commission (2006).

6 The pattern might be generalized involving more than two groups of people. In this regards, see Aprile and Palombi (2006), paragraph 5.

people. Since it can reasonably be taken that $\psi^{surv}_{t,s,x} \leq \psi^{death}_{t,s,x}$, $k_{t,s,x}$ is bound between 1 and $+\infty$.[7]

If we assume that age profiles of death-related and normal costs are both kept unchanged through time, then the overall age cost profile would vary according to the evolution of the probability of death. Analytically, we have:

$$\psi_{t,s,x} = \psi^{surv}_{t_0,s,x} \left[\left(1 - \pi_{t,s,x}\right) + k_{t_0,s,x} \ \pi_{t,s,x} \right] \tag{6}$$

and, given that age cost profile of surviving people in the base year can be estimated from the total one according to the following equation:

$$\psi^{surv}_{t_0,s,x} = \frac{\psi_{t_0,s,x}}{\left(1 - \pi_{t_0,s,x}\right) + k_{t_0,s,x} \ \pi_{t_0,s,x}} \tag{7}$$

equation (7) becomes:

$$\psi_{t,s,x} = \psi_{t_0,s,x} \frac{\left(1 - \pi_{t,s,x}\right) + k_{t_0,s,x} \ \pi_{t,s,x}}{\left(1 - \pi_{t_0,s,x}\right) + k_{t_0,s,x} \ \pi_{t_0,s,x}} \tag{8}$$

Such an equation expresses the time evolution of age consumption profile, for both genders, due to the dynamics of the probabilities of death underlying the demographic scenario, keeping the age profile of parameter *k* unchanged with respect to the initial level.

It can be argued that parameter *k* is likely to decline along with the age profile, especially in the second half of life when the probabilities of death tend to increase significantly as age rises.[8] This is due to the fact that normal costs for health care (*i.e.* of those surviving more than one year) are more sensitive to age than death-related costs (*i.e.*, of those dying within a year). In particular, while the former are likely to increase along with age because of the progressive worsening of health, the latter are likely to follow an opposite path insofar as, in the case of the more elderly people, the event of death is not as traumatic and for the young adults or children. Such an outcome is confirmed by the evidence. Figure 1 shows the graph of parameter *k* as a function of age estimated on the basis of hospital care expenditure observed in four Italian regions (Abruzzi, Apulia, Lombardy and Tuscany).[9] As can be seen, the value of the parameter under consideration is rather high in the age bracket characterized by low mortality rates, while it converges towards 1 as the mortality rates increase according to age in the right hand side of the graph. Such empirical findings seem to be consistent with those provided by other studies.[10]

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7 Assuming the lower limit value, we come again to the context of pure ageing scenario in which the state of health was not considered at all; however, the assumption of the upper limit value means that the lifelong health care consumption of a person is concentrated in the last year of his/her life or, alternatively, that the health care consumption of surviving people is nil for all ages and sexes. The latter also implies that the only demographic variable which is worthwhile considering in projecting health care expenditure would be the number of deaths.

8 In some studies, such an aspect is ignored or not explicitly analysed, assuming that parameter *k* does not depend on age. See Miller (2001).

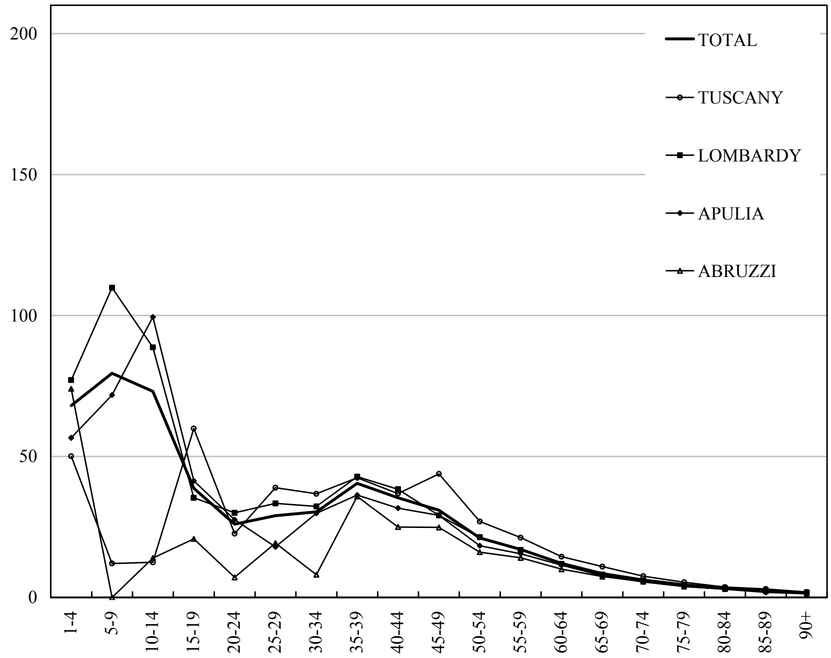
9 See ISAE (2005) and Gabriele *et al.* (2005).

10 See: Lubitz and Riley (1993); Van Vliet and Lamers (1998); and Madson (2004). For a review, see Raitano (2005).

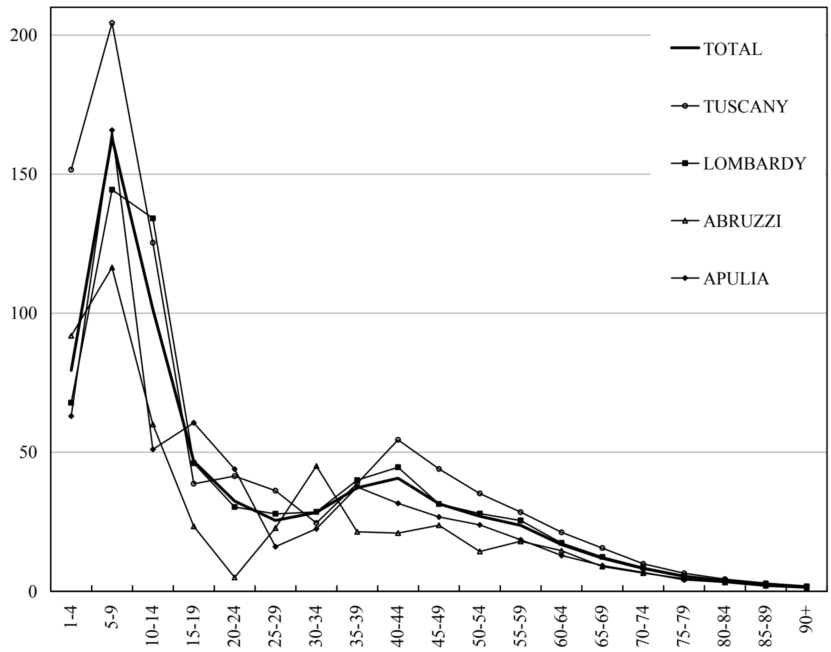
Figure 1

The Ratio of Death-related Costs to Normal Ones (Parameter *k*)

a) Males



b) Females



Source: ISAE (2005).

3.2 *The main results*

When assuming a decreasing evolution of the probabilities of death, as generally done in demographic projections, death-related costs methodology produces a reduction of health-care consumption, especially for older ages characterized by higher probabilities of death. Such an effect is shown in Figure 2, respectively for males and females. More specifically, the graphs compare the overall consumption profile at the beginning (solid line) and at the end of the forecasting period (dotted line) under the application of death-related costs methodology illustrated in the previous paragraph.

According to the methodological framework illustrated in paragraph 3.2, the ratio of death-related costs to normal ones (parameter *k*) have been estimated on the basis of the hospital discharging records of four regions, as mentioned above, and applied to Italy as a whole.

As shown in the Figure 2, the increase in longevity will result in a lowering of the overall consumption profile which is especially evident in ages characterized by higher improvement in the probabilities of surviving. After age 60, the percentage of consumption reduction accounts for some 6 per cent, for males, and 5 per cent, for females, in the period 2006-2050.[11]

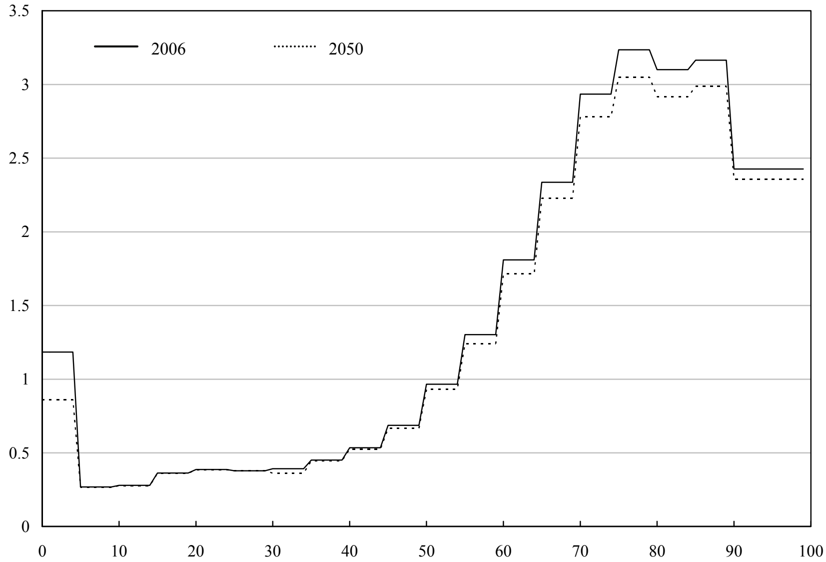
The effects of death-related costs on the evolution of health-care expenditure to GDP are presented in Figures 3. The projections have been made with the forecasting model of RGS under the National baseline scenario updated to 2007.[12] According to the evidence, the methodology of death-related costs has been applied only to the hospital component of the public health-care expenditure.[13]

The projection results show the relevance of death-related costs methodology in curbing the increase of health-care expenditure to GDP because of ageing. Assuming that the overall consumption profile remains unchanged with respect to the base year (*pure*

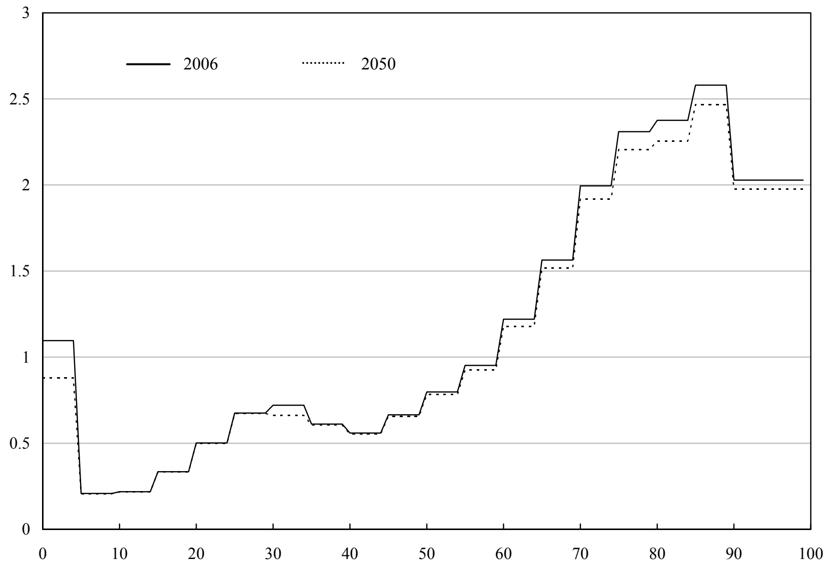
Figure 2

The Age-cohort Profile of Hospital Care Expenditure
Changes between 2006 and 2050

a) Males



b) Females



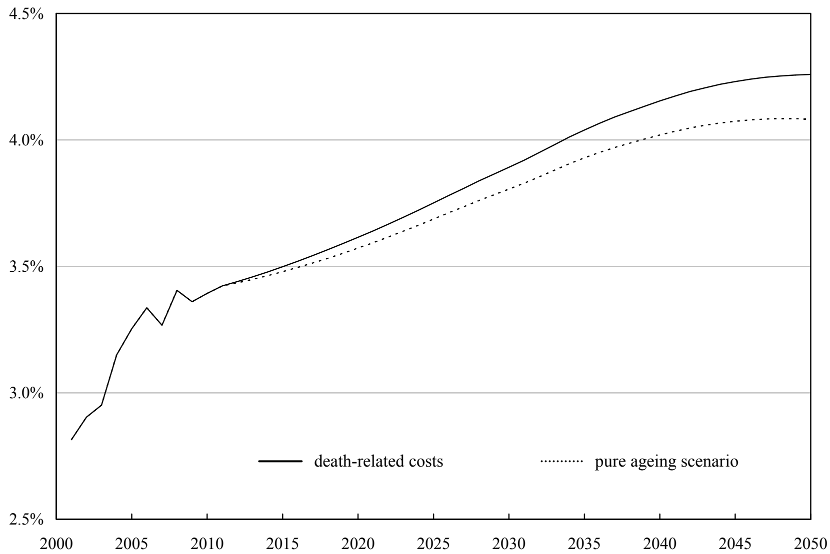
[11] Calculations are based on the probabilities of death underlying the demographic projection made by ISTAT in 2005, under the main variant assumption. See ISTAT (2005).

[12] See paragraph 6.3. For details, see Ministero dell'economia e delle finanze – RGS (2007).

[13] Similarly to LTC, health care expenditure items, other than the hospital one, depend on the incidence of disability or illnesses, by age and gender, and its evolution through time according to possible improvements of health status.

Figure 3

Projection of Hospital Care Expenditure according to Different Methodologies
(percent of GDP)



ageing scenario), the ratio would rise by about 1.4 percentage points between 2006 and 2050. When embodying death-related costs methodology, such an increase will be reduced by one-fifth.

In order to better assess the relevance of death-related costs, it should be noted that the overall increase in health-care expenditure to GDP, brought about by demographic drivers, is only partly due to improvement in life expectancies while the remaining part is caused by the baby boom generations exceeding the age threshold of 65. According to our calculations, the latter explains about half percent of the projected increase in the number of elderly persons.

4 Dynamic equilibrium theory

4.1 The traditional approach

The *dynamic equilibrium methodology* postulates that increases in life expectancy result in corresponding gains in healthy life. The basic idea behind this theory is that the postponement of death to higher ages due to falling mortality is accompanied by a parallel postponement of the beginning of disability. In other words, people may be expected to live longer, provided that the average health status at a given age improves.

Whereas the relationship between life expectancy increases and the improvements in health status is clear from the theoretical point of you, it is much more complex to embody it into a forecasting model, when assessing the impact of ageing to health and LTC expenditures.

The methodological approach applied by the RGS models and also adopted in the EPC-WGA[14] is based on the following simple assumption: disability rate (or per capita health and LTC consumption) at a given time (t), sex (*s*) and age (*x*) is set equal to the disability rate which, at the beginning of the forecasting period (t_0), corresponds to a lower age by exactly the same number of years that life expectancy is assumed to increase. As the latter normally presents a

[14] Economic Policy Commettee – European Commission (2006).

decimal digit, a linear interpolation is applied in order to take account of it. The formula is reported below:

$$\delta_{t,s,x} = \delta_{t_0,s,x-INT(e_{t,s,x}-e_{t_0,s,x})} + \\ + \left[\left(e_{t,s,x} - e_{t_0,s,x}\right) - INT\left(e_{t,s,x} - e_{t_0,s,x}\right)\right]\left[\delta_{t_0,s,x-INT(e_{t,s,x}-e_{t_0,s,x}+1)} - \delta_{t_0,s,x-INT(e_{t,s,x}-e_{t_0,s,x})}\right] \tag{9}$$

where: δ denotes the disability rate, e indicates the life expectancy and *INT*(.) rounds the number in bracket down to the nearest integer.[15]

This approach, although simple to be implemented, suffers from two shortcomings:

- the first one concerns the definition of life expectancy changes. According to the dynamic equilibrium theory, the improvement in health status of each cohort is to be related to the increase in the cohort life expectancy instead of the cross section one, which refers to different cohorts. As known, due to the increasing in longevity, cohort life expectancies are higher then the cross section ones. However, because of the assumption, generally underlying demographic projections, of an asymptotic trend in mortality rates towards a given level (which means that the gains in life expectancy are decreasing through time), changes in cohort life expectancies may be even lower than those calculated on the cross section ones.
- The second shortcoming refers to the fact that any increase in life expectancy at the given age results in a corresponding decrease in the disability rate at the same age. This means that, the simple fact a cohort of people is supposed to live longer, this in itself implies that a part of the disabled cease to be such. One of the most regrettable effects of this methodological approach is that life expectancy gains may cause, during a transitional phase, a reduction in disability rates such to reduce the overall number of the disabled, regardless of the increase in elderly people.

Instead of that, it appears more reasonable to interpret the basic idea of the dynamic equilibrium in the sense that the prospect of a longer life would improve general health conditions through a reduction of the probabilities of becoming disabled.

4.2 Proposing a new projecting methodology

In order to take account of the desirable requirements mentioned at the end of the previous paragraph, a new methodology has been set up based on a stock-flow approach. The starting point is given by the following equation:

$$P_{t,x,s} = P_{t-1,x-1,s} + D_{t,x,s} - E_{t,x,s} \tag{10}$$

where: $P_{t,x,s}$ indicates the number of disabled people in the year *t*, of age *x* and sex *s*; $E_{t,x,s}$ the number of those eliminated because of death, moving from *t-1* to *t*; $D_{t,x,s}$ the net number of those becoming disabled moving from *t–1* to *t.*[16]

As the elimination is only due to death, equation (10) may be rewritten as follows:

$$P_{t,x,s} = P_{t-1,x-1,s}\ (1 - \pi_{t-1,x-1,s}) + D_{t,x,s} \tag{11}$$

[15] This formula can be easily generalized and made applicable also to disability rates grouped by age classes.

[16] The number is net insofar as it is defined as the difference between those becoming disabled and those leaving this status.

where $\pi_{t-1,x-1,s}$ denote the probabilities of death of disabled people which, for the sake of simplicity, have been assumed to be the same as those of the population as a whole.[17]

At the same time, the number of disabled people may be expressed as a product of the disability rates $(\delta_{t,x,s})$ by the corresponding population size ($B_{t,x,s}$):

$$P_{t,x,s} = \delta_{t,x,s}\ B_{t,x,s} \tag{12}$$

Combining equations (11) and (12) we obtain the following:

$$P_{t-1,x-1,s}\ (1-\pi_{t-1,x-1,s}) + D_{t,x,s} = \delta_{t,x,s}\ B_{t,x,s} \tag{13}$$

on the basis of which it is possible to calculate the net flow of new disabled persons in the year t:

$$D_{t,x,s} = \delta_{t,x,s}\ B_{t,x,s} - \delta_{t-1,x-1,s}\ B_{t-1,x-1,s}(1-\pi_{t-1,x-1,s}) = B_{t,x,s}(\delta_{t,x,s} - \delta_{t-1,x-1,s}) \tag{14}$$

Assuming the constancy of disability rates with respect to the base year t_0, so that $\delta_{t,x,s} = \delta_{t_0,x,s}$, equation (14) becomes:

$$D_{t,x,s} = B_{t,x,s}\ (\delta_{t_0,x,s} - \delta_{t_0,x-1,s})$$

Let us now denote with ϑ the probability to become disabled. Starting from the initial disability rates referring to the year t_0, we may write:

$$\vartheta_{t_0,x,s} = \frac{D_{t_0,x,s}}{\underbrace{B_{t_0-1,x-1,s}\ (1-\delta_{t_0,x-1,s})\ (1-\pi_{t_0-1,x-1,s})}_{\substack{non-disabled\ population\ of\ age\ x-1\ in\ year\ t_0-1\ still\ alive \\ in\ year\ t_0}}} =$$

$$= \frac{B_{t_0,x,s}\left(\delta_{t_0,x,s} - \delta_{t_0,x-1,s}\right)}{B_{t_0,x,s}\left(1-\delta_{t_0,x-1,s}\right)} = \frac{\left(\delta_{t_0,x,s} - \delta_{t_0,x-1,s}\right)}{\left(1-\delta_{t_0,x-1,s}\right)} \tag{15}$$

Under the dynamic equilibrium methodology (*DE*), the basic assumption is that $\vartheta^{DE}_{t,x,s} = \vartheta_{t_0,x-g_t,s}$, where g_t measures the difference in life expectancy between the year t and the year t_0.[18] According to the equation (15), we may write:

$$\vartheta^{DE}_{t,x,s} = \frac{D_{t_0,x-g_t,s}}{B_{t_0-1,x-g_t-1,s}(1-\delta_{t_0,x-g_t-1,s})(1-\pi_{t_0,x-g_t-1,s})} = \frac{B_{t_0,x-g_t,s}(\delta_{t_0,x-g_t} - \delta_{t_0,x-g_t-1,s})}{B_{t_0,x-g_t,s}(1-\delta_{t_0,x-g_t-1,s})} =$$

$$= \frac{(\delta_{t_0,x-g_t,s} - \delta_{t_0,x-g_t-1,s})}{(1-\delta_{t_0,x-g_t-1,s})}$$

---

17 According to the equation (11), assuming a differential in the probabilities of death of the disabled would result in a compensating change in the number of those becoming disabled within the year (D), without significantly affecting the results.

18 Since such a difference normally presents a decimal digit, a linear interpolation needs to be applied as in the equation (9) of paragraph 4.1 which, for the sake of simplicity, has been omitted in this context.

Hence, rearranging the equation (11), we have:

$$P_{t,x,s}^{DE} = P_{t-1,x-1,s}^{DE}(1-\pi_{t-1,x-1,s}) + D_{t,x,s}^{DE} =$$
$$= P_{t-1,x-1,s}^{DE}(1-\pi_{t-1,x-1,s}) + B_{t,x,s}(1-\delta_{t-1,x-1,s}^{DE})\frac{\delta_{t0,x-g_t,s}-\delta_{t0,x-g_t-1,s}}{1-\delta_{t0,x-g_t-1,s}}$$

and, in terms of population:

$$\delta_{t,x,s}^{DE} = \delta_{t-1,x-1,s}^{DE} + (1-\delta_{t-1,x-1,s}^{DE})\frac{(\delta_{t0,x-g_t,s}-\delta_{t0,x-g_t-1,s})}{(1-\delta_{t0,x-g_t-1,s})} \tag{16}$$

Since the equation (16) is valid for both genders and considering that the year/age progression overlaps as they both proceed at the same pace, for the sake of simplicity, we may assume:

$$\delta_{t,x,s}^{DE} = y_n, \quad \delta_{t0,x-n,s} = y_0 \quad \text{and} \quad \frac{(\delta_{t0,x-g_t,s}-\delta_{t0,x-g_t-1,s})}{(1-\delta_{t0,x-g_t-1,s})} = \alpha_{n-1}$$

Consequently, equation (16) becomes:

$$y_n = y_{n-1} + (1-y_{n-1})\,\alpha_{n-1} = (1-\alpha_{n-1})\,y_{n-1} + \alpha_{n-1} \tag{17}$$

Since:

$$y_n = (1-\alpha_{n-1})\,y_{n-1} + \alpha_{n-1}$$
$$y_{n-1} = (1-\alpha_{n-2})\,y_{n-2} + \alpha_{n-2}$$
$$\dots\dots\dots\dots\dots\dots$$
$$y_2 = (1-\alpha_1)\,y_1 + \alpha_1$$
$$y_1 = (1-\alpha_0)\,y_0 + \alpha_0$$

equation (17) may be rewritten as follows:

$$y_n = (1-\alpha_{n-1})(1-\alpha_{n-2})\dots(1-\alpha_0)\,y_0 + (1-\alpha_{n-1})(1-\alpha_{n-2})\dots(1-\alpha_1)\,\alpha_0 +$$
$$+ (1-\alpha_{n-1})(1-\alpha_{n-2})\dots(1-\alpha_2)\,\alpha_1 + \dots\dots + (1-\alpha_{n-1})(1-\alpha_{n-2})\,\alpha_{n-3} + (1-\alpha_{n-1})\,\alpha_{n-2} + \alpha_{n-1}$$

and, finally:

$$y_n = \lambda_n\, y_0 \quad + \beta_n \tag{18}$$

where:

$$\lambda_n = \prod_{i=1}^{n}(1-\alpha_{n-i})$$

and

$$\beta_n = \begin{cases} \alpha_0 & n=1 \\ (1-\alpha_1)\,\alpha_0 + \alpha_1 & n=2 \\ \sum_{j=0}^{n-2} \alpha_j \prod_{i=1}^{n-j-1} (1-\alpha_{n-i}) + \alpha_{n-1} & \forall n > 2 \end{cases}$$

Equation (18) shows a linear link between the disability rate in the year *n* and that in the base year. However, it can be seen that the coefficients of the line vary through time according to life expectancy changes. In case of no change in life expectancy were assumed, disability rates would remain unchanged compared to the base year.

4.3 The new methodological approach versus the traditional one

At this point, it would be interesting to compare the new methodological approach with the traditional one in terms of the evolution of disability rates at a given age. In other words, the comparison concerns the curves resulting from the equation (18) and those calculated according to the equation (9) of paragraph 4.1.

The age profiles of disability rate utilised for this purpose have been estimated on the basis of the attendance allowances ("*indennità di accompagnamento*") database which includes all recipients of this kind of provision. This makes the estimate of disability rates significant by individual age amongst the very elderly. The latter is extremely important to test different approaches for implementing the dynamic equilibrium methodology in projecting models. Nevertheless, the attendance allowances may be considered representative of disability condition overall the country insofar as they are i) provided to disabled, blind and deaf people depending on physical and mental impairments; ii) acknowledged only on the basis of medical tests regardless of income (non means-tested). However, since the entitlements of the attendance allowances are based on institutional settings, the disability rates estimated on them may not be utilised for cross country comparisons.

The results in terms of disability rate projections, obtained by applying equation (18), are shown in Figure 4. Four specific ages have been selected: 70, 75, 80 and 85 which are significantly affected by changes in mortality rates. As shown in the graphs, the assumptions on life expectancies underlying ISTAT demographic projection[19] implies a reduction of disability rates by about 30 per cent, for females, and 20 per cent for males. More specifically, at age 80, the reduction accounts, respectively, for 4 percentage points (from 12 per cent of 2010 to 8 per cent of 2050) and 2 percentage points (from 8.6 to 6.6 per cent).

Furthermore, the comparison between the solid and the dotted lines allows us to assess the differences brought about by the traditional and the new proposed methodology to take account of the dynamic equilibrium theory (Figures 4a and 4b). As can be seen, the containment effect is more o less equivalent at the end of the forecasting period, where disability rates nearly overlap,

[19] ISTAT (2005). For details see paragraph 6.3.

while in the transitional phase the curve corresponding to the new proposed methodology settles above that of the old one, as expected (see paragraph 4.1).

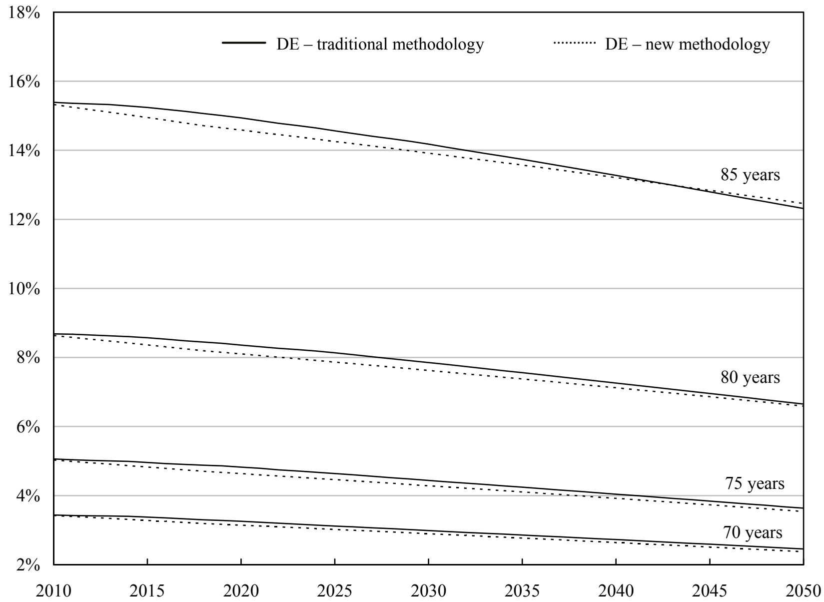
Figures 4c and 4d allow us to assess, for males and females, how relevant the adoption of cohort life expectancies may be, instead of cross section ones. From the comparison seems to emerge that the choice of either does not make much difference, in terms of disability rate projections. In fact, the dotted lines, corresponding to cohort life expectancies, settles just above those referring to cross section ones. However, this issue needs to be further investigated if only because the probabilities of death beyond 2050, necessary to calculate cohort life expectancies, are not available and they have been estimated just for the current purpose by extrapolating the cohort changes in the last year of the forecasting period.

Another important indicator to assess the relevance of the dynamic equilibrium methodology in curbing the increase of health and LTC expenditure due to ageing, is the average disability rate obtained

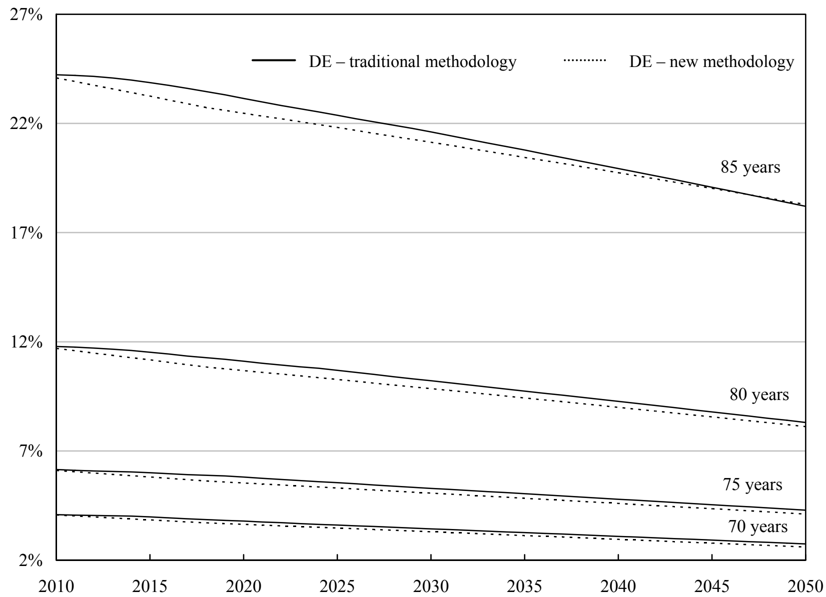
Figure 4

Projecting the Disablity Rate for Different Ages – New and Traditional Dynamic Equilibrium (DE) Methodologies under Cross Section and Cohort Definitions of Life Expectancy (LE)(1)

a) Cross Section LE – Males



b) Cross Section LE – Females

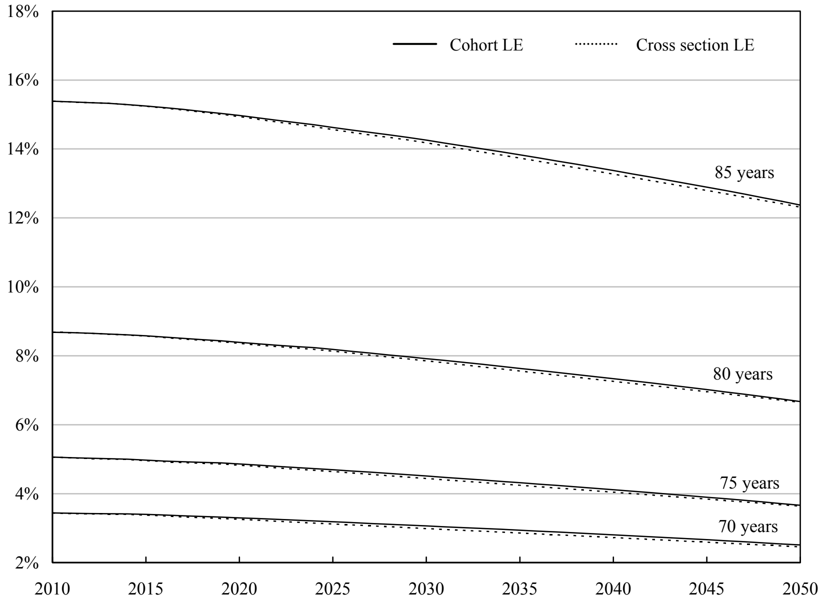


Source: Demographic scenario: ISTAT (2005), main variant, base year: 2005.

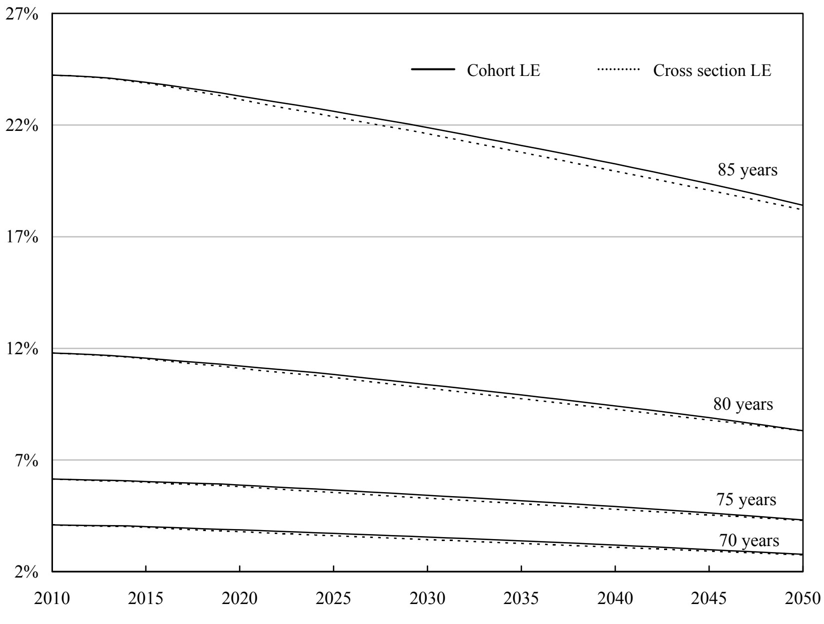
Figure 4 (continued)

Projecting the Disablity Rate for Different Ages – New and Traditional Dynamic Equilibrium (DE) Methodologies under Cross Section and Cohort Definitions of Life Expectancy (LE)[(1)]

c) DE New Methodology – Males



d) DE New Methodology – Females



Source: Demographic scenario: ISTAT (2005), main variant, base year: 2005.

dividing the projected number of the disabled (or recipients) by the corresponding population. The results, for males and females, are reported in Figure 5.

It can be seen that the implementation of the dynamic equilibrium contains the increase in the average disability rate, projected according to the *pure ageing scenario*, by more than one-third, which more or less corresponds to three-fifth of the effect of ageing due to changes in life expectancy alone.

As for the comparison between the two methodological approaches to embody the dynamic equilibrium theory in a forecasting model, the differences shown in Figure 5 confirm the indications emerged from the analysis of disability rates related to specific ages, reported above. So is for the implications of the two possible life expectancy definitions, the results of which are reported in Figure 6.

Finally, the curves in Figure 7 highlight the overall effect brought about by the new methodological approach together with the application of changes in the cohort life expectancies. As expected, the total effect can be described as the sum of the individual ones.

5 Technological progress

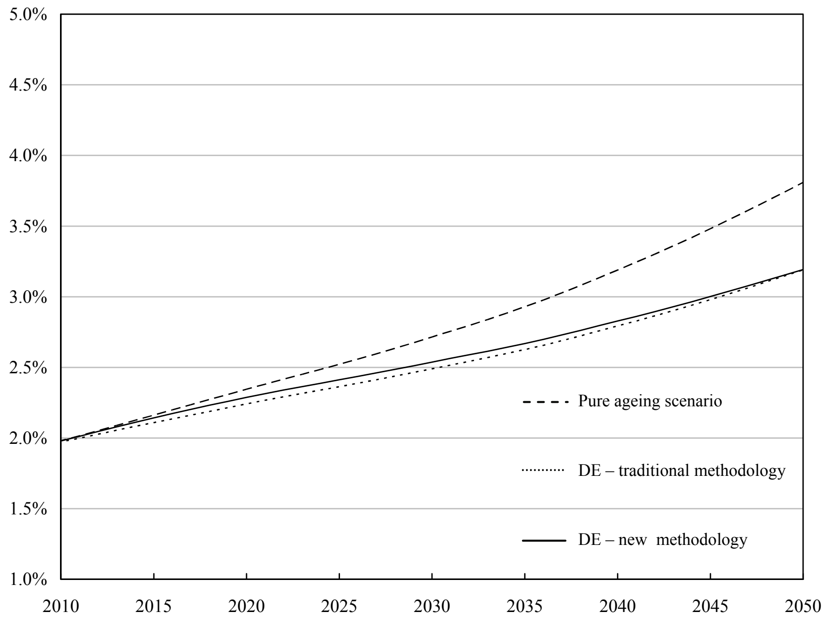
Amongst the non-demographic drivers of the health-care dynamics, particular attention has been paid to the effects brought about by the technological progress. However, notwithstanding the efforts made by the scholars and researchers, the literature on the subject has not come to conclusive results yet, either in terms of the magnitude or even the sign of the financial effects. This is certainly due to difficulties of finding suitable indicators able to approximate the evolution of technological progress and its impact to the health-care expenditure.

Besides, also from the theoretical point of view, the argumentations about the financial effects of technological progress are controversial. On the one hand it is argued that introducing more sophisticated devises and more effective medical treatments may cause a reduction in the health-care expenditure. On the other hand, the demand for increasingly stronger and innovative medical treatments may

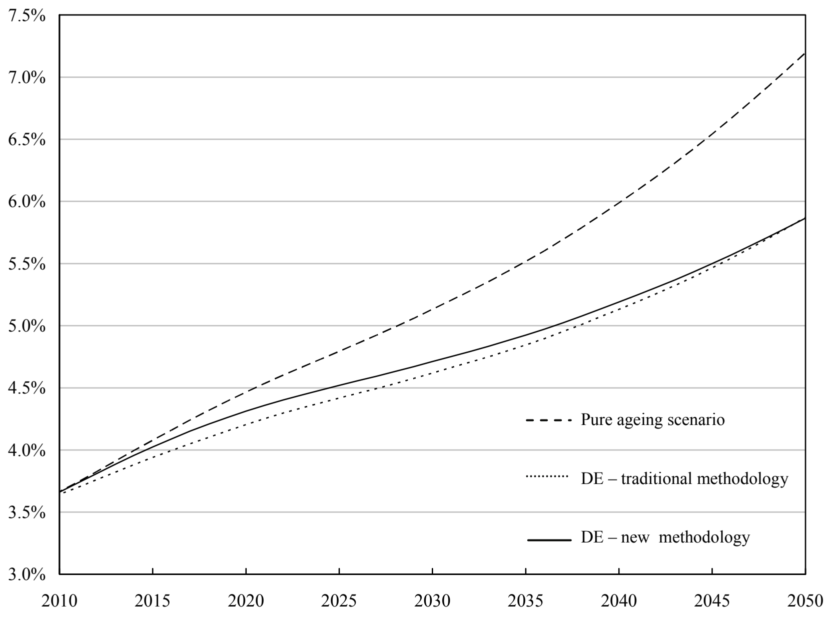
Figure 5

Projecting the Average Disability Rate – A Comparison between *Pure Ageing Scenario* and *Dynamic Equilibrium* (DE) Methodologies(1)

a) Cross Section Life Expectancy – Males



b) Cross Section Life Expectancy – Females

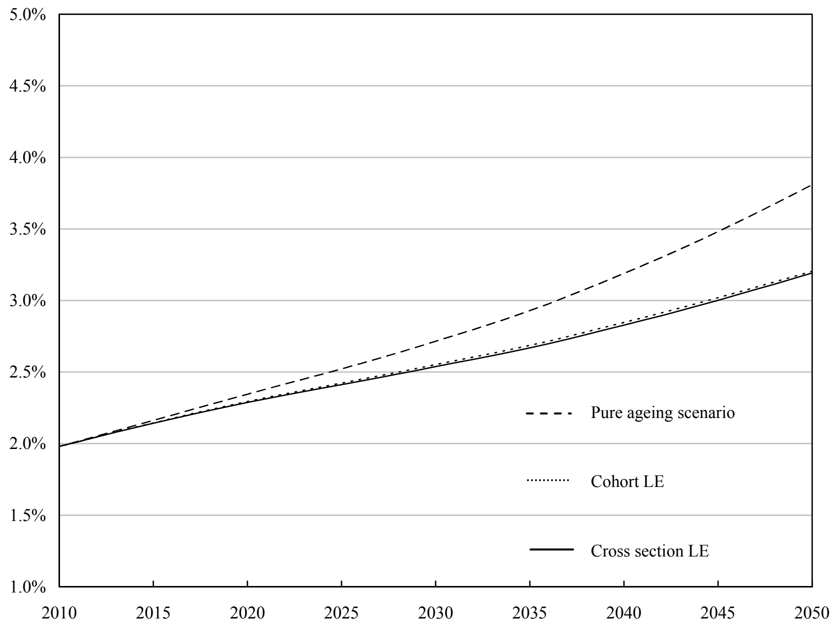


Source: Demographic scenario: ISTAT (2005), main variant, base year: 2005.

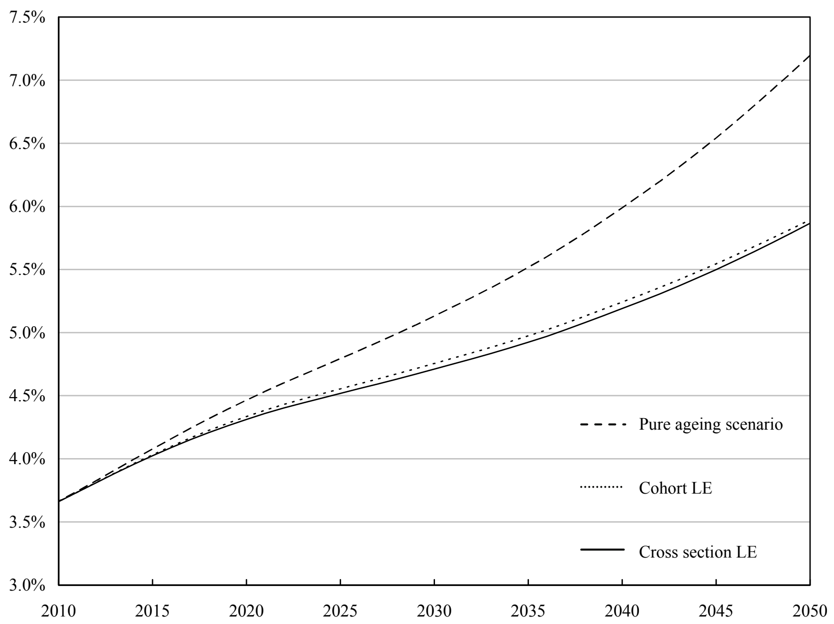
Figure 6

Projecting the Average Disability Rate – A Comparison between Cross Section and Cohort Life Expectancies (LE)(1)

a) New Dynamic Equilibrium Methodology – Males



b) New Dynamic Equilibrium Methodology – Females



Source: Demographic scenario: ISTAT (2005), main variant, base year: 2005.

compensate for, or even, overcome savings effects brought about by the stepping up of efficiency and effectiveness.

Despite the lack of reliable data, and then the possibility to carry out robust empirical analysis, a rather heated debate has recently taken place over the inclusion of technological progress amongst the main drivers in projecting health-care expenditure, especially at an international level. In this context, it is worthwhile pointing out the attention the OECD has paid to the subject, mainly in the ambit of mid-long term forecasting activities of social expenditure.

More specifically, OECD has developed a forecasting methodology including the technological progress amongst the health-care expenditure drivers. According to this methodological approach, the growth rate of health-care expenditure has been interpreted as explained by three driving forces: i) the "demographic" factor, which measures the impact to health-care expenditure due to changes in the population structure by age and sex; ii) the "income" factor, which measures the impact of demand to the dynamics of per capita health-care expenditure, set equal to GDP per capita (unit elasticity), iii) the "residual" factor, which, as such, expresses the effects brought about by all the factors other than the previous ones.

The methodology proposed by OECD hinges upon the assumption that an estimate of the residual component may be interpreted as a good indicator of the technological progress contribution to the dynamics of health-care expenditure. Consequently, the explanatory capacity of this component, estimated through an econometric model applied to most of the OECD countries, has been embodied in a mid-long term forecasting model.[20] Table 1 reports the estimates of the three explanatory factors of health-care expenditure mentioned above.

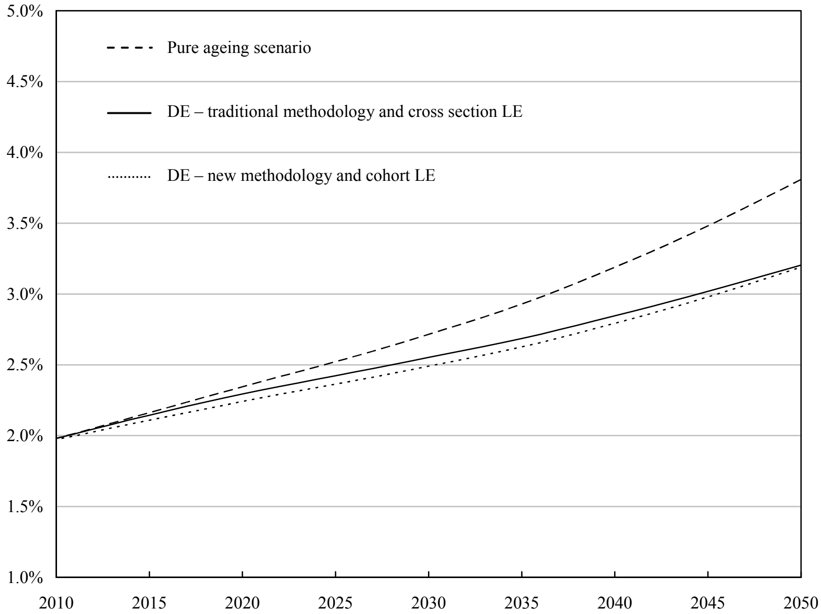
However, such a methodological approach presents a few shortcomings which render its implementation not entirely appropriate in a mid-long term projection model.

The major criticism is to be found in the basic assumption

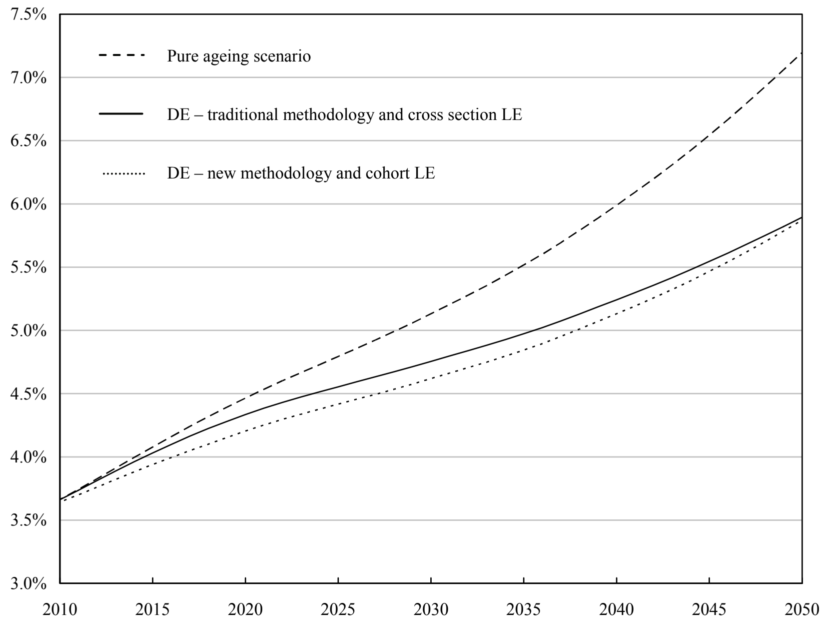
Figure 7

Projecting the Average Disability Rate – A Comparison between *Dynamic Equilibrium* (DE) Methodologies and Life Expectancy (LE) Definitions(1)

a) Males



b) Females



[20] OECD (2006a).

Source: Demographic scenario: ISTAT (2005), main variant, base year: 2005.

Table 1

Decomposing Growth in Public Health Spending,[1] 1981-2002[2]

	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 (1991-2001)	1.5	0.3	2.8	–1.5
Iceland	3.5	0.1	1.5	1.9
Irland	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 Zeland	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.

according to which the explanatory capacity of the residual component may be interpreted as completely attributable to the effect brought about by the technological progress. In fact, the residual component, by definition, cannot but measure the effects due to all the variables other than those explicitly considered as explanatory ones in the econometric model. Amongst the missing variables affecting the residuals, the most relevant ones are represented by health-care policies in the public sector which bear no relation to the technological progress and may vary significantly through time and from country to country. This fact explains the great variability of the explanatory capacity of the residual component estimated for different countries (for some of them it is even largely negative) and its declining trend through time for most of them (see Table 1).[21]

Besides, assuming an elasticity of the unit cost to GDP per capita equal to one represents an *a priori* constraint which automatically attributes to the residual component the possible effect caused by an elasticity actually higher than unity.

Apart from the great degree of arbitrariness in the choice of both the observation period and the countries to be considered for estimating the parameters of the model, the projected effects attributable to the technological progress would be qualitatively diverse in terms of policy implications compared to those stemming from ageing, according to the reasoning reported in paragraph 2.

Based on the previous considerations, the technological progress has not been taken on board, as health-care expenditure driver, either at the national level by the RGS model or at the European level within the EPC-WGA, at least as far as the "reference" scenario is concerned.

6 Health and LTC expenditure projections made by RGS

6.1 Health and LTC expenditure in Italy: definition

As far as Italy is concerned, the health-care expenditure definition utilized for mid-long term projections is that provided by National Accounts. In 2006 the aggregate accounted for 6.7 percentage points of GDP, of which nearly a half percent due to the hospital expenditure component.

Public expenditure for care of dependent people owing to old age and disability, better known as public expenditure on LTC, includes three components: i) the health component of LTC expenditure, already included in the health-care expenditure definition; ii) the costs of cash benefits (attendance allowances); iii) the expenditure on "other LTC provisions". The overall expenditure, which accounted for 1.6 percentage points of GDP in 2006, refers to all provisions regardless of the age of recipients.

However, considering that the incidence of dependency is strongly linked to age and that the part of the expenditure most exposed to ageing is that referring to the elderly population, the definition of LTC expenditure is sometimes limited to recipients of 65 and over. In this case, the expenditure for LTC would be reduced by about one-third. The break-down by component, macro-function, and age bracket (above and below 65) is reported in Table 2.

The health component of LTC expenditure is defined on the basis of the SHA (System of Health Accounts) of the OECD and the guidelines agreed in the ambit of the EPC-WGA. On the basis of these indications, reaffirmed on the occasion of the 2006-update of EPC-WGA projections,

[21] In fact, the shorter the observation period considered the lower the explanatory capacity of the residual component.

Table 2

Public Expenditure for Long-term Care (LTC) – Italy, 2006

	Totale	**[65+]**
Components		
LTC health component	0.8%	0.5%
Attendance allowances	0.7%	0.5%
Other LTC provisions	0.1%	0.1%
Total	1.6%	1.1%
Macro-functions		
LTC - *At home*	0.5%	0.3%
LTC - *In institutions*	0.4%	0.3%
LTC - *Cash benifits*	0.7%	0.5%
Total	1.6%	1.1%

the health-care services of LTC constitute a set of provisions complementary to the acute component of health-care ones, and this excludes any possibility of defining an intermediate heading, gathering together those items which cannot be univocally assigned.[22]

The other two components of LTC constitute social expenditure items, the forecast of which was first made in 2005. In particular, the attendance allowances ("indennità di accompagnamento") are cash benefits provided to dependent people without means testing.Differently, "other LTC services" component includes a heterogeneous group of benefits, largely in kind, mainly provided at local level by municipalities. These are generally means-tested.

6.2 Assumptions on health and LTC consumption

The projection of the ratio of public health and LTC care expenditures to GDP has been carried out on the basis of the methodological indications agreed within the EPC-WGA. In this regard, the base assumption concerning health and LTC care consumption – which has been adopted since 2001[23] – envisages that the consumption profile by age, sex and typology of provision is to be kept constant throughout the whole forecasting period, while the standardised per capita consumption (CPS)[24] is to evolve in line with GDP per capita. As explained in paragraph 2, such a methodological approach is labelled as "*pure ageing scenario*" insofar as it makes changes in the ratio of health and LTC care expenditure to GDP depend exclusively on the alterations to the demographic structure.

However, considering the existence of drivers other than purely demographic ones, alternative assumptions on health-care consumption have also been analysed, which take into account: i) the improvement of health status related to the projected increase in life expectancy;

[22] In particular, some kind of services like supplementary care services, prostheses care, care for drug addicts and alcoholics, and psychiatric care surely present some peculiarities with respect to typical LTC provisions (residential, semi-residential and home care). However, in the lack of analytical data and in view of the new methodological criteria to be adopted within the EPC-WGA for the third round of projections, the headings mentioned above have been attached to the LTC component.

[23] See Economic Policy Committee (2001).

[24] For a definition, see paragraph 2.

ii) the differences in price indexes referring to goods and services in the health and non-health care sectors, also depending on the diverse technological content; iii) the leading effect on health and LTC costs which arises from the compensation of labour factor. These different assumptions are suitably combined with each other according to the indications agreed within the EPC-WGA.[25]

The combination of the alternative assumptions, which is labelled as the "reference scenario" envisages: i) the application of "*death-related costs*" methodology to the hospital component of health-care expenditure;[26] ii) the "partial" application (50 per cent of changes in life expectancy) of "*dynamic equilibrium*" methodology to the other health-care provisions;[27] iii) the elasticity of CPS to GDP per capita above unity, as far as the "acute" component of health-care expenditure is concerned; iv) the linkage of CPS to productivity per worker, with regards to the LTC component of health-care expenditure. It is worthwhile pointing out that the definition of the reference scenario actually implemented within the EPC-WGA differs from that illustrated above insofar as it extends the application of the dynamic equilibrium methodology also to the hospital component of health-care expenditure.[28]

Similarly to health-care expenditure projections, an alternative scenario has also been constructed for LTC expenditure, concerning the dynamics of consumption. In this case, the reference scenario assumes: i) the partial application (50 per cent of changes in life expectancy) of dynamic equilibrium methodology; ii) the linkage of CPS to productivity per worker.

In a partial departure from the methodological indications given above, the projections of health-care and LTC expenditures, for the period 2008-11, has been carried out separately for each single expenditure item on the basis of the available information coming from the monitoring activity concerning the public health-care sector.

6.3 *Results under the National baseline scenario*

The main features of the National baseline scenario may be summarised as follows.[29]

The demographic component embodies the hypotheses underlying the population projection produced by ISTAT, in 2005.[30] Such hypotheses foresee, for the period 2005-50: i) an increase in the fertility rate from 1.3 to 1.6; ii) a rise in life expectancy of 6.2 years for males and 5.5 years for females; iii) a net migration flow of 150 thousand per year.

The macroeconomic scenario assumptions confirm the increasing profile of the growth rate of productivity which converges on about 1.8 per cent in 2026 and remains unchanged thereafter. Over the whole forecasting period the average productivity growth settles at an annual rate of 1.6-1.7 per cent.

As far as the labour market is concerned, the unemployment rate moves gradually to the level of 4.5 per cent in 2050. At the same date the participation rate in the 15-64 age bracket settles

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25 These assumptions have been firstly analysed individually. For the results, see Ministero dell'economia e delle Finanze – RGS (2007), chapters 3 and 4.

26 The methodology actually applied is that described in paragraph 3.1.

27 Such a methodology has been applied according to the traditional approach, as described in paragraph 4.1

28 This choice was made necessary since most member states had not provided the data required for death-related costs methodology to be applied.

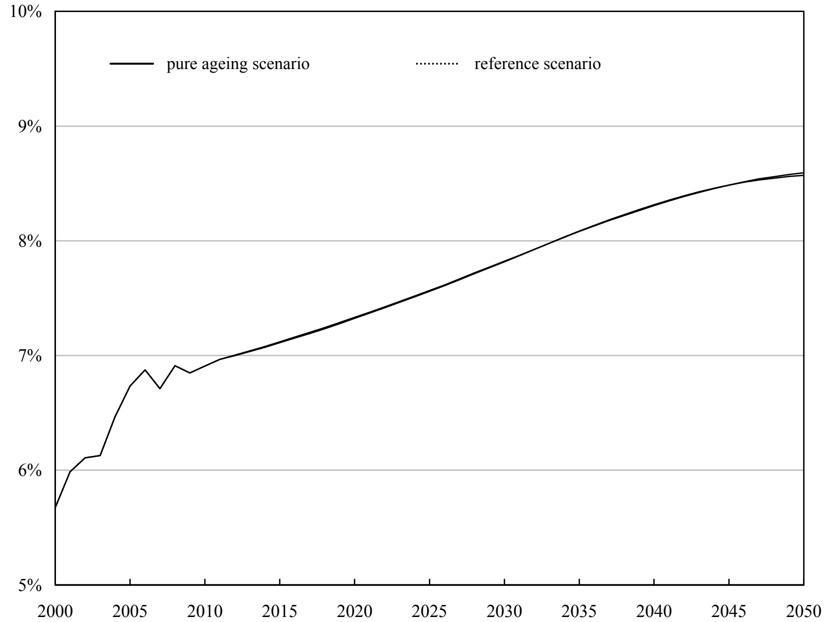
29 For more details, see Ministero dell'economia e delle Finanze – RGS (2007), chapter 2.

30 ISTAT (2005).

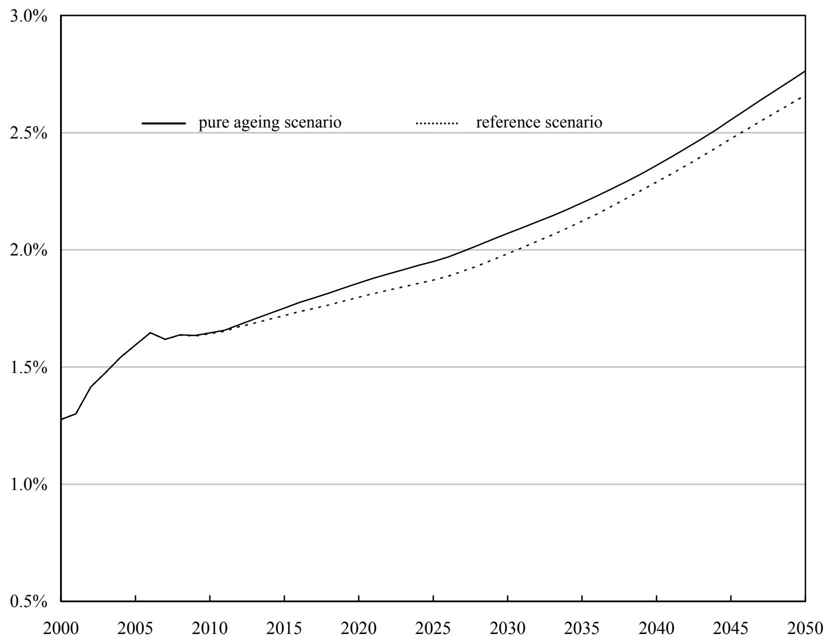
Figure 8

Public Expenditure for Health and Long-term Care – National Baseline Scenario
(percent of GDP)

a) Public Health Care Expenditure



b) Public Long-term Care Expenditure



at 71 per cent, with an increase of around 8 percentage points compared to the level in 2006. Correspondingly, the employment rate passes from 58.4 in 2006 to 67.7 per cent in 2050.

On the basis of the demographic and macroeconomic assumptions mentioned above, the real growth rate of GDP settles, on average, at an annual figure of around 1.4-1.5 per cent for the entire forecasting period, with a fluctuating profile showing an initial increase up to 2020, a subsequent decrease in the following 20 years and a slight recovery in the final decade.

In the short term, *i.e.*, the four-year period covered by the Economic and Finantial Planning Document for the period 2008-11 (Documento di Programmazione Economica e Finanziaria – DPEF), macroeconomic assumptions have been devised consistently with the average dynamics registered during the last 15-20 years. However for the 2007-update of the model, the resulting GDP growth rate is substantially in line with the macroeconomic indications underlying the Forecasting and Planning Report

(Relazione Previsionale e Programmatica) for 2008.

The projection of the ratio between public health-care expenditure and GDP (Figure 8a) based on the pure ageing scenario methodology (solid curve) shows a more or less regular growth until 2035. Only in the final fifteen years does the growth rate drop off slightly as a result of the death of the baby boom generations. In the whole forecasting period the ratio increases by about 1.7 percentage points, passing from 6.9 in 2005 to 8.6 per cent in 2050.

The projection consistent with the reference scenario (dotted line) almost overlaps that based on the pure ageing scenario throughout the whole forecasting period. This is due to the nearly complete compensation between the containing effects brought about by the assumptions on dynamic profiles of health-care consumption and the increasing effects stemming from the hypotheses on CPS evolution.

According to the pure ageing scenario, the features of which have been illustrated in paragraph 2, the projection of public

Figure 8 (continued)

Public Expenditure for Health and Long term Care – National Baseline Scenario
(percent of GDP)

c) Public Health and Long-term Care Expenditure

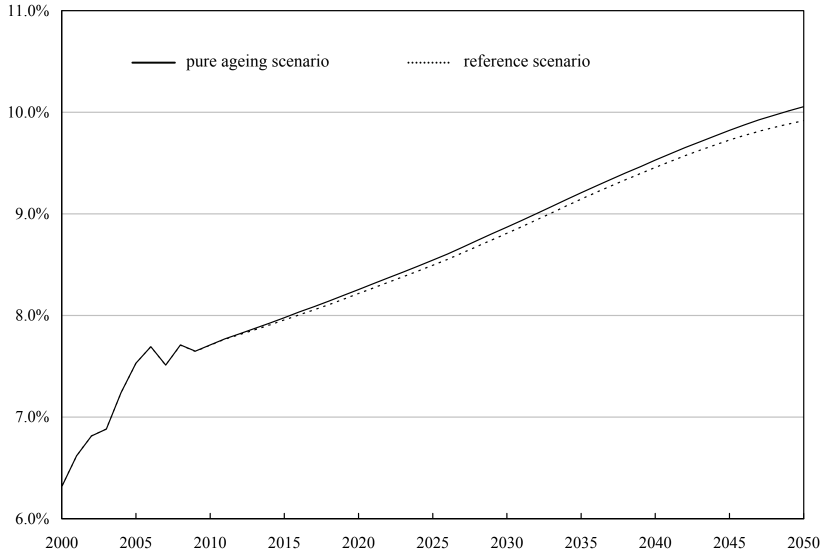
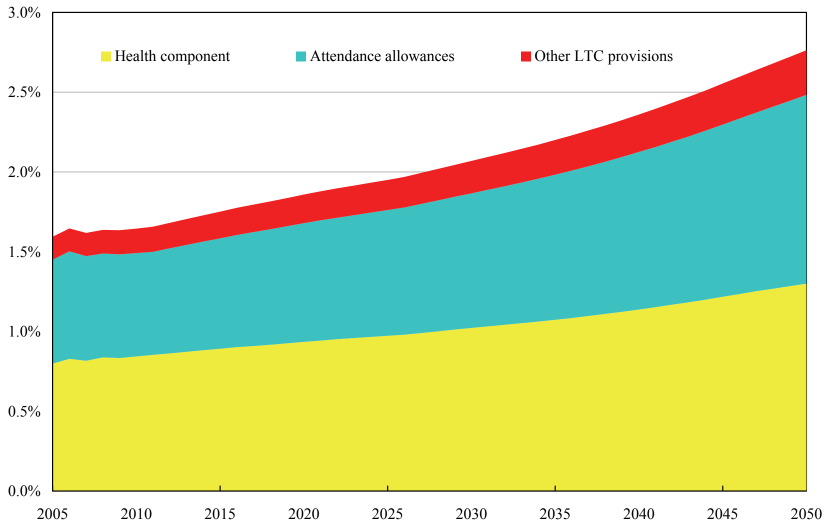


Figure 9

Public Expenditure for Long-term Care – National Baseline Scenario[1]

a) Long-term Care Expenditure
(percent of GDP)

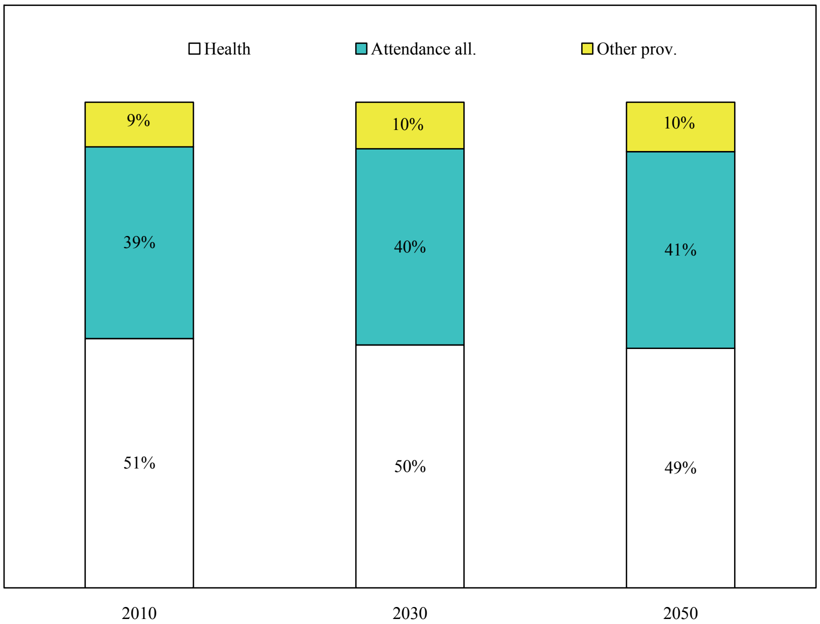


[1] Projections assume the hypotheses of pure ageing scenario.

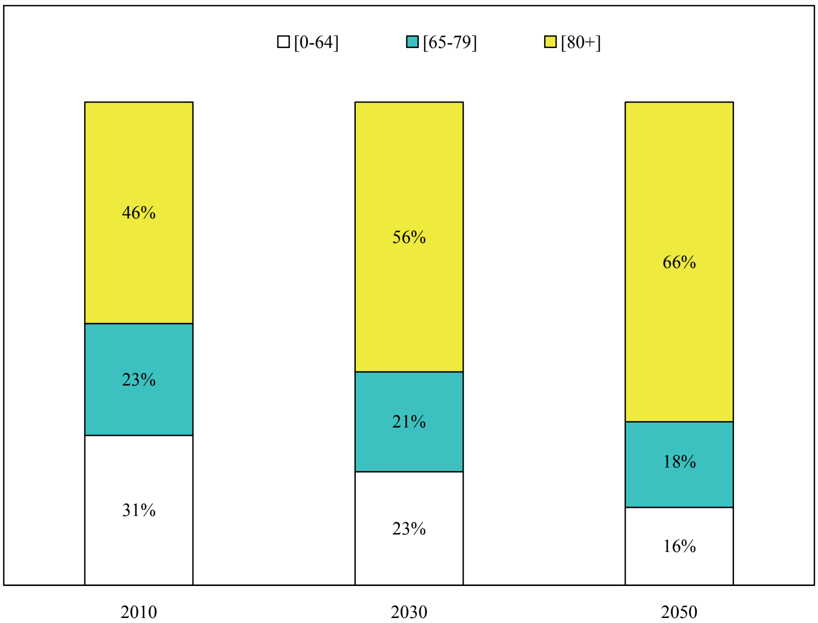
Figure 9 (continued)

Public Expenditure for Long-term Care – National Baseline Scenario[(1)]

b) Long-term Care Expenditure by Components



c) Long-term Care Expenditure by Age Brackets



[(1)] Projections assume the hypotheses of pure ageing scenario.

expenditure on LTC as a share of GDP remains substantially stable in the first five years of the forecasting period (Figure 8b, solid line). This is essentially due to the current indexation mechanism for attendance allowances. Successively, the hypothesis that such benefit will conform to the nominal dynamics of GDP per capita and the accentuated process of ageing cause an almost regular growth of the ratio, save a slight acceleration in the last decade. In the whole forecasting period, the ratio between expenditure on LTC and GDP passes from 1.6 in 2006 to 2.8 per cent in 2050. The break-down of the projection results by expenditure component and age bracket is reported in Figure 9.

Differently from health-care expenditure, the adoption of the reference scenario produces a slightly lower dynamics of LTC expenditure to GDP with a deviation of 0.1 percentage points at the end of the forecasting period (Figure 8b, dotted line).

The projection of total public expenditure for health and LTC, as a percentage of GDP, is reported in Figures 8c and 11b. As shown in the latter, the overall public expenditure for health and LTC counts the health component for LTC a single time, insofar as the latter is included in equal measure in total expenditure for both health care and LTC. The ratio shows a growth which reaches, in 2050, 10 per cent of GDP according with the pure ageing scenario (solid line) and 9.9 per cent of GDP under the reference scenario assumptions (dotted line).

6.4 Results under the EPC-WGA baseline scenario

The models utilised for the EPC-WGA projections are exactly the same as those adopted for the national ones. Any differences seen in the results are therefore solely due to the scenario hypotheses.[31]

The demographic and macroeconomic assumptions underlying the EPC-WGA baseline scenario have not undergone any significant revision compared to those agreed within the EPC-WGA in view of the second round of age-related expenditure projections.[32]

As far as the demographic parameters are concerned, the differences with the National baseline scenario do not seem particularly relevant. The EUROSTAT population projection ("*ad hoc* WGA" scenario) embodied in the EPC-WGA baseline scenario assumes a more contained increase both in life expectancy and fertility growth dynamics with respect to the ISTAT central scenario, whilst the net immigration flow is substantially the same. However, the differences in mortality and fertility rate hypotheses tend to balance each other out as regards effects on the elderly dependency ratio, which, at the close of the forecasting period, lies at 62.2 per cent in the EUROSTAT scenario and 62.6 per cent in that of ISTAT.

The differences are not especially relevant even regarding the variables in the macroeconomic scenario, particularly when referring to average values for the whole forecasting period. The growth rate of GDP is a little lower than that of the National baseline scenario, with a gap of 0.1-0.2 percentage points, due for around two-thirds to the different employment dynamics.

From the point of view of the temporal profile of economic growth, however, a greater misalignment may be noted. The difference in the average rate is the result of an algebraic balance between a slightly higher economic growth in the first years of the forecasting period, mainly due to a greater employment dynamics, and a lesser growth, of cumulatively greater dimensions, during the last decade. This latter depends, only in part, on the lower productivity growth in the EPC-WGA baseline scenario, which converges on 1.7 per cent in the second half of the forecasting period as against the 1.8 per cent of the National baseline scenario. The remainder of the difference may be explained by a more contained employment dynamic, consequent on the assumption of less favourable hypotheses regarding the revival in fertility rates and the increase in employment rates.

The results of the projections carried out according to the EPC-WGA baseline scenario are shown in Figure 10, in comparison with those based on the adoption of the national scenario. In both cases, projections refer to the adoption of the pure ageing scenario.

The ratio between health-care expenditure and GDP in the EPC-WGA baseline scenario settles at a level which is slightly lower than that of the National baseline one, although the gap shrinks towards the end of the forecasting period and becomes substantially nil in 2050

[31] Ministero dell'economia e delle finanze – RGS (2007)

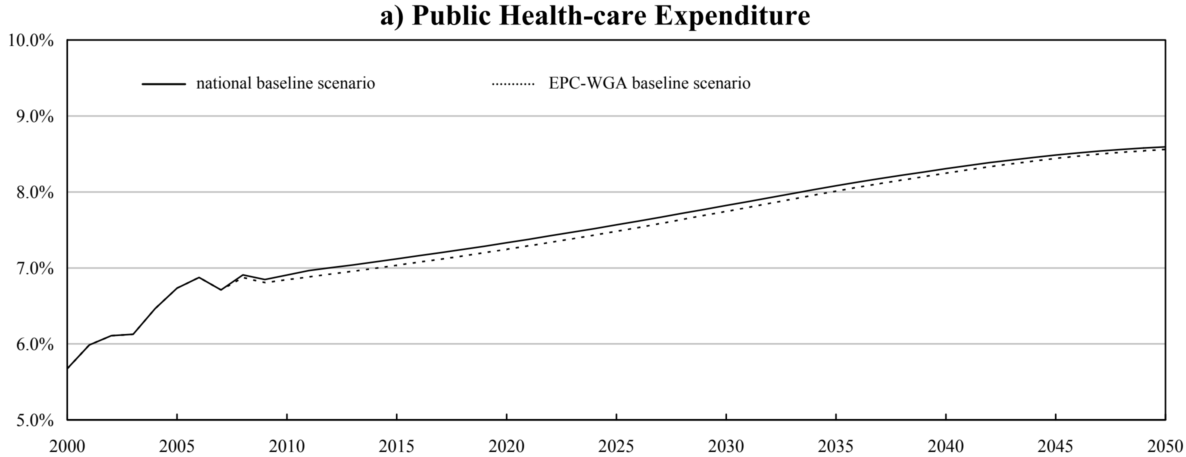
[32] See Economic Policy Commettee – European Commission (2006) and Ministero dell'economia e delle finanze – RGS (2007), chapter 2.

Figure 10

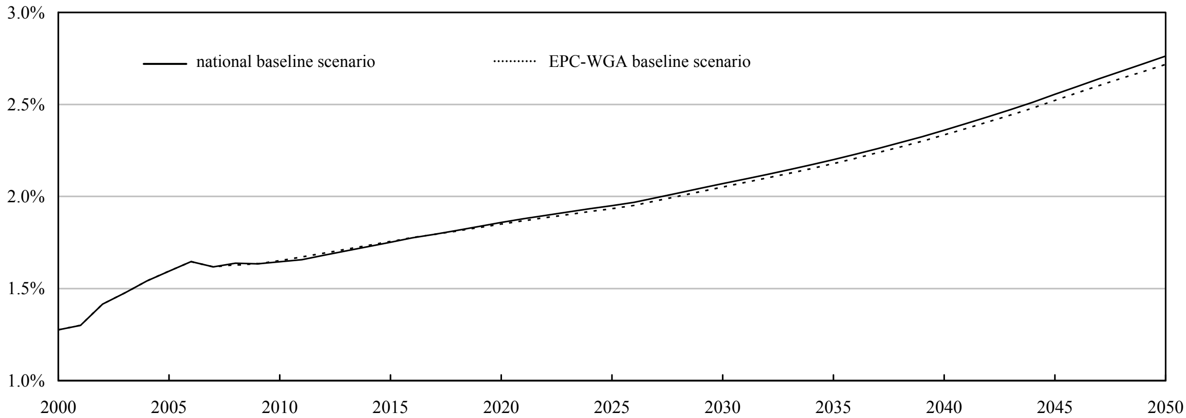
Public Expenditure for Health and Long-term Care – National and EPC-WGA Baseline Scenarios[(1)]

(percent of GDP)

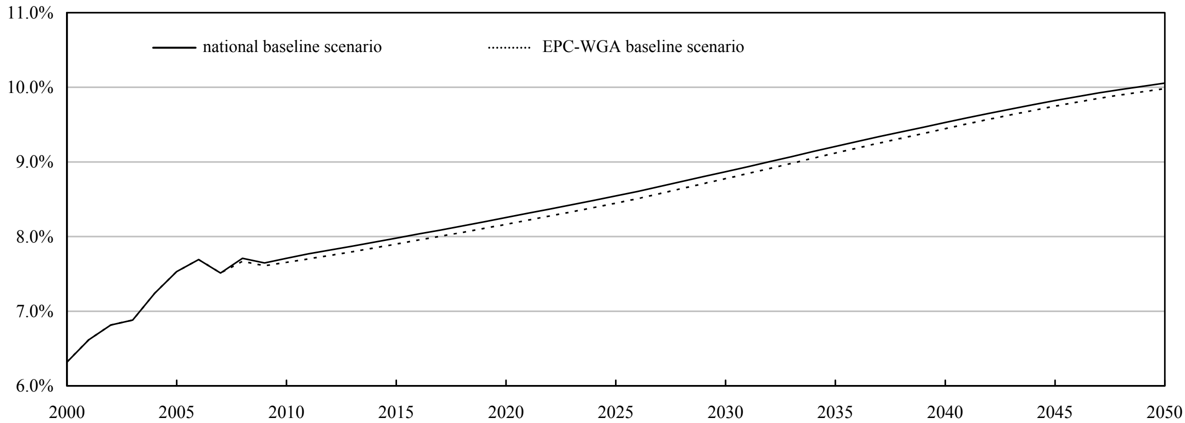
a) Public Health-care Expenditure



b) Public Long-term Care Expenditure



c) Public Health and Long-term Care Expenditure



[(1)] Projections assume the hypotheses of pure ageing scenario.

(Figure 10a). Such a difference is essentially accumulated during the first years of the forecasting period, owing to the diverse forecasting methodology applied in the National baseline scenario for the period covered by the DPEF. The slight shrinkage of the initial difference is explained by differences in demographic assumptions.

A substantially similar result is shown for the LTC component of public expenditure. Figure 10b demonstrates that the adoption of the EPC-WGA baseline scenario produces a projection of the LTC expenditure to GDP ratio almost overlapping that resulting from the National baseline scenario for the entire forecasting period. In this case, the scarce magnitude of the aggregate does not make for visible differences, which come about in the first years of the forecasting period for similar reasons to those mentioned for health expenditure.

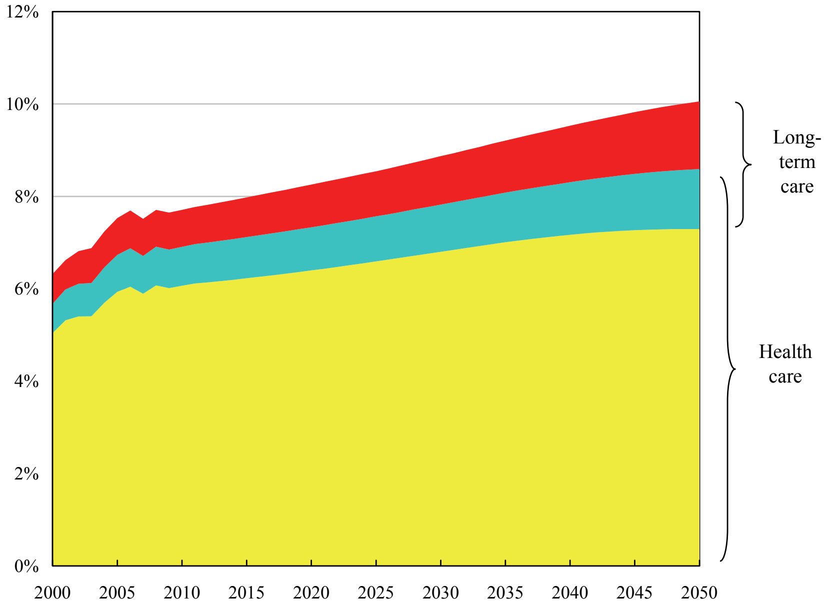
The projection results of the total public expenditure for health and LTC are reported in Figures 10c and 11b.

Figure 11

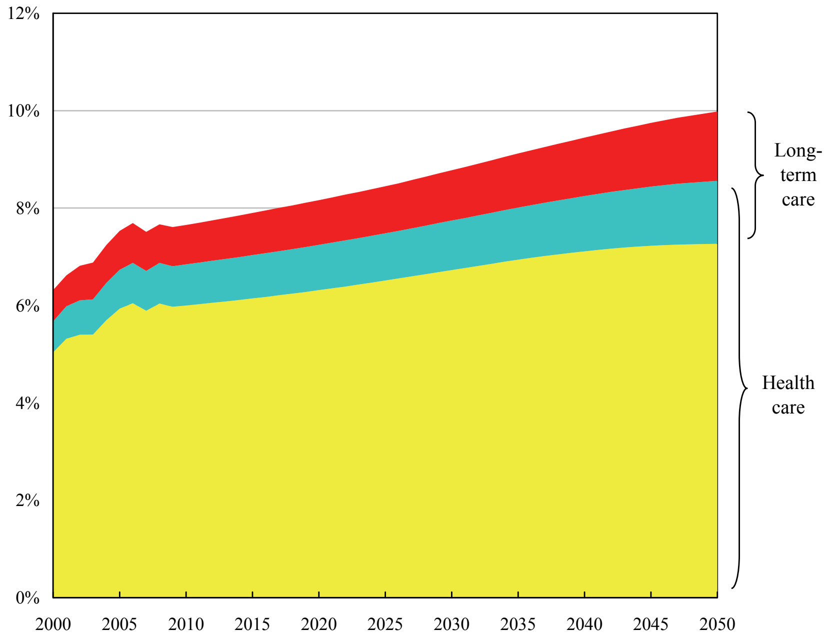
Public Expenditure for Health and Long-term Care – National and EPC-WGA Baseline Scenarios[1]

(percent of GDP)

a) National Baseline Scenario



b) EPC-WGA Baseline Scenario



[1] Projections assume the hypotheses of pure ageing scenario.

REFERENCES

Aprile, R. and M. Palombi (2006), "How to Take into Account Death-related Costs in Projecting Health Care Expenditure", *Genus*, No. 1.

Aprile, R. and A. Vestri (2006), "La spesa pubblica per long-term care in ambito EPC-WGA: definizione dell'aggregato, profili di spesa e dinamiche demografiche", paper presented at the AIES Conference *Sviluppo e sostenibilità dei sistemi sanitari: Dinamiche demografiche e ambientali*, Venice, November, 16-17. Web site: http://www.aiesweb.it/convegni/convegni.htm

Cislaghi, C., S. Forni and F. Tediosi (2002), "Hospital Expenditure as Function of the Distance from Birth and Death", paper presented at the *4th European Conference on Health Economics*, Université Paris V, Paris, July, 7-10.

Comas-Herrera, A., A. Di Maio, C. Gori and A. Pozzi (2003), "Description of the Italian Long-term Care Projection Model", in A. Comas-Herrera and R. Wittemberg (eds.), *European Study of Long Term Care Expenditure. Report to the European Commission*, Employment and Social Affairs DG, PSSRU, Discussion Paper, No. 1840.

Batljan, I. and M. Lagergren (2004), "Inpatient/Outpatient Health Care Costs and Remaining Years of Life – Effect of Decreasing Mortality on Future Acute Health Care Demand", *Social Science & Medicine*, No. 59, pp. 2459-66.

Breyer, F. and S. Felder (2004), "Life Expectancy and Health Care Expenditures in the 21st Century: A New Calculation for Germany Using the Costs of Dying", DIW Berlin, German Institute for Economic Research, Discussion Paper, No. 452.

Economic Policy Committee (2001), "Budgetary Challenges Posed by Ageing Populations. The Impact on Public Spending on Pensions, Health and Long Term Care for the Elderly and Possible Indicators of the Long Term Sustainability of Public Finances", EPC/ECFIN/655/01-EN final, Brussels, October.

―――――― (2003), "The Impact of Ageing Populations on Public Finances: Overview of Analysis Carried out at EU Level and Proposals for a Future Work Programme", EPC/ECFIN/435/03 final, Brussels, October, 22.

Economic Policy Committee – European Commission (2005), "The 2005 Projections of Age-related Expenditure (2004-2050) for the EU-25 Member States: Underlying Assumptions and Projection Methodologies", Special Report, No. 4/2005. Web site: http://europa.eu.int/comm/economy_finance/publications/european_economy/2005/eespecialreport0405_en.htm

―――――― (2006), "The Impact of Ageing on Public Expenditure: Projections for the EU-25 Member on Pensions, Health Care, Long-term Care, Education and Unemployment Transfers (2004-2050)", Special Report No. 1/2006. Web site: http://ec.europa.eu/economy_finance/epc/epc_sustainability_ageing_en.htm

European Commission – Working Group On Ageing, OECD (2005), "Understanding Trends in Disability among Elderly Populations and the Implications of Demographic and Non-demographic Factors for Future Health and Long-term Care Costs", workshop, Brussels, February, 21-22.

Fries, J.F. (2003), "Measuring and Monitoring Success in Compression of Morbidity", *Annals of Internal Medicine*, Vol. 139, pp. 455-59.

Gabriele, S., C. Cislaghi, F. Costantini, F. Innocenti, V. Lepore, F. Tediosi, M. Valerio and C. Zocchetti (2005), "Demographic Factors and Health Expenditure Profiles by Age: The Case of Italy", a deliverable for ENEPRI AHEAD (Ageing, Health Status and Determinants of Health Expenditure) project.

Gruenberg, E.M. (1977), "The Failure of Success", *Millbank Memorial Fund Quarterly*, Vol. 55, pp. 3-24.

Guralnik, J.M. (1991), "Prospects for the Compression of Morbidity: Evidence from the Alameda County Study", *Journal of Aging and Health*, Vol. 3, pp. 138-53.

ISAE (2005), *Finanza pubblica e redistribuzione*, ISAE Report, October.

ISTAT (2005), *Popolazione italiana al primo gennaio per sesso ed età. Anni 2005-2051*. Web site: http://demo.istat.it/altridati/previsioni_naz/tavola.xls

Jacobzone, S., E. Cambois and J.M. Robine (2000), "Is the Health of Older Persons in OECD Countries Improving Fast Enough to Compensate for Population Ageing?", OECD, Economic Studies, No. 30, 2000/I.

Jacobzone, S. (2001), "Healthy Ageing and the Challenges of New Technologies - Can OECD Social and Health Care System Provide for the Future?", proceedings of the workshop *Healthy Ageing and the Biotechnologies*, OECD and Japanese Ministry of Health, Labour and Welfare, Tokyo.

Lubitz, J.D. and G.F. Riley (1993), "Trends in Medicare Payment in the Last Year of Life", *New England Journal of Medicine*, Vol. 328, No. 15, pp. 1092-96.

Manton, K.G., E. Stallard and L. Corder (1995), "Changes in Morbidity and Chronic Disability in the U.S. Elderly Population: Evidence from the 1982, 1984 and 1989 National Long Term Care Surveys", *Journal of Gerontology: Social Sciences*, No. 50, No. 4, pp. S194-S204.

Miller, T. (2001), "Increasing Longevity and Medicare Expenditures", *Demography*, Vol. 38, No. 2, pp. 215-26.

Madsen, M. (2004), "Methodologies to Incorporate 'Death-related' Costs in Projections of Health and Long-term Care Based on Danish Data", Danish Ministry of Finance, note for the Ageing Working Group – Economic Policy Committee, November, 4.

Ministero dell'Economia e delle Finanze – RGS (2007), "Le tendenze di medio-lungo periodo del sistema pensionistico e sanitario. Previsioni elaborate con i modelli del Dipartimento della Ragioneria Generale dello Stato aggiornati al 2007", Report No. 9, December.

OECD (1998), *Maintaining Prosperity in an Ageing Society*, Paris, July.

—————(2000), *A System of Health Accounts, Version 1.0*.

————— (2003), "Spending on Health and Long-term Care: Projections to 2050 Revisited", *Ad hoc* Group on the OECD Health Project, SG/ADHOC/HEA(2003)3, March, 19.

————— (2004a), "Long-term Care for Older People", The OECD Health Project.

————— (2004b), "Estimating Expenditure on Long-term Care", Working Party on Social Policy, Health Policy Statistics, DELSA/ELSA/WP1/HS(2004)9. Web site: http://www.oecd.org/document/14/0,2340,en_2649_37407_33822862_1_1_1_37407,00.html

OECD (2005), "Projecting OECD Health and Long-term Care Expenditures: What Are the Main Drivers?", Working Party No. 1 on Macroeconomic and Structural Policy Analysis, ECO/CPE/WP1(2005)14.

——— (2006a), "The Drivers of Public Expenditure on Health and Long-term Care: An Integrated Approach", OECD, Economic Study, No. 43, 2006/2.

——— (2006b), "Costs of Care for Elderly Populations – Guidelines for Estimating Long-term Care Expenditure", Directorate for Employment, Labour and Social Affairs, DELSA/HEA/DIS(2006)4.

Olshansky, S.J., M.A. Rudberg, B.A. Carnes, C.K. Cassel and J.A. Brody (1991), "Trading off Longer Life for Worsening Health", *Journal of Aging and Health*, Vol. 3, pp. 194-216.

Polder, J. and P. Achterberg (2004), "Cost of Illness in the Netherlands", National Institute for Public Health and the Environment.

Przywara, B. (2005), "Projection of Expenditure on Health and Long-term Care at EU Level. Understanding Trends in Disability among Elderly Populations and the Implications of Demographic and Non-demographic Factors for Future Health and Long-term Care Costs", presented at the joint EU-OECD workshop, Brussels, February, 21-22.

Raitano, M. (2005), "The Impact of Death-related Costs on Health Care Expenditure: A Survey", a deliverable for ENEPRI AHEAD (Ageing, Health Status and Determinants of Health Expenditure) project (Work Package 7).

Robine, J.M., C. Jagger and H. Van Oyen (2005), "Interpreting National Evidence on the Evolution of Morbidity and Disability Prevalence over Time and Perspectives for Extended Healthy Life Expectancy", presented at the joint EU-OECD workshop, Brussels, February, 21-22.

Roos, N.P., P. Montgomery and L.L. Roos (1987), "Health Care Utilization in the Years Prior to Death", *The Milbank Quarterly*, No. 65, pp. 231-54.

Serup-Hansen, N., J. Wickstrom and I. Sonbo Kristiansen (2002), "Future Health Care Costs: Do Health Care Costs During the Last Year of Life Matter?", *Health Policy*, Vol. 62.

Seshamani, M. (2004), "The Impact of Ageing on Health Care Expenditures: Impending Crisis, or Misguided Concern?", Office of Health Economics.

Stearns, S. and E. Norton (2004), "Time to Include Time to Death? The Future of Health Care Expenditure Predictions", *Health Economics*, Vol. 13.

Van Vliet, R.C. and L.M. Lamers (1998), "The High Costs of Death: Should Health Plans Get Higher Payments when Members Die?", *Medical Care*, No. 36, pp. 1451-60.

Verbrugge, L.M. (1984), "Longer Life but Worsening Health? Trends in Health and Mortality of Middle-aged and Older Persons", *Millbank Memorial Fund Quarterly*, Vol. 62, pp. 475-519.

World Bank (1994), "Averting the Old Age Crisis: Policies to Project the Old and Promote Growth", New York, Oxford University Press.

Zweifel, P., S. Felder and M. Meiers (1999), "Ageing of Population and Health Care Expenditure: A Red Herring?", *Journal of Health Economics*, No. 8, pp. 485-96.