Intergenerational Solidarity of the Public Health Care Systems in Europe

Mezigenerační solidarita v systémech veřejného zdravotnictví v Evropě[1]

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Abstract

Ageing of the population has become one of the important topics in developed countries in recent times. Health care and pension systems based on solidarity are especially vulnerable to demographic changes associated with falling fertility rates and increasing life expectancy. The main task of the paper is to answer and quantify the question who bears the costs and who benefits from the public health care systems and reveal possible future imbalances. We introduce a long-term projection technique enhanced by some elements of generational accounting approach with intent to express the ageing problem in the health care sector. We explore both the revenue side of the public health care systems as well as the health care expenditures from the perspective of separate generations. Following countries have been selected as the representatives of the European health care systems: the Czech Republic, Denmark, Estonia, France, Italy, the Netherlands, Switzerland and the United Kingdom. The model points to un-sustainability of the current public health care systems if the effective tax rates did not increase. If the demand for health care had to be satisfied, the health care systems financed through social contributions and income-based taxes would be faced with increasing burden on working population.

Keywords

health care financing, sustainability, generational accounts, population ageing

JEL classification

E62, H51, I18

Abstrakt

Stárnutí obyvatelstva se stalo v poslední době jedním z důležitých témat v mnoha rozvinutých zemích. Důchodové systémy a systémy financování zdravotnictví založené na solidaritě jsou výrazně citlivé na demografické změny související s klesající porodností a rostoucí střední délkou života. Cílem tohoto článku je ukázat a vyčíslit možnou budoucí nerovnováhu v systémech financování veřejného zdravotnictví a prezentovat jej i z pohledu jednotlivých generací. Abychom lépe vyjádřili problém stárnutí obyvatelstva v systémech financování veřejného zdravotnictví, obohacujeme tak standardní přístup k dlouhodobým projekcím o prvky generačního účetnictví. Srovnání systémů napříč Evropou umožňuje výběr reprezentativních systémů financování zdravotnictví, a to České

1 *Award-winning essay of Prof. F. Vencovský 2009 Prize.*

republiky, Dánska, Estonska, Francie, Itálie, Nizozemí, Švýcarska a Velké Británie. Výsledek modelu ukazuje na neudržitelnost současných systémů financování. Má-li být poptávka po zdravotních službách uspokojena, budou systémy založené na veřejném zdravotním pojištění nebo na daních z příjmu klást rostoucí nároky na pracující populaci, a zvyšovat tak pnutí a požadavky na další redistribuci podmíněnou rostoucí daňovou zátěží, aby nedošlo k omezování zdravotních služeb. Míru ohrožení starší populace omezením poskytované zdravotní péče v jednotlivých letech a zemích vyjadřujeme indexem soběstačnosti, který ukazuje na některá rizika vybraných systémů.

Klíčová slova
financování zdravotnictví, udržitelnost, generační účty, stárnutí obyvatelstva

Introduction

Ageing of the population has become an important topic in developed countries in recent times. European health care and pension systems based on solidarity are especially vulnerable to demographic changes associated with falling fertility rates and increasing life expectancy. Even though new approaches to the modelling of health care sector expenditures predicting lower increases in ageing-related health care expenditure than previously assumed have emerged, health care systems will be affected by population ageing.

Modifying a long-term projection approach with some fragments of the generational accounting methodology, we explore the revenue side of public health care systems as well as the health care expenditure side from the perspective of separate generations. Due to an increasing dependency ratio, health care systems financed through social contributions and income-based taxes will be faced with an increasing burden on the working population if the demand for health care is to be satisfied. In the long term, however, health care expenditure will always tend to equal the revenues of the health care system. In other words, if revenues remain at current levels, some of the demand for health care will not be satisfied.

In order to represent the differences between the various systems of health care financing we have chosen eight representative countries from all over Europe. These countries are: Denmark, Estonia, France, Italy, the Netherlands, Switzerland, the United Kingdom and the Czech Republic.

The plan of this study is as follows. First of all, we briefly discuss economic implications of the phenomena known as ageing, which reflects most of major changes the study count with. Thereafter we continue with a detailed description of the long-term projection technique developed for the study and give the descriptive statistics of the main variables. The third part then summarises results and conclusion discusses the implications for policy-makers.

1 Ageing society and its basic economic implications

Ageing of the population may be characterised as a long-term process where the structure of the population changes due to falling fertility rates or increasing life expectancy or both, on condition that net migration does not contribute too extensively to reverse the

process. In such a population the group of elderly, i.e. people usually older than 64 years or even better those of retired from the economic point of view[2], considerably enlarges and becomes a significant social, economic and political unit.

The "graying" of the population in the developed part of the world is a result of three factors. First, post-war "baby boom" generation, i.e. generation born between 1946 and 1964, comprising now 25% (Eurostat, 2009) of the European population is approaching retirement age (Chamberlain and Prante, 2007), second, rising living standard and female labour force participation supported by higher education cause that families have decided to have fewer children which results in decline of the population growth rate (Day and Dowrick, 2004).[3] And last but not least, higher quality of health care, generous social systems guaranteeing substantial minimum living standard and environment without any serious war conflicts or environmental disasters, jointly contribute to longevity.

Turner et al. (1998) provides a number of main channels the ageing affects the macroeconomics through. First, changes in the labour force are supposed to be most directly involved by ageing as labour force is expected to shrink and change its structure. Second, increasing share of older workers could possibly have adverse effects on productivity since they might be "less dynamic and innovative". On the other hand, the labour shortage might work as an incentive to technological investments[4] and findings of new substitutes to scarce labour. Third, the "life-cycle" hypothesis reflects the influence on private saving behaviour. However, the effect is ambiguous as it may stem from lower fertility or greater life expectancy in the ageing process. "Under the life-cycle hypothesis, a rise in life expectancy would lead individuals to save more during their working years in order to maintain consumption over a longer retirement period, and so generate higher aggregate private savings. By contrast, a decline in population growth due to lower fertility would leave individual savings profiles unchanged, but lead to lower aggregate savings as the proportion of the low-saving elderly in the population increased…" (Turner et al., 1998, p. 12). Momentous changes in national savings might further influence flows of goods, services and capital amongst economies and thus contribute to exchange rate and balance of payments adjustments. The final channel is a frequent topic in nowadays academic and policy research studies – the pressure of ageing on public finance, the aspect we deal with in this study from the public financed and provided health care point of view. Higher pension and both acute health and long-term care[5] expenditures, possibly mitigated by lower educational costs, represent the main expenditure drivers, which, along with uncertain revenues, are challenging task for many researchers and policy-makers at the present time.

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2 In demographic perspective, the end of reproduction period of women is taken into account (usually age of 50).

3 Simultaneous influence of the effects of falling fertility and increasing longevity relates to a "double ageing".

4 Cutler's et al. (1990) evidence suggests that countries experience higher productivity growth if the labour force develops slower.

5 The term health care refers to the acute health and long-term care further in the text.

The gradually taking place ageing is likely to change demand for goods and services provided by both private and public sector (Denton and Spencer, 1998). The product and service structure is probable to be modified, some of them may disappear and others may have to be developed and introduced entirely new. And even if the effect of some of them is to appear in one, two or maybe three decades, it would be quite desirable to start preparing new capacities as soon as possible in order to be ready for different demand (in product market) and supply (in labour market) in every area of our life.

Ageing has far-reaching consequences associated with each of us. Changes in health and long-term care might represent only a small fraction, however a significant one.

2 Methodology

First of all we would like to point out that all calculations in the model are based on demographic and economic projections which more or less predetermine the results. Estimates of the future path of variables such as participation and unemployment rates, labour productivity growth, life expectancy and total fertility rates play an important role in the correctly calibrated model and its output. One should bear in mind that the results of such studies are not an accurate forecast of the future. Rather, they present the possible path stemming from the trend evolution of the projected variables and their mutual relationships. Furthermore, they are based on a so-called "no-policy-change scenario", which means that no future corrections and changes e.g. to tax bases, tax rates, transfer policies or any other policy measures are taken into account.

The basic approach we have used for long-term projections of the economic variables as well as the expenditures side of the public health care systems is the methodology of the Ageing Working Group of the European Commission (2008b). However the model is modified and augmented by the analysis of the revenues side of the healthcare systems as well as by some features of the generational accounting method.

The projection model is further augmented by some elements of generational accounting, a method originally developed by Auerbach et al. (1991) designed to evaluate and compare the burdens of current and future generations stemming from recent government policy. The method provides a very useful tool for public finance sustainability assessment of the present arrangements. The calculations are thus made for every age and gender cohort instead of approach per each year. Nevertheless, our technique allows us to calculate the outcomes retrospectively in the other way as well.

The main idea behind the concept of the generational accounting is the fact that every individual is both a taxpayer and, on the other hand, a transfer beneficiary during his life. In the life cycle hypothesis[6], the various burdens and transfers arising out of the government sector are age and gender specific. For example, personal income taxes are, in a simplified way, paid only when an individual is working. Moreover, the amount of tax collected differs according to the amount of the wage. Young and elderly people are assumed not to pay these taxes. Alternatively, the higher life expectancy of women implies that old-age

6 *Developed by Ando and Modigliani (1963) – see Dybczak (2006), p. 3.*

pensions will be paid to women for a longer time than to men. Nonetheless, the average old-age pension paid to men is supposed to be higher due to the higher levels of their previously earned wages. In the health care sector the situation is in many aspects similar. The retirees paying only consumption taxes are at major risk to a range of illnesses and health difficulties, whereas people at working age bear the most costs connected with the health care.

Broadly speaking, "…generational accounts indicate, in present value, what the typical member of each generation can expect to pay, now and in the future, in net taxes (taxes paid net of transfers received)" (Auerbach et al., 1994, p. 75). Considering the age dependency, generational accounting takes into account the age profile of an average person, presenting "…whether the tax and transfer-policy of a selected base-year can be maintained into the indefinite future or whether sooner or later adjustments will be necessary in order to meet the government's intertemporal budget constraint" (European Commission, 1999, p. 1).

The following text describes how we have incorporated the generational aspect into the projection technique, whereas six sections (modules) relating to the diverse projection subjects are distinguished. The first one is devoted to the core element of all economic projections – the demography development. The second module explains how to use demographic projection to determine the future labour market development. Labour productivity as well as gross domestic product are subjects of the third and fourth module together with closer ruminating of constant factors of production shares. And last but not least two final sections deal with health care expenditure and revenue estimates and projections.

In this place, it is worth noting that the projection should not be affected by current economic crisis as it is a long term projection. Values of selected variables will probably differ from the observed ones also in a short time horizon but the aim of a long term projection is not to predict future but to point out to possible problems arising from current trends.

2.1 Demography

The overall "exercise" starts with a demographic projection based on Eurostat's EuroPop 2008 migration convergence scenario. The projection assumes that the socio-economic and cultural differences between the EU Member States, Norway and Switzerland will fade out in the very long run. This assumption implies convergence of demographic values (see Table 1 for the Eurostat's assumptions). The migration flows will converge to zero net migration. The methodology consists essentially of setting the values of the demographic indicators for the convergence year 2150, i.e. the year in which the theoretical convergence would be achieved, and of appropriately interpolating from the starting value for each country and each demographic component (fertility, mortality). The national values for the year of interest (target year, 2060) are thus derived (in appendix I "Population pyramids – 'trees and coffins' of life" can be found a graphical description).

Table 1: Assumptions for the Eurostat's EuroPop 2008 demographic projection

Country	Total fertility rate	Life expectancy at birth		Migration assumptions
		Males	Females	
Czech Republic	1.52	83.2	87.8	13.0
Denmark	1.85	84.3	88.4	6.5
Estonia	1.66	80.8	87.5	-0.1
France	1.93	85.1	90.1	6.0
Italy	1.55	85.5	90.0	19.9
Netherlands	1.77	84.9	88.9	3.0
United Kingdom	1.84	85.0	88.9	10.1
Switzerland	1.59	85.8	89.9	19.1

Source: Eurostat (2008c).

Additionally in **Table 1,** it is worth noting that the fertility rates are below the natural population replacement rates, which are required to maintain population.

Table 2 gives a simple data description where economic, i.e. young and old-age, dependency ratios are displayed. The economic (or total) dependency ratio reflects the decreasing share and ageing of the working-age population. From the current level, ranging between 40.8% in the Czech Republic to 53.7% in France, the dependency ratio is supposed to change dramatically. High increases in the Czech Republic (by 47.5 p.p. to 88.4%), Estonia (by 35.8 p.p. to 82.8%) and Italy (by 33.0 p.p. to 84.9%) anticipate a rising ageing problem that will have to be faced in the not-too-distant future. All the other countries considered are confronted with a similar problem, even if some of them rather less so than the others.

Table 2: Economic dependency ratios (in %, p.p., 2008 – 2060)

Country	2008	2010	2020	2030	2040	2050	2060	Change 2060 – 2008
Czech Republic	40.8	42.1	53.8	57.0	64.8	79.9	88.4	47.5
Denmark	52.0	53.2	59.3	68.0	74.8	72.4	74.1	22.1
Estonia	47.0	47.3	56.3	60.1	63.9	75.0	82.8	35.8
France	53.7	54.5	63.2	69.9	76.1	77.6	77.6	23.8
Italy	51.9	52.4	56.7	64.0	77.8	84.2	84.9	33.0
Netherlands	48.6	49.2	56.3	67.9	76.5	75.1	76.7	28.2
Switzerland	47.0	47.5	52.7	61.9	67.4	69.6	73.3	26.4
United Kingdom	50.8	51.4	57.9	64.5	69.2	72.5	76.5	25.8

Note: The Economic dependency ratio is calculated as the ratio of the number of people aged 0 – 14 and 65 and older to those of working age (15 – 64). Since the Eurostat's projection is always dated to the 1st January, annual averages are presented in the table.
Source: Eurostat (2008c). Author's calculations.

2.2 Labour market

Demographic projection is then used to calculate the total labour force (EA_t). Due to accessibility, we use the European Commission's age and sex-specific participation rates (defined as the ratio of economically active men/women in a given year to the total number of men/women of this age):

$$EA_t = \sum_{s=1}^{2} \sum_{x=15}^{75} pr_t^{s,x} \cdot POP_t^{s,x} \quad , \tag{1}$$

where EA_t stands for the total labour force and $pr_t^{s,x}$ for the age (x) and sex (s) specific participation rate in year t and $POP_t^{s,x}$ is analogously the age (x) and sex (s) specific part of the population. For the purposes of further proceedings we had to decompose the labour force into employment and unemployment.

Several assumptions concerning employment and unemployment had to be made. First, we hold constant the share of employees and the self-employed over the projection span. Second, we do not distinguish between part-time and full-time work and all data are taken for or recalculated to the full-time employment equivalent in the process. Next, we presume that hours worked and the full-time and part-time ratio do not change. And finally, the European Commission's (2008a) NAWRU (Non-Accelerating Wage Rate of Unemployment) values were considered as a proxy for structural unemployment rates (Carone, 2005). Current unemployment rates converge to these structural levels in the medium term, with the speed of convergence derived from historical trends of unemployment rates. The past and future estimated NAWRU values (the NAIRU – Non-Accelerating Inflation Rate of Unemployment – was selected for Switzerland, because other data are not available) can be seen in **Table 3**.

Table 3: Non-accelerating wage rate of unemployment (in %, 2000–2060)

Country	2000	2005	2008	2010	2015	2020 – 2060
Czech Republic	6.92	7.18	6.18	4.50	4.50	4.50
Denmark	5.17	4.30	3.77	3.25	3.25	3.25
Estonia	10.66	9.14	5.43	3.46	3.46	3.46
France	9.63	9.06	8.64	7.81	7.00	6.20
Italy	9.13	7.91	7.23	5.75	5.75	5.75
Netherlands	3.35	3.31	3.29	3.01	3.01	3.01
Switzerland*	3.27	3.73	3.69	3.69	3.70	3.70
United Kingdom	5.68	5.00	5.66	5.43	5.43	5.43

*Note: *) Non-Accelerating Inflation Rate of Unemployment (NAIRU).*
Source: For years 2000–2008 European Commission (2008a). For years 2010 – 2060 European Commission (2008b). OECD (2008a) NAIRU values for Switzerland.

In order to preserve the NAWRU and NAIRU values over time, the age and sex-specific unemployment rates were derived as follows (European Commission, 2008b, page 79):

$$un_t^{s,x} = \frac{NAWRU_t \cdot \sum_{x=1}^{2}\sum_{x=15}^{75} EA_t^{s,x}}{\sum_{x=1}^{2}\sum_{x=15}^{75} un_{2007}^{s,x} \cdot EA_t^{s,x}} \cdot un_{2007}^{s,x} \tag{2}$$

where $un_{2007}^{s,x}$ is the fixed unemployment rate for age x and sex s in year 2007 and $un_t^{s,x}$ is the desirable sex and age-specific unemployment rate in year t. Therefore, the structure of unemployment in 2007 is kept constant. The age and sex-specific employment is then easily the product of the sex and age-specific participation, one minus unemployment rate and the number of persons in the age-sex category:

$$L_t^{s,x} = pr_t^{s,x} \cdot \left(1 - un_t^{s,x}\right) \cdot POP_t^{s,x}. \tag{3}$$

Total employment (L_t) is calculated as the sum of all of the specific employments:

$$L_t = \sum_{s=1}^{2}\sum_{x=15}^{75} L_t^{s,x}. \tag{4}$$

2.3 Labour productivity and gross domestic product

By multiplying total employment (L_t) and labour productivity ($\boldsymbol{P}_t$), we are able to compute gross domestic product (GDP_t) in real terms:

$$GDP_t = L_t \cdot \boldsymbol{P}_t. \tag{5}$$

For simplicity, we adopted the EC's labour productivity growths summarised in **Table 4.** A crucial assumption about labour productivity growth is that in all countries it converges to 1.7% in 2050 (see European Commission, 2008b, p. 94). For short and medium-term development the GDP growth was decomposed using the Cobb-Douglas production function with constant returns to scale. The main drivers of labour productivity growth are thus total factor productivity growth and capital deepening.

Table 4: Labour productivity growth projection (in %, 2008–2060)

Country	2008	2010	2020	2030	2040 – 2060
Czech Republic	4.3	3.8	2.9	1.8	1.7
Denmark	1.9	1.9	1.8	1.7	1.7
Estonia	5.3	4.9	3.3	2.7	1.7
France	1.6	1.6	1.7	1.7	1.7
Italy	0.6	0.6	1.6	1.7	1.7
Netherlands	1.7	1.7	1.8	1.7	1.7
Switzerland	1.9	1.7	1.8	1.7	1.7
United Kingdom	2.6	2.1	1.8	1.7	1.7

Source: European Commission. Switzerland – Author's calculation based on similar assumptions.

In other words, GDP growth (g_t) is determined by the growth of total employment and labour productivity growth, so the model does not assume any changes in the capital-labour ratio:

$$GDP_t = (1 + g_t) \cdot GDP_{t-1} = \left(1 + \frac{\Delta L_t}{L_{t-1}}\right) \cdot \left(1 + \frac{\Delta P_t}{P_{t-1}}\right) \cdot GDP_{t-1} \,. \tag{6}$$

Moreover, the labour productivity development determines the progression of the average real wage, which is essential for labour supply income afterwards (see below).

Nominal GDP (GDP_t^N) is then a product of real GDP and the GDP deflator (def_t), which converges to the European Central Bank's inflation target, ensuring "…inflation rates close to 2% over the medium term" (ECB, 2003):

$$GDP_t^N = GDP_t \cdot (1 + def_t). \tag{7}$$

2.4 Rationalising constant shares of factors of production

Arising from previous part of this chapter, the constant ratio of production factors per output is considered in the long-term over the projection span. The stable shares assumption might be verified directly or derived indirectly via theories of growth models. Herein, we would like to warn of possible deceptive information given by all long-term time series of indicators as their contents and definitions could have been changing in time.

As far as direct approach is concerned, Kaldor (1963) gives six basic "stylized facts" about economic growth which also encounter constant shares of labour and physical capital in national income. Barro and Sala-i-Martin (2003) then provide several other studies indicat-

ing the factors long-term stability. Gollin (2001) revised the Kaldor's "fact" and assessed that "…factor shares give estimates that are remarkably consistent with the claim that factor shares are approximately constant across time and space…", moreover he suggests "… to use models that give rise to constant factor shares" (p. 15). As well as Gundlach (2007) asserts that "…the cross-country data on output per worker can be consistently summarized by a specification that allows for international variation in technology conditional on a constant capital output ratio" (p. 17). Analogously Bernanke and Gurkaynak (2001) finds out "…the time series of labour shares by country tend to be quite stable, with no systematic tendency to rise or fall over time" (p. 26).

Besides, some theories of growth models might support the stable shares hypothesis as well – either those based on neoclassical Solow growth model, both basic and encompassing Harrod-neutral technical change, as well as later Ramsey-Cass-Koopmans model or Diamond's overlapping generations model. The convergence to steady state observed in reality is built in these models. The variables develop at constant rates in the steady state and do not change the capital-labour ratio. Later theories coping with endogenous growth of internalised technology could keep the ratio constant in the long-run, however, there are some theories (e.g. pure "AK model") where the convergence to steady state is broken and thus the ratio might vary in time.

Empirical verification of the growth models, which should help with selection of the right model, is quite disputable. Some of them support the claim that the Solow model "…is consistent with the international evidence if one acknowledges the importance of human as well as physical capital…" (Mankiw, Romer, Weil, 1992, p. 433), nevertheless Bernanke and Gurkaynak (2001) nail down that Mankiw's, Romer's and Weil's "…basic estimation framework is broadly consistent with any growth model that admits a balanced growth path" (p. 1). Similarly, Gundlach (2007) concedes his empirical results are "…in line with the Solow model…" (p. 17). Others like Okada (2006) contribute the Solow's mechanism serves as a good explanation of convergence amongst developed countries such as OECD but not when taking into account less developed countries. To the contrary, study of Arnold et al. (2007) suggests that the "…estimated speed of convergence appears to be too high to be consistent with the human-capital-augmented version of the Solow model, but rather support the endogenous growth model…" (p. 21).

Moreover, the verifications of the models with human capital seem to be problematic. Not only they are tremendously data-consuming, they also often quantify qualitative categories to specify human capital like level of knowledge, quality of health care, education, social security environment, etc., substituted by questionable proxies in econometrical estimates.

Thus, analyzing developed countries, considering convergence of the economies and on reflection of standard long-term projection methodology we have decided to develop the model on the neoclassical economic framework with constant factor shares. The non-negligible impact of this choice will be presented in the chapter dedicated to results of the projection model.

Having described the major macroeconomic prerequisites we can continue with government health care expenditures and revenues.

2.5 Expenditure projection

In order to present different hypothesis about the evolution of the health care costs that appear in the literature and to show possible ways of development arising from these hypothesis we have developed four scenarios of health expenditure evolution based on standard methods used in health care expenditure projection models such as the model of the European Commission, the model of the OECD or the model of the WB.

The first scenario, called "pure ageing scenario", represents the basic projection method. The health expenditure projection starts with age-related health care costs profiles for acute and long-term care of the initial year that are applied to the demographic projection for future years. The age-related health care cost profiles of the selected countries expressed in per cent of GDP per capita denote average annual health care expenditure for five-year categories. For the model these were smoothed to one-year categories. The average health care costs for an individual of age x and sex s in the initial year 2007 are multiplied by the number of individuals of age x and sex s in every year of the demographic projection. The spending in a particular year can be described by the following equation:

$$C_t = \sum_{s=1}^{2} \sum_{x=0}^{110} c_{2007}^{s,x} \cdot POP_t^{s,x} \tag{8}$$

where $c_{2007}^{s,x}$ are the costs per capita for each sex and age that are given by the initial year of the projection and $POP_t^{s,x}$ stands for the number of individuals in the defined age and sex categories in year t given by the demographic projection.

Yet the above described method implies the so called "expansion of morbidity" hypothesis that was first proposed already in 1977 by Grunenberg. According to the hypothesis, the number of years of life spent in good health will remain constant and all the additional years gained by increases of life expectancy will be spent in bad health due to chronic illnesses and other causes. However more optimistic scenarios have been proposed in the literature latter on. The so called "compression of morbidity" hypothesis, published only three years later by Fries (1980), states on the contrary that the part of life spent in bad health will remain constant and the health status of the population will thus improve. In long term health expenditure projections, the hypothesis is represented by shifts of the age-related health care costs profiles to the right in line with the growth of the life expectancy. The medium way between the two hypothesis is the so called "dynamic equilibrium" according to which the proportion of life lived in bad health will remain constant. Last but not least, according to the death-related costs hypothesis according to which the health expenditure is concentrated in last years of life the health expenditure will be postponed to higher age in line with the growth of the life expectancy (for more details see Pavlokova, 2009).

In order to represent the above mentioned hypothesis, the second scenario we develop in the model is the so called "constant health scenario" taking into account the possible improvements of the health status of the population or the postponement of health care

costs in line with the death related costs hypothesis. The constant health scenario represents the dynamic equilibrium hypothesis (i.e. the medium way). The age-related health care cost profiles are shifted by the change in life expectancy:

$$c_t^{s,x} = c_{2007}^{s,x-\Delta e_t^{s,x}} \tag{9}$$

where $\Delta e_t^{s,x}$ is the change in life expectancy of a given gender s and age x between year t and the base year 2007, i.e. $\Delta e_t^{s,x} = e_t^{s,x} - e_{2007}^{s,x}$. The final total costs C_t can be described by the following equation:

$$C_t = \sum_{s=1}^{2} \sum_{x=0}^{110} c_t^{s,x} \cdot POP_t^{s,x} \quad . \tag{10}$$

The importance of the change in life expectancy is described by **Table 5**:

Table 5: Life expectancy at birth (in years, 2008–2060)

Country	2008		2030		2060		Diff. between 2060 and 2008	
	Males	Females	Males	Females	Males	Females	Males	Females
Czech Republic	73.9	80.2	78.1	83.7	83.2	87.8	9.3	7.6
Denmark	76.4	81.0	80.0	84.5	84.3	88.4	7.9	7.4
Estonia	68.0	78.7	74.0	82.9	80.8	87.5	12.8	8.8
France	77.5	84.3	81.0	87.0	85.1	90.1	7.6	5.8
Italy	78.5	84.2	81.7	86.9	85.5	90.0	7.0	5.8
Netherlands	77.9	82.2	81.1	85.3	84.9	88.9	7.0	6.7
Switzerland	79.3	84.2	82.3	86.9	85.8	89.9	6.5	5.7
United Kingdom	77.4	81.5	80.9	85.0	85.0	88.9	7.6	7.4

Source: Eurostat (2008c).

Countries can be divided into three categories according to the projected change in life expectancy at birth. The group of higher-than-average life expectancies consists of the Czech Republic and Estonia, values around the average are represented by Denmark, France, Italy, the Netherlands and the United Kingdom, and life expectancy at birth is slightly below the average in Switzerland. The numbers fully correspond with the demographic convergence scenario and the lower initial life expectancy values.

Furthermore, next important driver of health care expenditure, the income elasticity of health care, cannot be omitted in a health expenditure projection model. The third and fourth scenario called "pure ageing with elasticity" and "constant health with elasticity" are an enlargement of the first and second scenario that take into account the income

elasticity of health care expenditure converging in a linear manner from 1.1 to 1 in line with the EC reference scenario. The average health and long term care costs for gender s and age x in year t are computed by multiplying the average costs for the age and sex category from the previous year by sum of one and the multiple of the elasticity and the growth of the GDP per capita between the two years:

$$c_t^{s,x} = c_{t-1}^{s,x} \cdot \left(1 + \mathrm{e}_t \left(\frac{GDP_t^N / POP_t}{GDP_{t-1}^N / POP_{t-1}} - 1 \right) \right) \tag{11}$$

where e_t represents the income elasticity of 1.1% diminishing linearly to 1.0% in 2060. The final spending C_t is described by equation 10.

Whether the income elasticity of health care is higher than one ore not has been subject to large discussion in the literature with ambiguous results. The differences result broadly from diverse methodological approaches used. We can however observe both in history and in cross-country comparisons that the part of GDP spent on healthcare grows in line with GDP per capita. This development can result also from another driver that can be modelled by the above described methodology – the technological progress. The measurement of the importance of the technological progress for health care expenditure is however one of the very controversial ones. The importance of the technological progress is usually measured as the residual in the regression model of total health care expenditure on GDP per capita and an ageing-related variable. The use of the income elasticity factor in our model with the methodology that is described above can be used as a proxy for both factors.

2.6 Revenue projection

The financing of the public healthcare systems differ by the mix of taxes in the selected countries. Broadly, the general government sector tax-to-GDP ratio[7] T_t / GDP_t^N might serve as a tool in modelling government revenues. It can be disintegrated into three components:

$$\frac{T_t}{GDP_t^N} = t_L \frac{W_t^N \cdot L_t}{GDP_t^N} + t_K \frac{K_t}{GDP_t^N} + t_C \frac{C_t}{GDP_t^N} \tag{12}$$

where T_t represents the total amount of tax revenues in year t, GDP_t^N is gross domestic product in current (t) prices, t_L is the average effective tax rate of personal income tax including social security contributions, W_t^N is the average nominal wage, L_t is total employment, K_t is the total value of capital, t_K is the average effective tax rate on capital, C_t is total consumption and t_C is the average effective tax rate on consumption.

7 *Tax-to-GDP ratio is the approximation of total government sector revenues.*

The model requires associating the relevant types of taxes with age and gender. As for government sector revenues affiliated with labour income assigned to every age and sex, we determined: "1100 Taxes on income, profits and capital gains of individuals" and "2000 Social security contributions"[8]. The sum of the variety of indirect taxes – "5111 Value added taxes" and "5121 Excises" – is supposed to be born fully by individuals, which allows restoration of their age profile. **Table 6** then reveals the total amount of age-related taxes included in the model.

Table 6: Age related taxes considered in the model (in % of the total tax revenues, 2006)

Country	Taxes on income of individuals	Social security contributions	Value added tax	Excises	Total age related taxes
	1100	2000	5111	5121	
Czech Republic	11.5	43.9	18.0	10.1	83.5
Denmark	50.0	2.1	20.9	9.8	82.8
Estonia	7.1	40.3	32.9	12.1	92.4
France	20.1	37.0	16.4	5.5	79.0
Italy	25.7	29.9	14.9	5.4	75.9
Netherlands	18.9	36.4	18.7	8.6	82.7
Switzerland	35.0	23.6	13.2	5.5	76.9
United Kingdom	29.1	18.6	18.2	8.2	74.0

Note: Four-digit numbers and the revenue categories refer to the OECD international government revenue classification.
Source: OECD (2008b). Ministry of Finance of Estonia (2008).

Final determination of the sources of financing needs to find out, what revenues are directly linked to health care financing. That is why the following few short paragraphs describe closer the systems of health care financing.

In the Czech Republic, social health insurance is compulsory and the contributions are paid mostly by employees, employers and the self-employed. The State contributes in the system on behalf of special groups of non-wage earners, such as children, pensioners, parents on maternity leave, the unemployed, asylum seekers etc. Except for the State contribution on behalf of non-wage earners, the State finances capital investments in hospitals it manages, in training of medical personal etc. The social security contributions cover thus only 69.6% of public health care spending.

The public health care system in Denmark is financed through general and municipal taxes. Health care in the regions, which accounts for most of the health care spending, is financed by four kinds of subsidies: a block grant from the State (75%), a State activity-related subsidy (5%), a local basic contribution (10%) and a local activity-related contribu-

8 *See OECD Revenue Statistics (2008) for the tax classification.*

tion (5%). The part coming from the State is financed mainly by health contributions that account for 8% of wage.

In Estonia, the social health insurance contributions are paid by most of the employees and the self-employed, the State contributes only for less than 3% of the non-wage earners (individuals on parental leave, the unemployed, people receiving social benefits and other minor groups). Major groups of non-wage earners (pensioners, children etc.) are covered by the social health insurance without contributing and without the State contributing for them.

In France, every working person and his/her dependants belong to a health insurance scheme according to occupation.[9] The revenues of the health insurance schemes are raised from social health insurance contributions paid by employees, employers and self-employed (46% of revenues of the general scheme), from all income including retirement pensions and invalidity and pre-retirement benefits and other replacement income, investment income and property income (34%), from taxes on car insurance premiums some alcoholic drinks, tobacco, advertising for pharmaceuticals and medical products etc. (9%) and from other sources including government contribution (11%).

The main source of finance of the Italian National Health Service is general taxation but the regions and autonomous provinces are entitled to set the level of regional taxes, which account for 40% of public health care sector resources. The main regional tax dedicated mostly to health care is the tax on productive activities (IRAP) which is a flat-rate tax on the value added generated by all types of business and self-employed activities. The second regional source of income of the Italian National Health Service is a personal income surcharge.

The Dutch public health care system has two components, the first of which is the statutory health insurance system financed by a mixture of social health insurance contributions and nominal premiums paid by insurees and the second of which, covering the long term care, is the AWBZ (defined under the Exceptional Medical Expenses Act) raising funds purely from social health insurance contributions. The State contributes for the premiums of children up to the age of 18 in the first component and a grant to the AWBZ.

In Switzerland, two thirds of public health expenditure is financed through mandatory health insurance purchased on individual basis. The nominal premia differ among funds and purchased policies and are not income-related. Children benefit from lower nominal premia. The remaining one-third of public expenditure is financed by cantons from general taxation and consists mainly of subsidies to institutional providers (hospitals, nursing homes).

The National Health Service of the United Kingdom is funded mainly by general taxation (76%), but also by national insurance contributions (19%) and user charges (5%). National

9 *In 2001, 84% of the population belonged to the general scheme (Régime Général) that covers employees in commerce and in industry and CMU beneficiaries (CMU is a subsidiary system which provides medical coverage for persons who do not benefit from any other existing medical coverage schemes).*

insurance contributions are paid by employers and employees and are counted as general government revenue in the National Health Accounts.

The systems based on social health insurance (Czech Republic, Estonia, France, Netherlands, Switzerland) use mostly social security contributions to cover the public health expenditure, however general taxation is often used in these systems to cover the costs of selected groups of non-wage earners (children, pensioners) or capital investments in publicly owned health care facilities. In Switzerland and partly in the Netherlands the nominal premia replace social security contributions based on wages. The systems of National Health Service (Denmark, Italy, United Kingdom) raise funds mostly from general taxation but in some countries special taxes are assigned purely to health care.

Table 7 gives a quick preview of the structure of all considered tax revenues in 2007. The structure of financing of 2007 as the initial year is preserved over time in the projection.

Table 7: Structure of the government sector sources financing acute and long-term care (in %, 2007)

Country	Social security contributions	Nominal premia	Personal income tax	Value added tax and excises	Other tax revenues
Czech Republic	69.6	-	6.2	15.2	8.9
Denmark	0.0	-	51.1	31.4	17.5
Estonia	82.3	-	3.8	6.1	7.8
France	93.6	-	2.1	2.2	2.1
Italy	0.1	-	9.6	72.7	17.6
Netherlands	0.0	31.4	62.0	4.1	2.6
United Kingdom	0.0	-	35.7	32.4	31.9
Switzerland	0.0	71.4	13.0	7.0	8.6

Source: OECD (2008b), OECD (2008c). Author's calculations.

Now, step further to the modelling of every relevant type of taxes. Computing labour income taxes, the effective tax rates of social contributions and personal income taxes are applied to the tax base in every following year. The tax base for every age and sex category is equal to the product of the number of employed persons in every age and sex category and the modelled average wage in the age and sex category. The average effective tax rates (t_{PIT} and t_{SSC}) are at the same time held constant over the projected period.

$$T_{PIT} + T_{SSC} = (t_{PIT} + t_{SSC}) \cdot W_t^{N,s,x} \cdot L_t^{s,x} \tag{13}$$

The age and sex-specific nominal wage ($W_t^{N,s,x}$) is supposed to grow in line with an average nominal wage (W_t^N) that rises by the percentage change of labour productivity ($\boldsymbol{P}_t$) and the GDP deflator (def_t), which for the sake of simplicity is taken as the rate of growth of the price level:

$$W_t^{N,s,x} = W_t^N = \left(1 + \Delta \boldsymbol{P}_t / \boldsymbol{P}_{t-1}\right) \cdot \left(1 + def_t\right) \cdot W_{t-1}^N . \quad (14)$$

Whereas indirect taxes are said to be typically proportional to their tax base (see André and Girouard, 2005; or European Commission, 2005), personal income taxes are usually constructed as progressive[10], i.e. the higher the tax base, the higher the rate of the tax (the so-called marginal tax rate). In such a system of taxation, increasing the average wage would raise the effective tax rate, which might boost the total tax burden and the size of the government sector in the economy indefinitely. That is why we assume all effective tax rates to be constant in the projection, rather than using constant statutory tax rates. A similar problem arises for gradual tax progressivity (tax brackets) and taxflation, the process of shifting of all incomes to the upper tax brackets and taxing them at higher statutory marginal tax rates.

The age distribution of value added tax and excise revenues is calculated from the age distribution of consumption as defined by COICOP[11] per adult equivalent. The effective tax rates for age categories are applied to the demographic projection. The ratio of consumption to GDP is held constant over the projected period.

Other revenues, which are not connected with age or sex, are held constant to GDP over the projected span and are proportionally allocated to the total population. Thus, we consider them to be a lump sum proportionally divided per capita:

$$OR_t^{s,x} = \frac{OR_{2006}}{GDP_{2006}^N} \cdot \frac{POP_t^{s,x}}{POP_t} \cdot \frac{GDP_t^N}{GDP_{2006}^N} \cdot GDP_t^N \quad (15)$$

where $OR_{,}^{s,x}$ denotes the age and sex-specific unit of other government sector revenues, OR_{2007} the total value of other revenues in 2006 and GDP_{2006}^N the nominal gross domestic product in 2006.

In summary, tax incidence is another simplifying assumption, especially with regard to taxes that cannot be simply assigned to a specific age and gender. Capital income taxes represent one example. A variety of studies presume that capital income taxes are treated in the same way as personal income tax (Cardarelli et al., 2000, van Ewijk et al., 2002, Gál

10 A statutory flat tax rate does not necessarily mean that the tax is proportional to its base. Flat taxes are usually computed as the product of a constant (the statutory tax rate) and the difference between income (or another tax object) and a stable deductible item (alternatively there is a deduction from the calculated tax). Thus, deductible items/tax deductions imply progressivity of the flat tax, since the higher the value of the object of the tax, the higher the relative tax base (see Kim et al., 2006, for details).

11 COICOP stands for Classification of Individual Consumption According to Purpose. The decomposition of individual consumption and assignation of taxes was made on the basis of the following sources: Deloitte & Touche (2004), Taxation.ch (2009), European Commission (2007), Eurostat (2008d), OECD (2008b) and European Commission (2009).

et al., 2005). In other words, they assume these types of taxes might be divided according to the nominal wage, thus fully borne by employees. Nonetheless, there are at least three circumstances which complicate this decision. First, capital taxes may be partly included in the price of current or old assets; second, the tax payments may differ from the income on the assets. And third, the view of both the theoretical and empirical literature regarding tax incidence is not unambiguous.

Now we are prepared to modify the equation No. 12 in order to express age and sex-related government revenues:

$$\frac{T_t}{GDP_t^N} = \sum_{s=1}^{2}\sum_{x=15}^{75}(t_{PIT} + t_{SSC})\frac{W_t^{N,s,x} \cdot L_t^{s,x}}{GDP_t^N} + \sum_{s=1}^{2}\sum_{x=0}^{110} t_{IT}\frac{C_t^{s,x}}{GDP_t^N} + \frac{OR_t}{GDP_t^N} \qquad (16)$$

where t_{PIT} stands for the average effective personal income tax rate, t_{SSC} for the average effective tax rate of social security contributions (paid by employees, employers and the self-employed), $W_t^{N,s,x}$ for the age (x) and sex (s) specific nominal wage, $L_t^{s,x}$ for employment broken down by age (x) and sex (s), t_{IT} for the effective indirect tax rate, $C_t^{s,x}$ for age and gender-specific household consumption and finally OR_t for all other revenues.

With respect to the previously derived kinds of taxes, the average effective tax rates were calculated as the ratio of the tax part used for health care funding and its tax base. In the case of social security and personal income effective tax rates, the product of total employment and the average nominal gross wage was applied as the tax base. Effective consumption tax rates were calculated by dividing the part of value added tax and excise revenues that serves for health care financing by the final consumption expenditure of households.

The next section summarises and discusses the results and main findings from the projection.

3 Results

Recapping expenditure scenarios, we have calculated four different expenditure developments: conventional pure ageing scenario (no shifts of cost-profiles are considered), pure ageing scenario enriched by heightened income elasticity of health care (the elasticity gradually declines to 1.0 in 2060 from 1.1 in the base year), constant health scenario taking into account life expectancy change reflecting improvements in health of the population, and finally constant health scenario with increased health care income elasticity. The results in the terms of deficits of public finance health care financing are depicted in **Table 8.**

The average increase of health care expenditure per GDP equals 36% in the selected countries. Nevertheless, different health expenditure scenarios change the picture quite dramatically. Without adjusting a health cost profile, the pure ageing scenario belongs to the middle pathway of the future health expenditure development in all cases. However

together with the income elasticity, the scenario seems to be the most powerful expenditure driver, where the elasticity contributes 1% GDP on average in the last projection year, which is approximately 2.3 percentage points higher than the lowest scenario. Next, similarly constant health scenario with elasticity assigns itself to the middle of considered expenditure variants. And there is another interesting point we would like to emphasise. Whilst the pure ageing scenario with elasticity and the constant health scenario extend similarly in all selected countries, the pure ageing scenario without elasticity and constant health scenario with elasticity develop differently. In almost all countries, with the exemption of Estonia, the constant health scenario with elasticity exceeds the pure ageing scenario in the beginning, which sooner or later transcends the former scenario, as the non-changed health status starts dominating. On the other side of spectrum, the constant health scenario represents the most modest expenditure development ranging from 0.4 in the Switzerland, across 1.5 in the Czech Republic, Denmark or Italy, to 3.2 in the Netherlands.

Constant shares of factors of production discussed in chapter 2.4 coupled with the assumption of equal growth rate of consumption and the GDP implies, under the assumption of constant effective tax rates, constant share of the revenues of the public health care systems on GDP.

Actually, sources of the public health care systems raised by any kind of personal income tax or social security contributions are proportional to the volume of wages and salaries that evolves in line with GDP. Indeed, the GDP growth in the model is the result of the labour productivity growth (and thus the growth of the real wage) and the total employment that are the two drivers of the volume of wages and salaries. Constant share of revenues coming from consumption taxes and excise duties results from the assumption of constant effective tax rates coupled with constant share of consumption on GDP which is assumed on the balanced growth path in standard growth models. The deficits of the public health care systems the evolution of which is expressed in table 8 thus result purely from higher growth of expenditures than the GDP.

Table 8 reveals the differences in the height of deficits amongst countries. Our projection estimates suggest that the Netherlands is expected to face the largest pressure on public finance: from 3.2 to 6.3% deficits in terms of GDP, i.e. more than double in comparison with other countries. This striking imbalance has its roots in the over-proportional height of long-term care costs, which are more vulnerable to population ageing and increase the sensitivity of the Dutch system to economic dependency ratio. Actually, the AWBZ covers not only pure health care but also part of the social care offered to the elderly that is financed differently in other countries. Slightly above-average public deficit might be envisaged in Denmark, conversely, below average in Estonia, Italy, the United Kingdom and also in France, despite of high expenditure-to-GDP ratios. The quite plausible development in Estonia (a difference amounting to 1.2% less than average in 2060) is mainly due to lower long-term care expenditure per capita. The Czech Republic and Switzerland are the two countries with closed-to-average deficits in the area of public health care, with both revenues and expenditures lower than usual.

Table 8: Deficits of the public finance health financing under different expenditure scenarios (in % GDP, 2008 – 2060)

Country	Expenditure scenario	2008	2010	2020	2030	2040	2050	2060
Czech Rep.	Pure Ageing Scenario	0.05	0.16	0.66	1.30	1.86	2.30	2.69
	Pure Ageing Scenario with Elasticity	0.10	0.30	1.13	2.00	2.76	3.32	3.79
	Constant Health Scenario	0.03	0.08	0.33	0.68	0.99	1.23	1.47
	Constant Health Scenario with Elasticity	0.08	0.22	0.77	1.33	1.79	2.12	2.42
Denmark	Pure Ageing Scenario	0.03	0.10	0.79	1.78	2.44	2.96	3.16
	Pure Ageing Scenario with Elasticity	0.07	0.22	1.18	2.43	3.31	3.99	4.25
	Constant Health Scenario	0.00	0.01	0.33	0.95	1.29	1.52	1.50
	Constant Health Scenario with Elasticity	0.04	0.12	0.70	1.54	2.06	2.41	2.43
Estonia	Pure Ageing Scenario	0.02	0.06	0.24	0.44	0.76	1.03	1.26
	Pure Ageing Scenario with Elasticity	0.09	0.24	0.71	1.10	1.57	1.94	2.22
	Constant Health Scenario	0.00	0.02	0.06	0.11	0.26	0.41	0.55
	Constant Health Scenario with Elasticity	0.07	0.20	0.50	0.73	1.00	1.23	1.39
France	Pure Ageing Scenario	0.06	0.16	0.62	1.15	1.75	2.06	2.21
	Pure Ageing Scenario with Elasticity	0.09	0.26	1.00	1.78	2.59	3.04	3.25
	Constant Health Scenario	0.03	0.09	0.31	0.59	0.96	1.07	1.04
	Constant Health Scenario with Elasticity	0.07	0.18	0.68	1.18	1.74	1.96	1.96
Italy	Pure Ageing Scenario	0.05	0.15	0.59	1.08	1.63	2.10	2.25
	Pure Ageing Scenario with Elasticity	0.08	0.23	0.91	1.61	2.32	2.92	3.12
	Constant Health Scenario	0.03	0.09	0.32	0.59	0.94	1.26	1.30
	Constant Health Scenario with Elasticity	0.06	0.17	0.63	1.09	1.58	2.00	2.07
Netherlands	Pure Ageing Scenario	0.11	0.29	1.19	2.57	3.91	4.93	5.11
	Pure Ageing Scenario with Elasticity	0.15	0.38	1.56	3.21	4.82	6.06	6.30
	Constant Health Scenario	0.08	0.20	0.74	1.69	2.59	3.26	3.22
	Constant Health Scenario with Elasticity	0.12	0.29	1.09	2.27	3.40	4.23	4.22
Switzerland	Pure Ageing Scenario	0.05	0.13	0.60	1.24	2.05	2.57	2.84
	Pure Ageing Scenario with Elasticity	0.09	0.24	0.95	1.79	2.80	3.46	3.78
	Constant Health Scenario	0.02	0.06	0.29	0.66	1.21	1.49	1.55
	Constant Health Scenario with Elasticity	0.06	0.16	0.62	1.17	1.89	2.28	2.37
United Kingdom	Pure Ageing Scenario	0.04	0.10	0.41	0.90	1.45	1.90	2.19
	Pure Ageing Scenario with Elasticity	0.07	0.20	0.76	1.46	2.21	2.79	3.14
	Constant Health Scenario	0.01	0.03	0.08	0.28	0.61	0.84	0.93
	Constant Health Scenario with Elasticity	0.05	0.12	0.42	0.80	1.30	1.63	1.75

Source: Author's calculations.

Generally, the gap between projected health care sector expenditures and revenues implies, ceteris paribus, important fiscal imbalances. The question rising from the results is whether society will choose to satisfy the growing demand for health care from public sources and increase the effective tax rates or whether it will shift the burden onto individuals or whether the demand for health care will be restricted in some way. The second two alternatives seem to be inappropriate for the elderly, who cannot increase their effort to raise their labour income.

The division of expenditures and revenues between different generations in every year of the projection (for details in all the selected countries see Annex II, with a graphical illustration of the development of generational revenues and expenditures covering acute and long-term health care) shows important differences between who bears the costs and who benefits from health care sector expenditures. Unlike in pensions, the entitlement in health care is never precise. The easiest way to cut expenditures in health care might thus be simply not to provide care. The most sobering finding of the study is the vulnerability of the large elderly populations to cuts in health care expenditures arising from the possible unwillingness of young generations to cover the ever increasing health care sector expenditures.

As for the illustration of the intergenerational burden carried by population, we have calculated "self-sufficiency index", comparing revenues (in the view of public finance) and public expenditures covering health care for those older than 65 year old.

In **Table 9** one can distinguish four groups of countries. On the one hand Italy and Switzerland show lowest intergenerational solidarity and thus highest self-sufficiency of the elderly (approximately 33 and 30%). The fact stems from the use of the nominal premia for financing healthcare in the Switzerland and from high proportion of consumption taxes used to finance healthcare in Italy. On the other hand we find France, where the self-sufficiency belongs to smallest in Europe (just above 5%) even if our calculations estimate a tendency to increase up to 1.8 percentage points. High intergenerational solidarity in France results from prevailing financing based on social security contributions and personal income tax and it may induce future intergenerational imbalances and tensions. Then, the "self-sufficiency index" in the Czech Republic, Denmark, Estonia and the Netherlands moves predominantly inside of the 10 to 16% interval. And finally the United Kingdom, a special case, whose index culminates around 21% and lies between the others as the National Health Service is financed more or less uniformly by all the main tax aggregates (see **Table 7**).

From the point of view of the different systems of financing healthcare we can state, based on the index, that systems of National Health Service show generally higher self-sufficiency of the elderly. Actually, these systems use more consumption taxes that are paid by all the population. The public health insurance systems raise revenues mostly from social security contributions (i.e. contributions based on wages) and they thus reveal higher intergenerational solidarity. However, as we mentioned above, the division of the systems is not so simple as the systems of public health insurance may use nominal premia or partly general taxation as well and on the other hand the systems of National Health Service are in some countries financed by personal income taxes assigned to healthcare such as in Denmark.

The indexes seem to fluctuate nearly around a subtly decreasing trend in time, or possibly around a growing trend in the Czech Republic and France (in Italy and United Kingdom the constant health scenario indicates increasing direction as well) and there are no important changes in the indexes such as in the economic dependency ratio. Thus, any considerable improvement of the old-age sufficiency and decreasing vulnerability of the elderly to the policy decisions about redistribution might not be expected under the current unchanged

conditions. The important question that arises now is whether the working population will be able to cover the healthcare costs of the dependent population if, based on the index, we do not expect the dependent population to cover more of their costs. The proportion of the costs of the dependent population that can be covered by the working population without changes in the effective tax rates is summarised in **Table 10.**

Table 9: Self-sufficiency index of the elderly people (65+) in financing health care (in % expenditure, 2008-2060)

Country	Expenditure scenario	2008	2010	2020	2030	2040	2050	2060
Czech Rep.	Pure Ageing Scenario	10.4	10.5	12.8	11.7	11.9	12.7	12.2
	Pure Ageing Scenario with Elasticity	10.3	10.3	12.0	10.7	10.7	11.4	10.9
	Constant Health Scenario	10.4	10.6	13.3	12.3	12.8	14.1	13.6
	Constant Health Scenario with Elasticity	10.3	10.4	12.5	11.3	11.6	12.6	12.1
Denmark	Pure Ageing Scenario	16.2	16.4	16.4	15.8	15.8	14.5	14.6
	Pure Ageing Scenario with Elasticity	16.1	16.1	15.7	14.8	14.5	13.2	13.3
	Constant Health Scenario	16.3	16.6	17.4	17.4	17.8	16.8	17.3
	Constant Health Scenario with Elasticity	16.2	16.3	16.6	16.3	16.4	15.3	15.7
Estonia	Pure Ageing Scenario	12.8	12.8	9.8	10.1	9.6	9.8	9.5
	Pure Ageing Scenario with Elasticity	12.6	12.3	9.1	9.0	8.4	8.5	8.2
	Constant Health Scenario	12.8	12.8	10.1	10.6	10.3	10.7	10.6
	Constant Health Scenario with Elasticity	12.6	12.4	9.3	9.5	9.1	9.4	9.2
France	Pure Ageing Scenario	2.9	3.4	5.1	4.8	4.8	4.4	4.3
	Pure Ageing Scenario with Elasticity	2.9	3.4	4.9	4.5	4.4	4.0	3.9
	Constant Health Scenario	2.9	3.5	5.3	5.1	5.2	4.8	4.7
	Constant Health Scenario with Elasticity	2.9	3.4	5.1	4.8	4.8	4.4	4.3
Italy	Pure Ageing Scenario	34.4	34.1	33.5	33.4	34.0	33.1	32.4
	Pure Ageing Scenario with Elasticity	34.3	33.8	32.1	31.3	31.5	30.3	29.6
	Constant Health Scenario	34.5	34.4	34.6	35.4	36.8	36.3	35.8
	Constant Health Scenario with Elasticity	34.4	34.0	33.2	33.2	34.1	33.2	32.7
Netherlands	Pure Ageing Scenario	14.4	14.5	15.6	14.3	13.1	11.3	10.7
	Pure Ageing Scenario with Elasticity	14.4	14.3	14.9	13.5	12.2	10.3	10.4
	Constant Health Scenario	14.5	14.7	16.6	16.0	15.2	13.3	13.7
	Constant Health Scenario with Elasticity	14.4	14.6	15.9	15.0	14.0	12.2	12.5
Switzerland	Pure Ageing Scenario	31.1	31.1	31.4	31.1	29.2	27.4	27.1
	Pure Ageing Scenario with Elasticity	30.9	30.6	30.0	29.1	26.9	25.1	24.7
	Constant Health Scenario	31.2	31.4	32.8	33.5	32.1	30.9	31.1
	Constant Health Scenario with Elasticity	31.0	30.9	31.3	31.3	29.6	28.2	28.3
United Kingdom	Pure Ageing Scenario	21.4	21.3	21.8	21.3	20.7	19.6	20.1
	Pure Ageing Scenario with Elasticity	21.3	21.1	20.8	19.9	19.1	17.9	18.2
	Constant Health Scenario	21.5	21.6	23.1	23.5	23.6	22.9	24.0
	Constant Health Scenario with Elasticity	21.4	21.3	22.1	21.9	21.7	20.8	21.8

Source: Author's calculations.

Table 10: Proportion of the healthcare costs of the dependent population that the working population can cover without changes in effective tax rates (in %, 2010-2060)

Country	Scenario	2010	2020	2030	2040	2050	2060
Czech Rep.	Pure Ageing Scenario	76.9	62.3	51.9	42.7	41.3	40.6
	Pure Ageing Scenario with Elasticity	72.5	52.9	40.8	31.6	31.2	31.2
	Constant Health Scenario	77.4	64.1	54.6	45.8	45.2	44.9
	Constant Health Scenario with Elasticity	74.9	60.8	53.0	46.1	45.7	46.0
Denmark	Pure Ageing Scenario	71.5	61.3	49.4	44.7	42.0	39.8
	Pure Ageing Scenario with Elasticity	69.3	55.9	43.2	38.0	34.8	32.7
	Constant Health Scenario	69.3	55.9	43.2	38.0	34.8	32.7
	Constant Health Scenario with Elasticity	71.2	62.7	52.2	48.4	46.8	46.0
Estonia	Pure Ageing Scenario	80.8	74.6	68.9	60.9	55.7	55.5
	Pure Ageing Scenario with Elasticity	73.8	60.0	51.3	42.8	39.1	40.4
	Constant Health Scenario	81.2	76.3	71.9	64.7	60.4	61.2
	Constant Health Scenario with Elasticity	75.6	66.7	61.7	56.5	53.2	54.3
France	Pure Ageing Scenario	88.6	78.1	71.1	65.2	62.4	61.1
	Pure Ageing Scenario with Elasticity	86.6	71.6	62.5	55.8	52.3	50.8
	Constant Health Scenario	89.2	80.4	74.9	69.8	67.7	67.2
	Constant Health Scenario with Elasticity	88.2	77.1	70.8	65.5	63.8	64.2
Italy	Pure Ageing Scenario	56.1	46.5	37.4	31.6	29.1	28.2
	Pure Ageing Scenario with Elasticity	54.6	41.6	31.0	25.4	23.0	22.0
	Constant Health Scenario	56.5	47.9	39.4	34.0	31.7	30.9
	Constant Health Scenario with Elasticity	55.8	46.2	37.9	32.9	31.0	31.0
Netherlands	Pure Ageing Scenario	75.4	59.3	46.3	39.4	35.2	34.9
	Pure Ageing Scenario with Elasticity	75.3	55.8	41.9	34.8	30.4	29.3
	Constant Health Scenario	78.1	64.4	52.4	46.1	42.1	41.6
	Constant Health Scenario with Elasticity	77.0	61.6	49.5	43.0	39.2	39.1
Switzerland	Pure Ageing Scenario	57.1	47.1	37.8	31.6	28.4	27.1
	Pure Ageing Scenario with Elasticity	55.0	41.7	31.7	25.4	22.2	21.1
	Constant Health Scenario	57.6	49.0	40.5	34.6	31.7	30.8
	Constant Health Scenario with Elasticity	56.4	46.9	38.7	33.3	31.1	30.9
United Kingdom	Pure Ageing Scenario	65.7	59.8	52.2	47.1	42.6	40.2
	Pure Ageing Scenario with Elasticity	63.9	54.3	45.2	39.4	34.7	32.7
	Constant Health Scenario	66.5	62.7	56.8	52.7	48.9	47.2
	Constant Health Scenario with Elasticity	65.4	59.7	53.3	48.4	44.8	43.5

Note: The values are calculated as the ratio of the difference of the revenues from the 15-64 years old and their expenditures and the sum of the expenditures of the 0-14 years old and the 65+.
Source: Author's calculations.

According to the **Table 10**, the proportion of healthcare expenditure of the dependent population that can be covered by the working population without changes in the effective tax rates will drop dramatically in all of the analysed countries. The phenomenon is in line with the increasing economic dependency ratio as the demographic projections expect the drop of the proportion of the economically active population on total population.

Based on the self-sufficiency index and the values from table 10, we can expect that if the effective tax rates are not increased the large elderly population will be menaced by important rationing of the healthcare. Countries with high intergenerational solidarity such as France or Estonia are especially vulnerable to such a development.

Conclusion

Population ageing as a long-term process seems to be inevitable in the European economies during next 50 years, at least according to all available demographic projections. Ageing will have significant impact on the life of current and future generations affecting the market of goods, services, inputs and financial products. The effects of ageing on long-term and acute health care with a special focus on intergenerational solidarity have been the main concern of this paper.

Having built a macroeconomic long-term projection model, we have outlined and computed four expenditure scenarios, which might characterise future health care development in the selected eight countries denoting different systems of the health care financing. Population ageing coupled with increasing expectations of society concerning access to and quality of health care represent an important driver of health care costs. In order to satisfy the needs of the population, public health expenditure as a percentage of GDP would have to grow by 36% on average in the selected countries. The results show that the expenditures will be mostly boosted (up to 53%) by considering no shifts in cost-profiles and pondering initially higher elasticity to diminish to unit one, i.e. pure ageing scenario with elasticity. On the contrary, the restrained expenditure development could be expected if the constant health scenario projecting the life expectancy change into the health care costs is the right future expenditure driving force. The expenditure driven by this scenario may increase by 20%.

Bearing in mind constant tax-to-GDP development in the future, expenditure scenarios imply noticeable fiscal imbalances. The average deficit necessary to cover health care expenditure in 2060 varies from 1.4 to 3.7% GDP, depending on the selected scenario. However, in some countries like the Netherlands, the deficit will most likely range from 3.2 to 6.3% GDP, which might be substantial burden for the public finance.

Yet the flip side of the health expenditure is who is going to cover the increasing costs. Current revenue collection systems differ considerably across the European countries. Some systems are dominated by intergenerational solidarity (the healthcare expenditure is financed mostly by the working population) others raise revenues of the public healthcare more equally either from nominal premia or from consumption taxes. In order to express the intergenerational solidarity of the systems we have developed the so called "self-sufficiency index". We have found that France is a leading country in solidarity of financing health care. As well former communist countries like the Czech Republic and Estonia show lower self-sufficiency index of the elderly. Denmark and the Netherlands with indices between 14 to 16% also belong to the more "generous" countries. Then the United Kingdom and in particular Switzerland and Italy have the least vulnerable elderly people from the studied point of view. The current state of the self-sufficiency is not to be changed markedly during next 50 years. The question we tried to answer to was thus

whether the working population will be able to cover the remaining healthcare costs of the dependent population. The answer to the question, under the assumption of constant effective tax rates, is however one of the very unfavourable ones in all of the analysed countries. The proportion of healthcare costs of the dependent population that the working population could cover after covering their own healthcare will drop on average by 45% by 2060 (from current 74% to 41%).

The imbalance between who bears the costs and who benefits from the health care systems reveals a possible future risk of health care being denied to the large elderly generations. Situation may require special attention especially if the elderly people have objectively some difficulties connected with earning additional income to ensure the level of the health care they need. Decisions regarding this problem are not trivial and request deep knowledge of the whole social system since the problematic is interconnected with pension system and system of social network specific for every country.

The obligation of policy-makers is thus to design measures that will ensure accessible health care for all. Possible measures include policies aiming at higher flexibility of the labour markets allowing the elderly populations to remain in the labour force and thus decreasing the negative impact of ageing, adequate settings of the pension systems motivating to remain in the labour force if possible, support of the savings of households aimed at financing the long term care when needed and last but not least standardizing of the provision of healthcare in order to limit the rationing of healthcare for the elderly.

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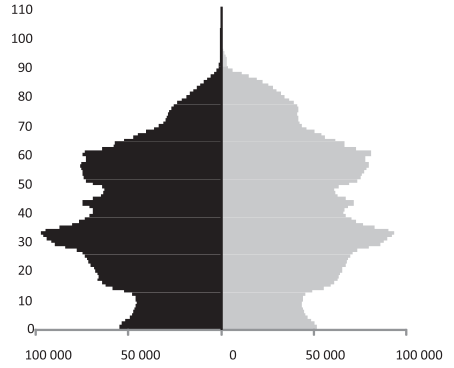
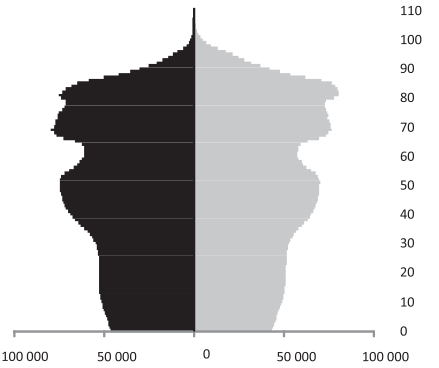
ANNEX1: Population pyramids – "trees and coffins" of life

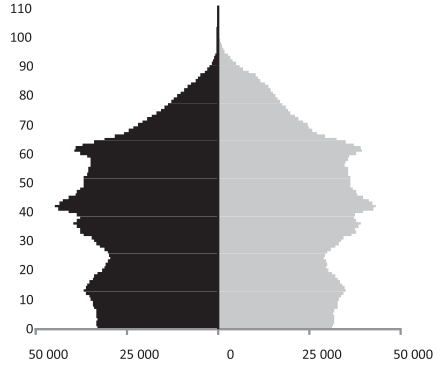
2008
Czech Republic

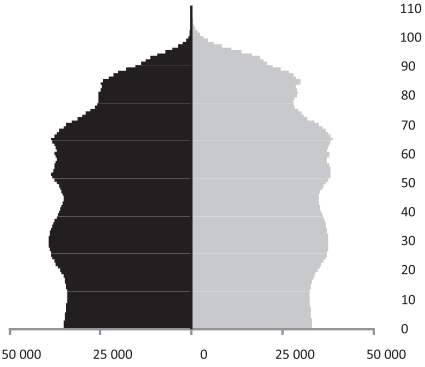


2060

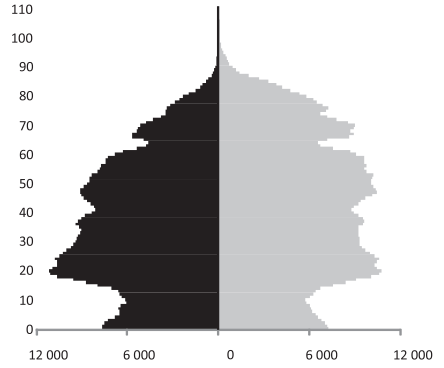


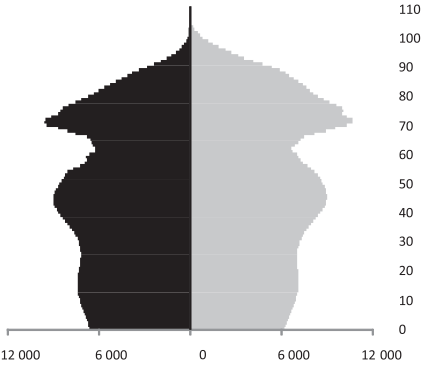
Denmark





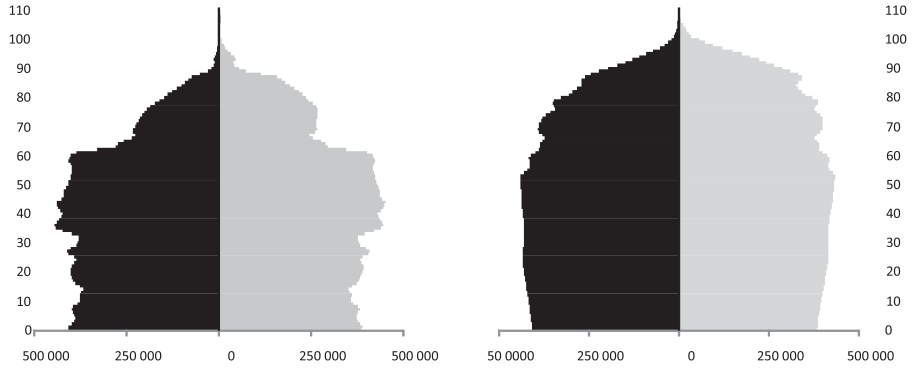
Estonia



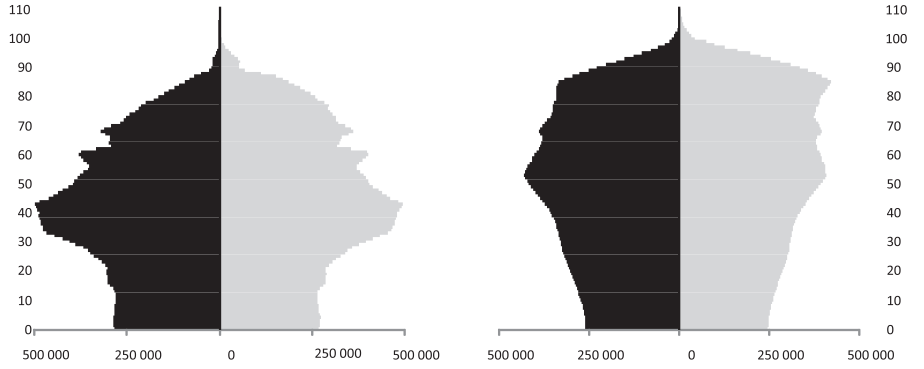


2008 **2060**

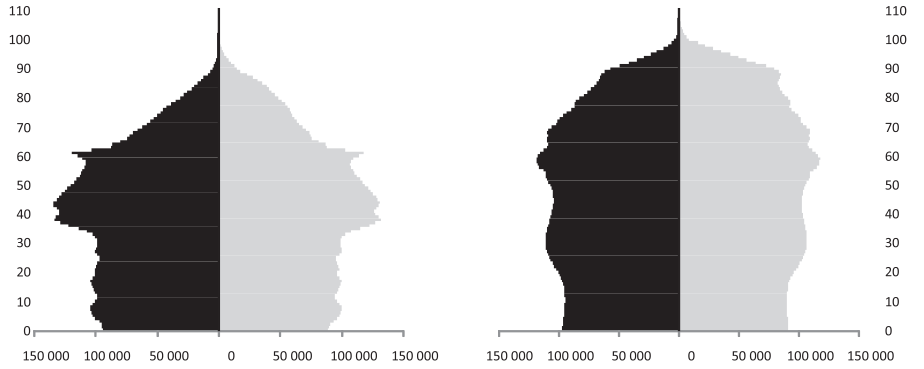
France

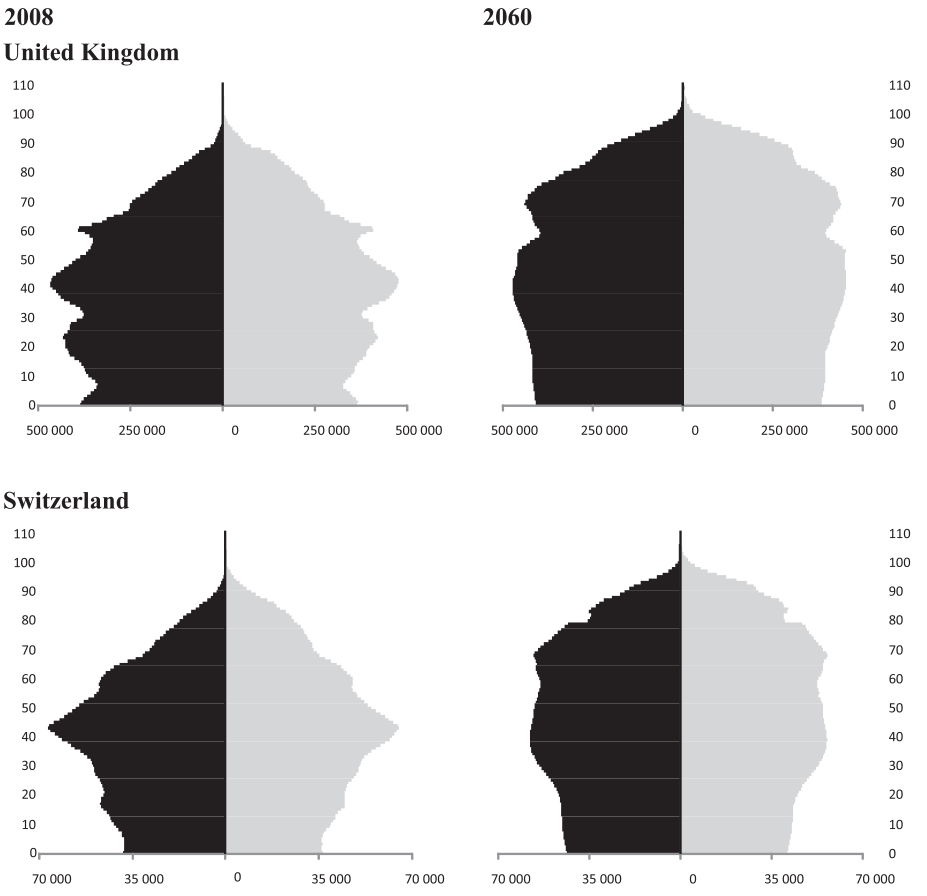


Italy



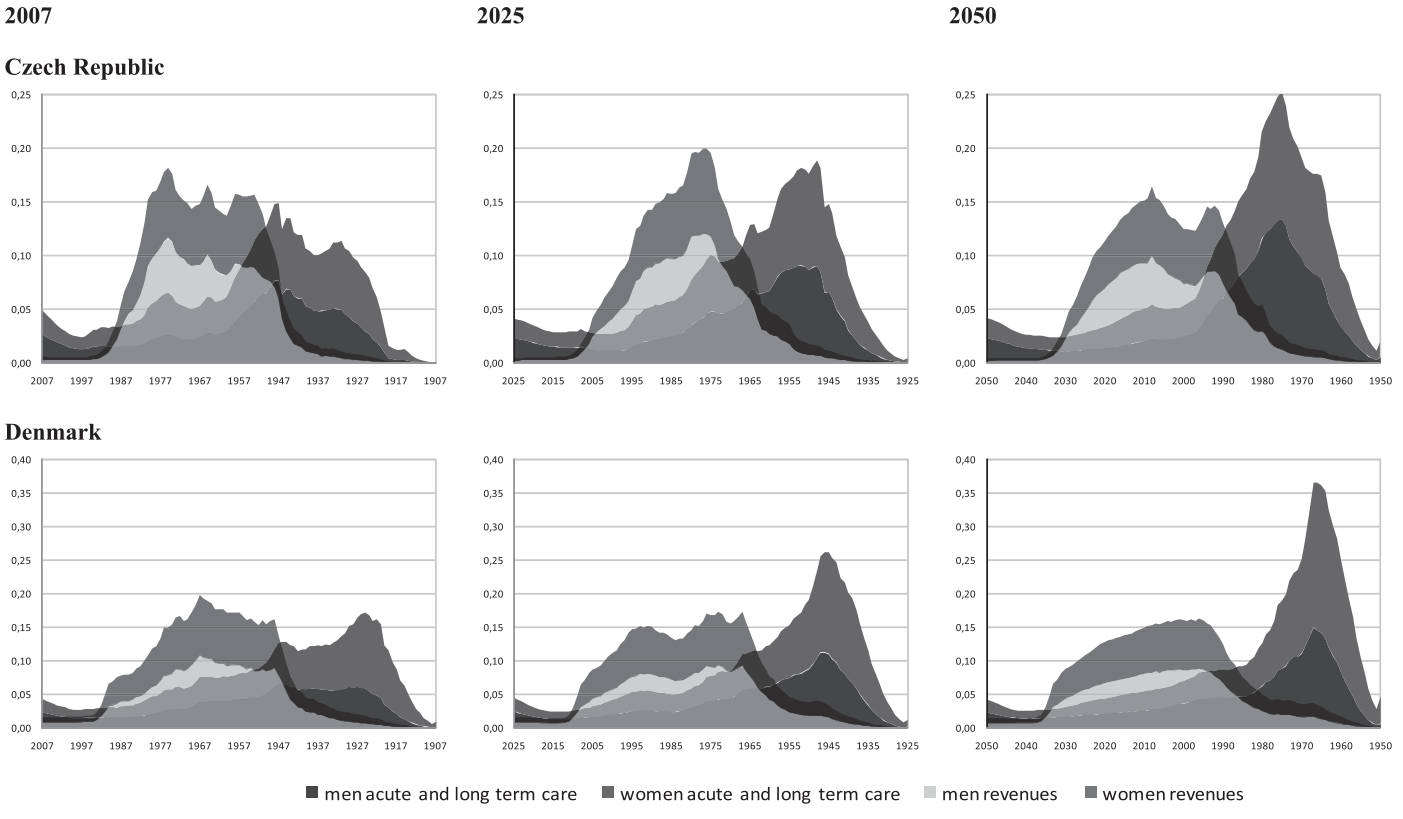
Netherlands

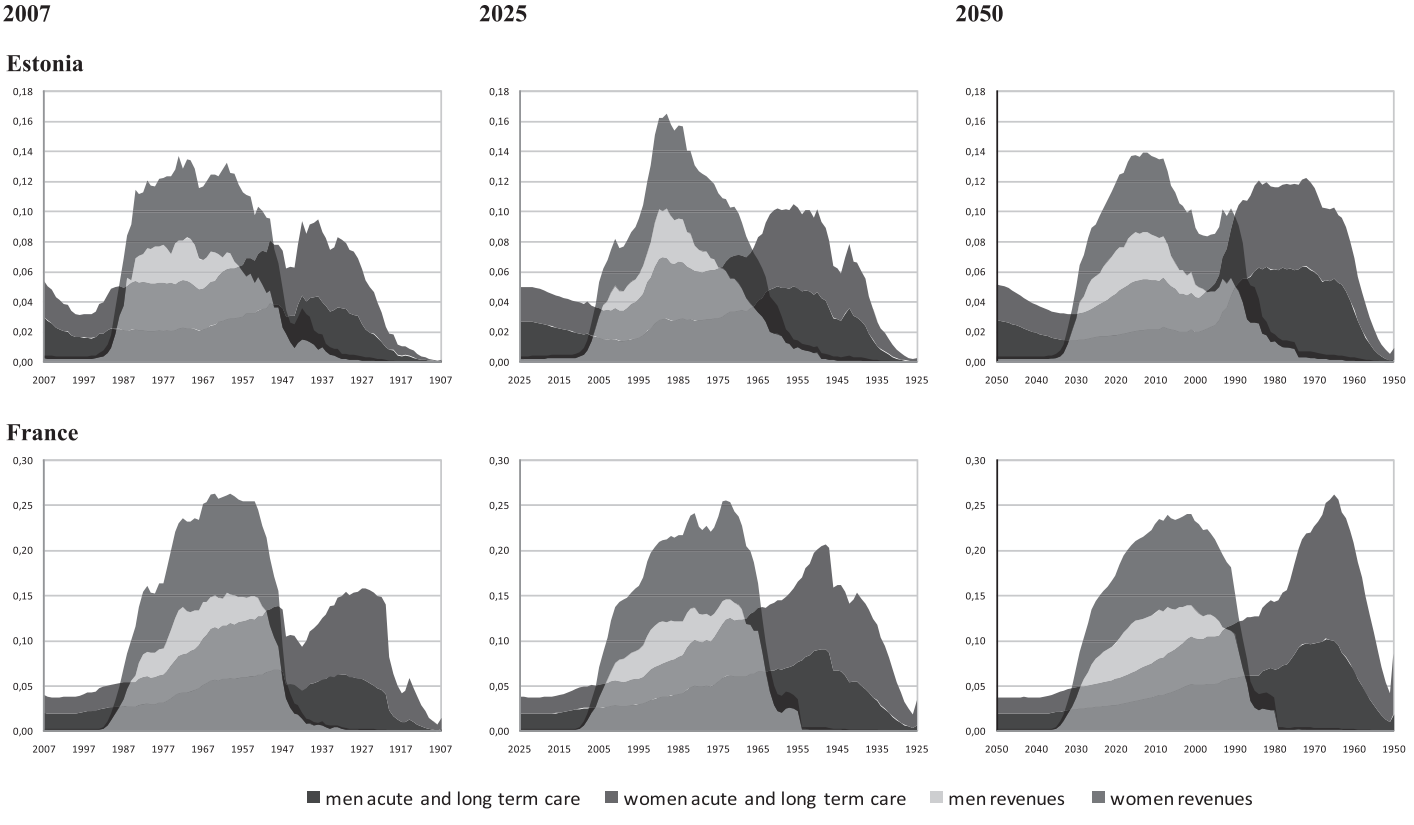




Source: Eurostat (2008c).

ANNEX 2: Public health care sector revenues and expenditures (constant health scenario with elasticity) by generations (in % GDP)

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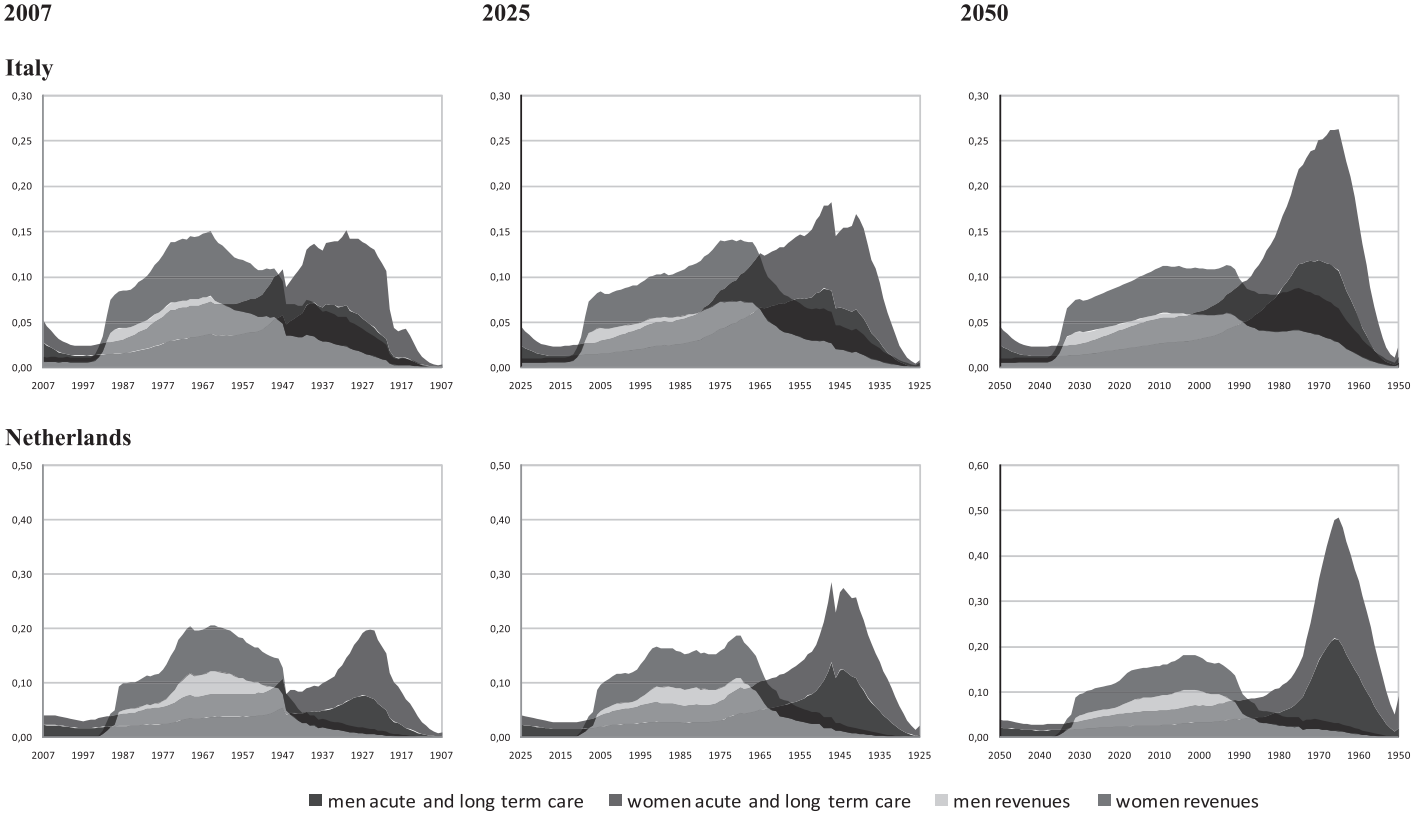
2050 2040 2030 2020 2010 2000 1990 1980 1970 1960 1950
men acute and long term care
women acute and long term care
men revenues
women revenues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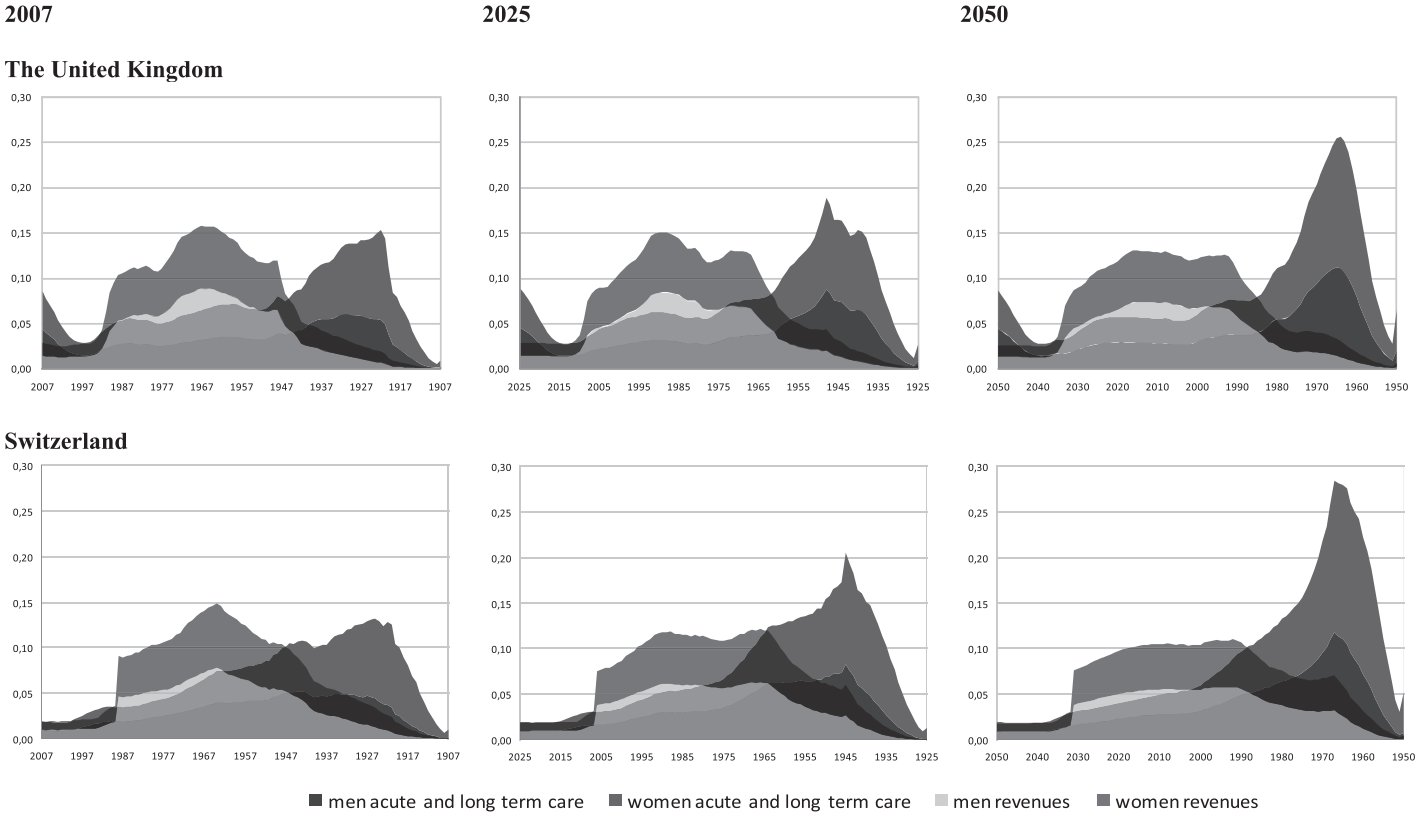
women acute and long term care
men revenues
women revenues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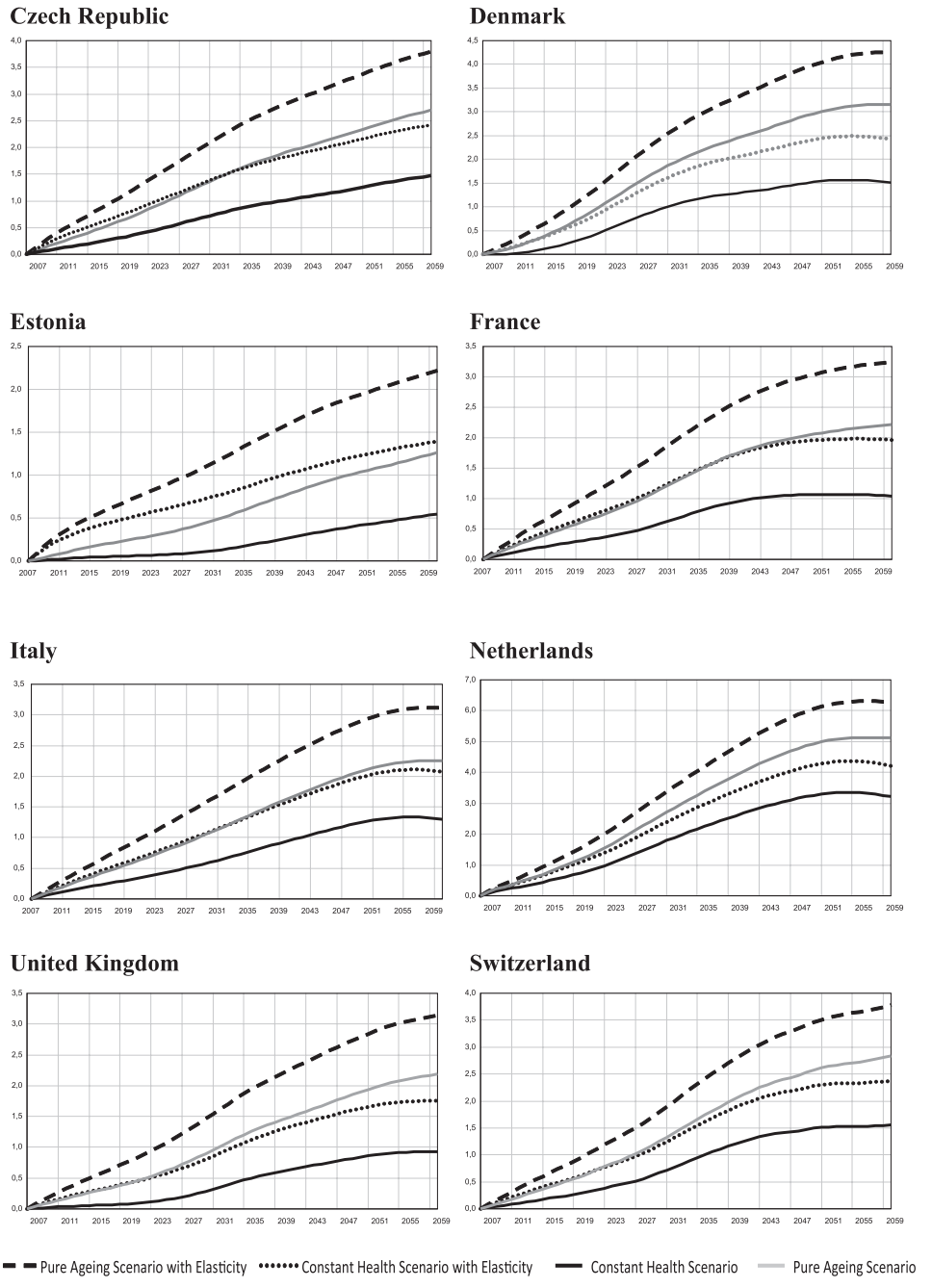
2007 1997 1987 1977 1967 1957 1947 1937 1927 1917 1907
2025 2015 2005 1995 1985 1975 1965 1955 1945 1935 1925
2050 2040 2030 2020 2010 2000 1990 1980 1970 1960 1950
men acute and long term care
women acute and long term care
men revenues
women revenues

ANNEX 3: Public finance deficits scenarios (in % GDP)



Source: Author's calculations.