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LONGEVITY, WORKING LIVES AND PUBLIC FINANCES

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Abstract:

Can longer working lives bring sufficient tax revenues to pay for the growing public health and care expenditure that longer lifetimes cause? We review studies concerning retirement decisions and pension policies, the role of mortality in health and long-term care costs, and errors in mortality projections. We combine key results into a numerical OLG model where changes in mortality have direct effects both on working careers and on per capita use of health and long-term care services. The model has been calibrated to the Finnish economy and demographics. Although there are huge uncertainties concerning future health and long-term care expenditure when people live longer, our simulations show that without policies directed to disability admission rules and old-age pension eligibility ages, working lives are unlikely to extend sufficiently. But, importantly, with such policies it seems quite possible that generations enjoying longer lifetimes can also pay for the full costs by working longer.

Key words: life expectancy, working careers, health and long-term care expenditure, fiscal sustainability

JEL: H30, H63, H68, J11

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1. INTRODUCTION AND MOTIVATION

We are interested in how longer lifetimes affect public finances in a welfare state. We discuss especially how living longer affects the length of working lives and the use of health and long-term care services. We ask whether longer work careers can bring sufficient increases to tax revenues to offset the negative effects of growing health and care expenditure that longer lifetimes cause. The paper also discusses policies, especially policies attempting to make working lives longer.

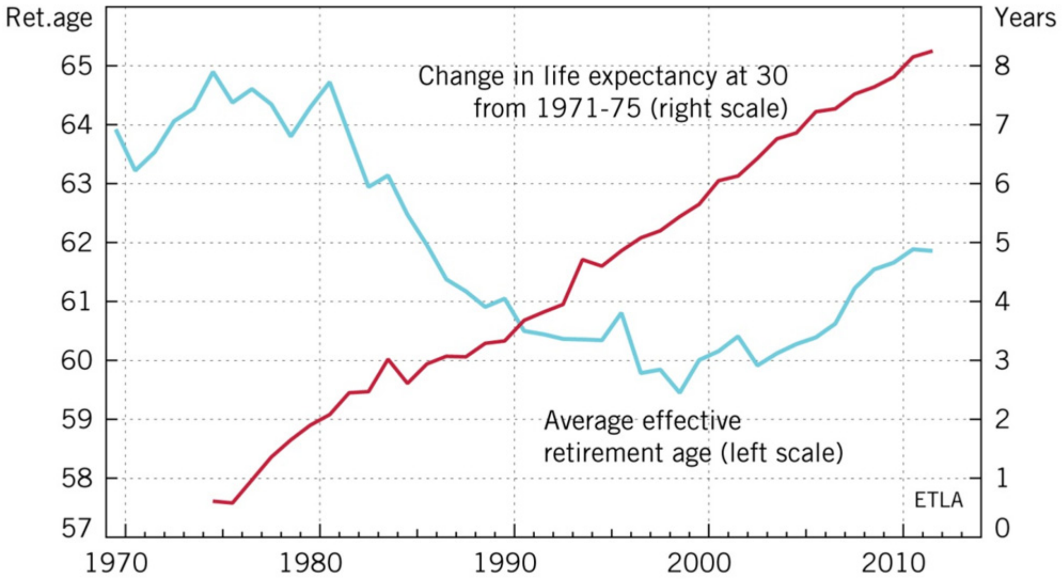
We elaborate on the idea presented by Andersen (2012, p.20): “Sustainability problems are to a large extent driven by underlying trends of which changing demographics are an important contributory factor. An important driver of these changes is increasing longevity (healthy ageing), and for this component it is highly questionable whether it should be addressed by pre-funding or savings”…. “Increasing longevity is a welfare improvement, and the reason it creates financial problems is that some future generations enjoy increases in longevity, while retirement ages do not necessarily follow, and at the same time various entitlements for services provided by the public sector are used more. This shifts the balance between the years contributing to and benefiting from the scheme, causing a sustainability problem. It is not obvious that current generations should be contributing to the financing of this, or whether the proper response is to change entitlements (e.g. retirement age or pensions). Important trade-offs are at stake here between consolidation and reforms changing the underlying entitlements to welfare policies broadly defined.”

To illustrate and quantify the shifts in the balance between the years contributing to and benefiting from the welfare state, caused by variation in longevity, we simulate what happens in the Finnish economy when mortality differs from what is expected in Statistics Finland’s 2012 population projection. We use a general equilibrium model jointly with stochastic mortality simulations. Using a model has the usual positive aspect that consistency is in some well-defined ways preserved. In dynamic general equilibrium models consistency prevails in market equilibria and intertemporal budget constraints. Here consistency also concerns impacts of longevity, in the sense that changes in mortality have direct effects on working careers, on length of retirement and on per capita use of health and long-term care expenditure, in addition to the aggregation effects to the economy that come from the number of people in different age groups.

Besides Andersen (2012), we build on and utilize heavily the following studies: Auerbach and Kotlikoff (1987) on numerical general equilibrium models with overlapping generations, Alho (2002) on stochastic population simulations, Häkkinen et al, (2007) on the role of mortality in health and long-term care expenditure, Määttänen (2014) on eligibility ages and working careers, and on our own previous work (Lassila and Valkonen, 2008 and Lassila, Valkonen and Alho, 2011) on fiscal sustainability.

As a historical background, Figure 1 shows that while life expectancy in Finland has risen steadily during the last 40 years, the average retirement age is currently a couple of years below what it was 40 years ago. Healthy life years have increased almost the same speed as life expectancy[1]. From this perspective a significant increase in the retirement age is certainly possible, but one cannot expect that it will take place automatically. Policies related to various retirement channels and age limits are among the factors that explain the decline in average retirement age during the 1980s, and although many measures have since been reversed, there is a need to reconsider all eligibility ages and rules when aiming for longer work lives.

Figure 1: Life expectancy and retirement age in Finland, 1970 - 2012



Note: Averages of males and females. The average retirement age is influenced by sizes of cohorts.

Sources: OECD (retirement age), Statistics Finland (life expectancy).

Section 2 discusses the demographic aspects of longevity and the uncertainty in population projections. Section 3 concentrates on the effects of longevity to length of average working lives, and the consequences of pension policies. Section 4 studies the effects of longevity on health and long-term care expenditure. Section 5 presents the simulated sustainability results, and Section 6 concludes.

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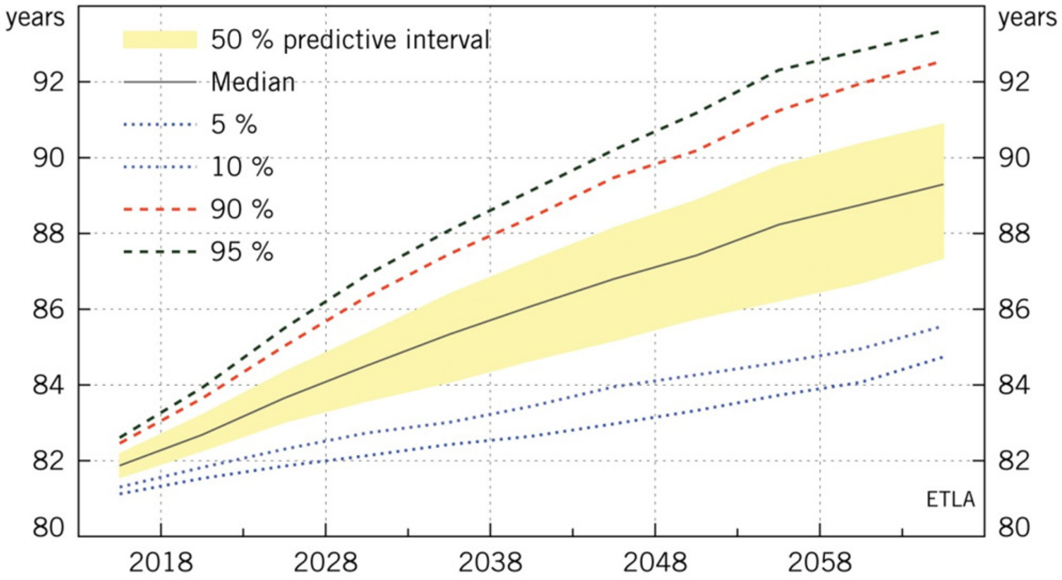
[1] Both ECHP data from years 1996-2001 and SILC data from years 2004-2010 shows that healthy life years (HLY) have increased more than life expectancy among the population 65+ in Finland.

2. LONGEVITY AND DEMOGRAPHICS

As a descriptor of the length of life, we use period life expectancy at 30, average of males and females. We express it as total life expectancy, that is, 30 years plus the remaining life expectancy at 30. During the next fifty years this life expectancy is expected rise to an unprecedented level in Finland. It is, however, very hard to say exactly how high. That is why we resort to stochastic simulations, which are based on statistical analysis of past demographics and forecast errors. We cite Alho (2002): "The analysis of uncertainty was based on the relative error of the naive forecast with data for 5-year age-groups for 1900-1994. In the case of mortality, the naive forecast assumed that the recent past decline in mortality continues indefinitely. As discussed in Alho (1990) and Lee and Miller (2001), the naive method and related extrapolation methods perform typically equally well as (or better than!) the judgmental official forecasts."

Figure 2 shows the predictive distribution of the total life expectancy at 30 for the next 50 years. The median increases by 7.5 years. The 50 % probability interval is about 3.5 years wide in 2060s, and the width of the 80 % interval is 7 years. The predictive distribution is calculated from a stochastic population projection produced by Juha Alho in 2013 by a computer program PEP[2] . This stochastic projection is built around Statistics Finland's 2012 projection.

Figure 2. Predictive distribution of total life expectancy at 30 in Finland



For our OLG model analysis, we first make a constant-mortality version of Statistics Finland's 2012 population forecast. The constant-mortality population starts from the prevailing age structure in the beginning of 2013 and assumes a constant inflow of persons below 20 years of age in the future, no net migration, and the latest (2012) observed age-specific mortalities in all future

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[2] For a description of PEP, visit http://www.joensuu.fi/statistics/juha.html. For a probabilistic interpretation of stochastic population simulations, visit http://www.stat.fi/tup/euupe/sf_interpretation.html. Note that all probabilistic results in this article are conditional on the constant-mortality projection.

periods. This population evolves so that new young generations are all of the same size, and the cohorts diminish in time by mortality rates that are the same as currently observed.

In the alternative population paths, we start from the constant-mortality projection but allow future mortalities to deviate from those currently observed. These deviations follow the assumptions used in the stochastic population projection. We will use 500 simulated population paths which differ only due to different mortality developments[3].

Although we will concentrate on stochastic simulations, it is worth noting that the expected development in lifetimes would change the population structure quite a lot. Figure 3 shows how the ratio of population aged 60 years or more to those in ages 20 to 59 would develop in the official population projection (SF2012), in the constant-mortality projection (Pcons) and in a scenario (Pmort) where mortalities develop according to SF2012 but otherwise it follows the constant-mortality path. The age ratio related to the constant-mortality scenario peaks around 2030, then declines and gradually stabilizes to a higher level than currently. The contribution of the projected increase in life expectancy can be found by comparing age ratios related to scenarios Pcons and Pmort. Thus it is certainly reasonable to assume that longevity will have significant effects to public finances and to the economy. Note that the differences between SF2012 and Pmort are due to differences in the sizes of new young cohorts and in net migration.

Figure 3. Projected age ratios, 60+/20-59

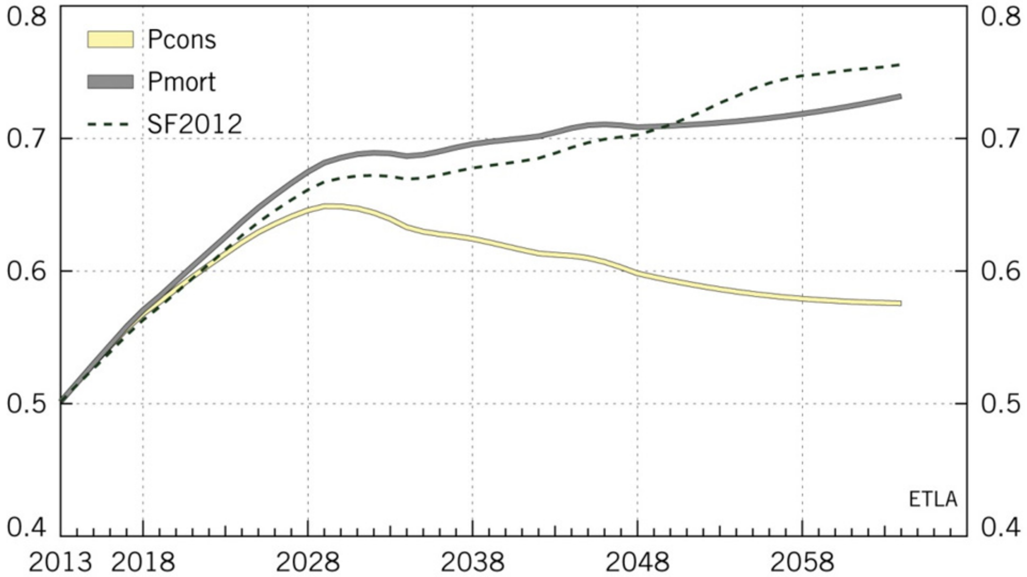

Figure 4 depicts the effect of longer lifetimes on number of persons over 80 years. This is the age after which public long-term care expenditure per capita begins to increase rapidly. Compared to what current mortalities would produce, the predicted longer lifetimes will mean a bigger 80+ population by over 70 % in 2063.

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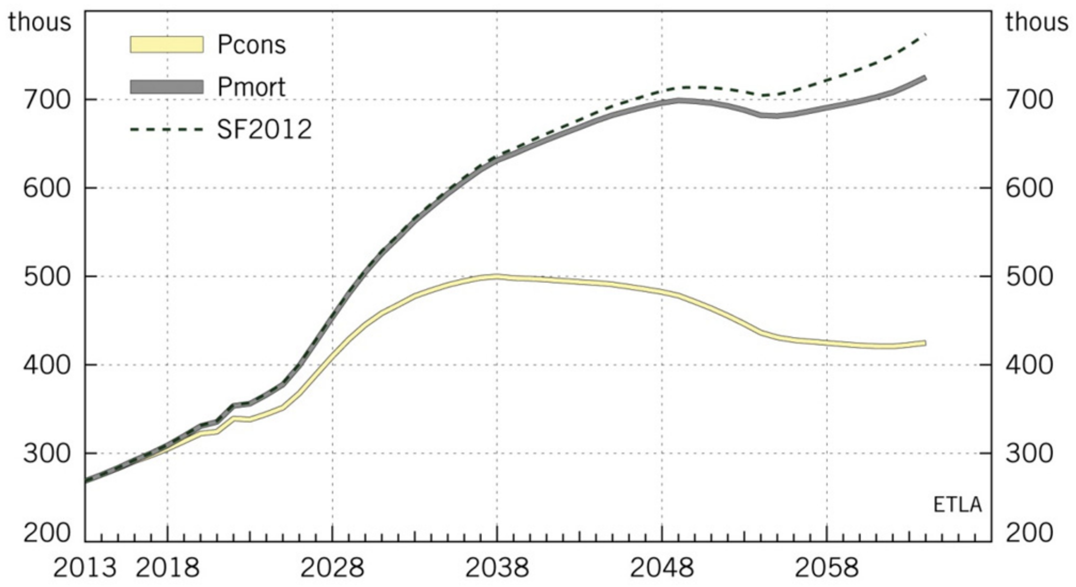
[3] Actually, since there is marginal variation in the surviving number of women in childbearing age, the assumption of stable size of young generations implies that there is marginal variation in fertility rates or net migration.

Figure 4. Projections for population in ages 80+



3. LONGEVITY AND WORKING LIVES

Living longer raises the need to acquire more disposable income during the lifetime, simply to finance consumption for more years. More income can be obtained by working more or being better paid in work; the latter often meaning that work is done more productively due, e.g., to better education.

Longer lifetimes are likely to create incentives to invest in human capital, because the higher wages and pensions due to the years spent in education can be enjoyed longer. Verifying this effect is nonetheless difficult, since higher education also increases life expectancy.

We concentrate on working more, and especially in the form of higher retirement ages. Increasing life expectancies reflect smaller effects of risks that cause deaths. One can assume that some of these risks also cause disabilities that prevent people from extending their working lives. Thus longer lifetimes are accompanied by the possibility of continuing working to older age. Living longer both requires and facilitates longer working careers.

Määttänen (2014) studied policies aiming to extend working lives on the labour supply decisions and income distribution of employees close to the earliest eligibility age for retirement. He used a stochastic life-cycle simulation model that depicts the decision-making of wage earners in different situations. Individuals are grouped in the model according to their age, gender and education. The decision to continue working, or to use one of the various exit routes from working life, is made with the insecure future in mind. Wage earners face the risk of losing their jobs, the risk of becoming disabled and the risk of a surprisingly long life. The size of these risks has been evaluated based on statistics. For instance, people with a low education have a higher disability risk and shorter average life cycle than others.

According to the estimates of Määttänen (2014), adding an additional 3 years to the life expectancy of a 30-year-old would extend working lives by 6 months, assuming that any health problems are likewise postponed by 3 years. This estimate has been used in our numerical OLG model in such a way that the change in life expectancy automatically affects the length of working lives in accordance with the ratio depicted, even if pension rules were left unchanged[4]. In the baseline scenario the realized retirement age will rise by a year and a quarter at every education level from 2013 to 2063. There are also two other factors that increase the projected retirement age. The first is the ongoing change in education structure and the other is the influence of recently implemented pension reforms. The final result is an approximate increase in the actual retirement age by about two years in 50 years in the baseline scenario.

In the retirement age reform, the earliest pensionable age is linked to the adulthood life expectancy. Adulthood is defined as having begun when the legal coming of age takes place at age 18. The pensionable age adjusts every year to changes in mortality so that it divides the expectancy for time lived as an adult to working lives and retirement years at the same ratio (roughly 2:1). If the life expectancy of a 63-year-old grows by just over six years over a period of 50 years, this method of linking would raise the pensionable age by four years. The earliest eligibility age for the part-time pension and the unemployment pathway are changed to the same degree as the pensionable age, since, according to Määttänen (2014), simply raising the pensionable age would not really extend working lives due to an increased use of other exit routes from working life.

Linking the retirement age to life expectancy affects the length of working lives. Based on the model used by Määttänen, raising the eligibility ages of the pensionable age, the unemployment pathway and the part-time pension by two years would extend working lives by 7 months. This estimate has been calculated in a situation where life expectancy has already been extended by three years from the current situation[5].

The retirement age reform raises the average retirement age by over a year by the 2060s, compared to the baseline scenario.

If longevity would follow Statistics Finland’s 2012 projection, working lives will develop as depicted in Figure 5. The ‘No change’ alternative is used as a reference in calculations later.

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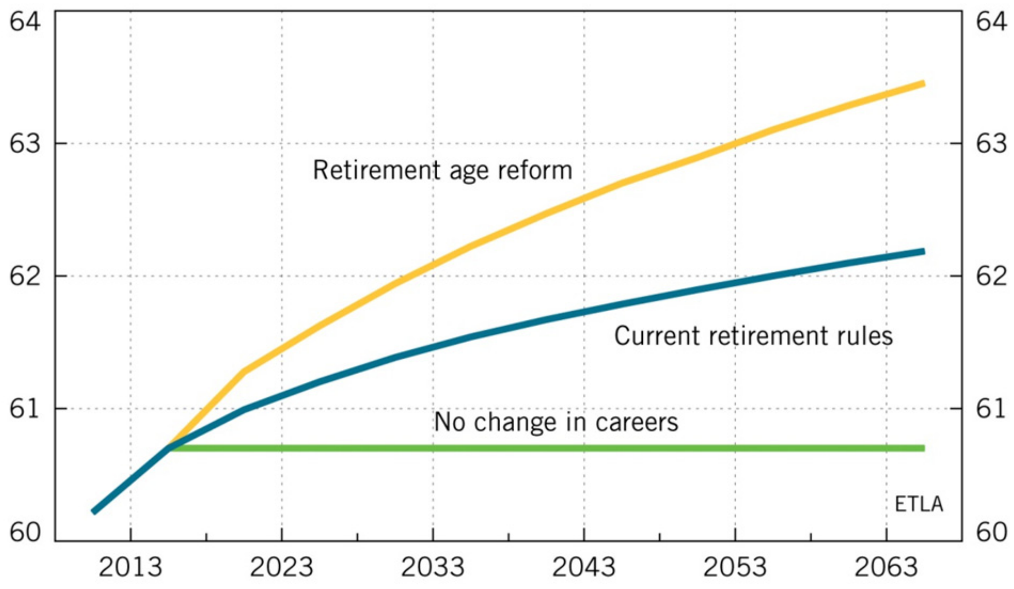
[4] It should not, however, be expected that better health would automatically and fully reduce the willingness to apply for a disability pension. According to Börsch-Supan (2007), differences in prevalences of disability pensions between EU-countries reflect country-wise rules and admission practices, not observed health differentials. Thus constant monitoring and adjustment of rules is required in practice, and the study described above should be interpreted in that vein.

[5] Extending working lives are included in the OLG model through the pensioner proportion, since the model does not contain pensionable age as a variable. In the reform proposal two other changes are also made to the pension system. First, the longevity adjustment of pensions is mitigated by introducing a small increase for deferred retirement age. Second, the current age limits for different accrual rates will change in proportion to the old-age retirement age. See Lassila (2014) for details.

Figure 5. Average effective retirement age



The numerical example above gives good reasons to believe that longer lifetimes themselves will lead to longer work careers, when accompanied with adjustments to disability pension rules so that the effects of better health are fully reflected in lower number of disabilities. Thus there is a possibly significant self-correcting mechanism concerning for public finances. Furthermore, accompanied by retirement age policies, working lives can be made even longer. The presented Finnish reform example was very moderate compared to most European reforms that have been implemented, decided or are discussed.

4. LONGEVITY AND HEALTH AND CARE EXPENDITURE

When discussing population ageing and health and long-term care expenditure, a proper way to start is to acknowledge that rather little is known and uncertainty is large. This concerns the understanding of the driving forces and causalities both currently and in the past. Projections for future are thus based on shallow ground, and uncertainties are magnified by the obvious possibility that whatever the current connections are, they may change in the future. The most relevant issues include technological change, Baumol's disease, income effects and demographic effects (see, e.g. de la Maisonneuve et al., 2013, Häkkinen et al., 2007, and Tuovinen, 2013).

Concerning demographic effects, a basic statistical fact is that per capita health and long-term care expenditure is bigger in older age groups than in younger. The magnitudes vary between countries, and need not be completely monotonic by age, but usually people over, say, 60 years of age use more of these services per person than people under 60. And because population ageing usually means that the number of people over 60 grows more rapidly than those below 60, the worry about increasing costs is obvious.

We concentrate on issues that can be related to mortality changes. Some illnesses and injuries both hasten the death and increase the health and long-term care (LTC) costs in the last years of life. Thus when modeling the dependence of health and LTC expenditure on population and its age structure, it is reasonable to include also mortality as an explanatory variable. This can be used in long-term projections also, since population forecasts include also mortality, implicitly or explicitly.

Our starting point is Häkkinen et al. (2006), who used individual-level health and care expenditure for a large sample of persons in ages 65+ in 1998. According to their calculations, 49 % of health expenditure and 75 % of care expenditure went to persons who died in 1998 – 2002.

From these figures one can deduce that 51 % of health and 25 % of care expenditure was not directly death-related, because they occurred to persons who were still alive five years later. Furthermore, part of the expenditure for those who died during these years obviously had no causal connection with death. A person who died because of lung cancer in 2002 may have been treated for a dislocated shoulder in 1998.

Using mortality data, we can estimate the share of expenditure occurring to those who die within five years, assuming that proximity to death has no effect on the expenditure. To do this by age group, we have to use also data for 2006, and implicitly assume that the per capita supply and unit costs of health and care services were the same as in 1998. The weighted average of this share, estimated over 5-year age groups for persons aged 65 and above, was 28 % of health expenditure and 48 % of care expenditure. These are smaller shares than Häkkinen et al. (2006) report. The difference in health expenditure share, 21 %, can be interpreted as a lower limit for the health cost that proximity to death causes. A corresponding lower limit for care is 27 %. Thus 21 – 49 % of health expenditure and 27 – 75 % of care expenditure has links to proximity to death.

Thus the Finnish data shows that there are costs that depend on the proximity to death and costs that do not depend on it. Assuming that the latter, within each age group, are on average the same per capita for those who died and for those who did not, we can calculate the share of the former. This was 29 % in health expenditure and 51 % in care expenditure. We modeled it to be the same per capita, irrespective of the person's age. Thus the total expenditure depends both on the number of people in each age group and the number of people who will die within the next five years.

Figure 6. Health care costs per capita by age in 2006

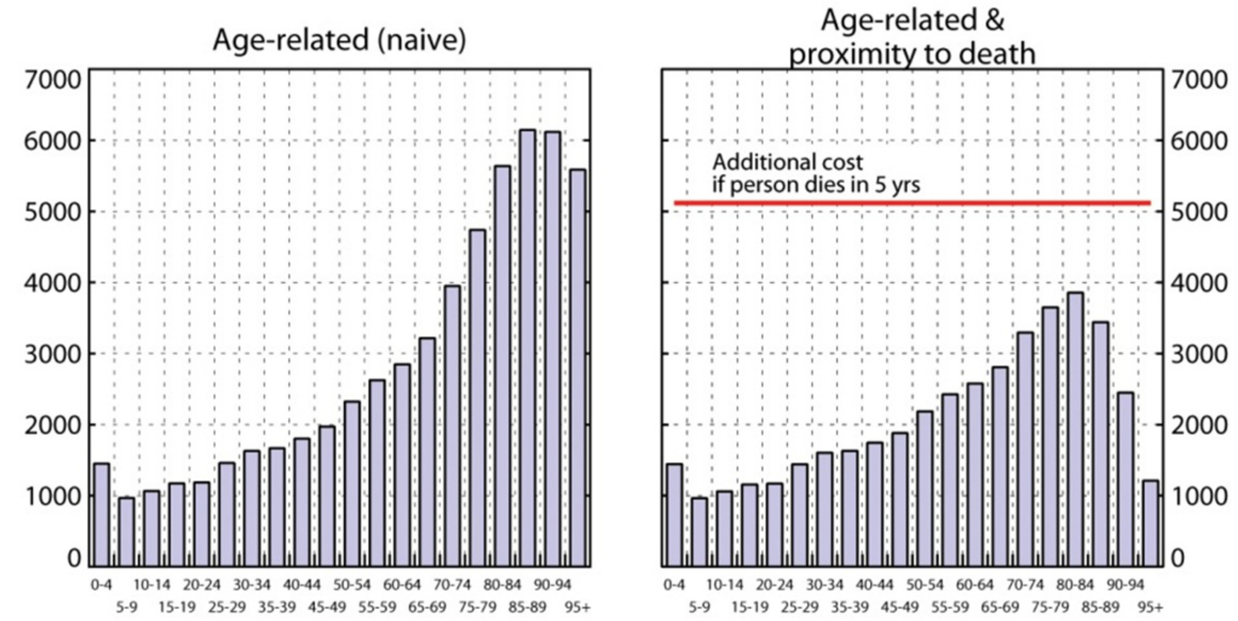


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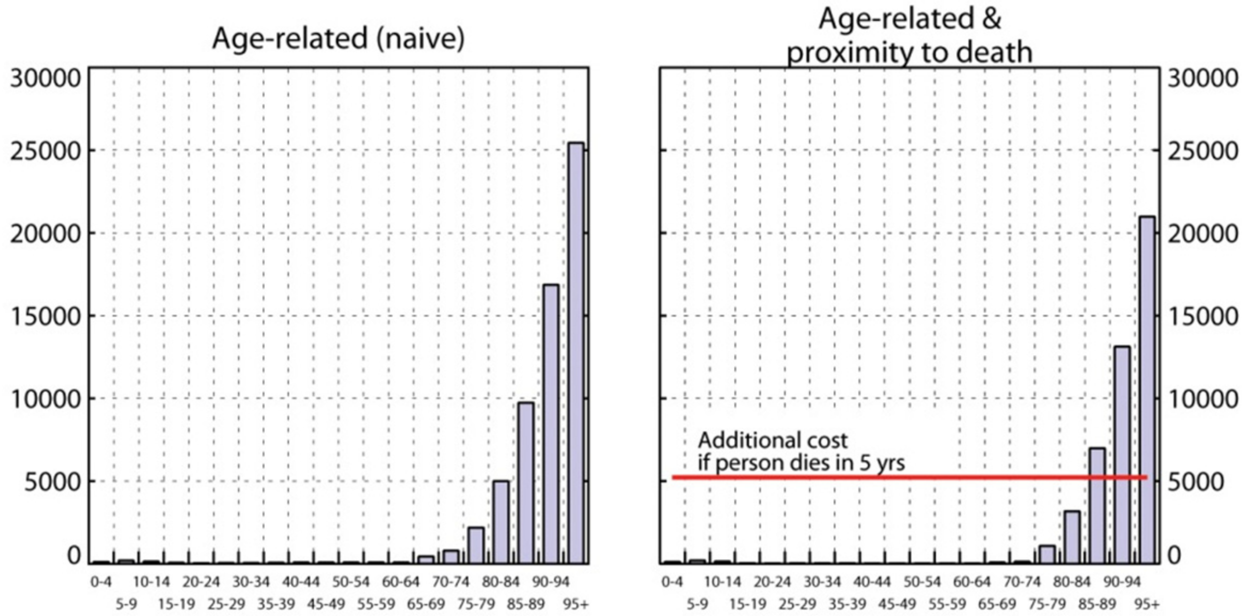
Figure 7. Long-term care costs per capita by age in 2006



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We make two set of sustainability calculations. As discussed above, it is reasonable to include mortality as an explanatory variable, and our first set of sustainability calculations does that. The second sustainability projections are based on per capita costs that stay constant in each age group in the future. These calculations are naïve in the sense that they ignore the concentration of expenditures on the last years of life and assume that the age profile of per capita costs does not change in time. Figure 6 and 7 show the weights that are used.

5. LONGEVITY AND FISCAL SUSTAINABILITY

THE ECONOMIC MODEL

The 500 population projections with different mortalities are used as inputs in an economic model. We simulate the sustainability of public finances using a perfect foresight numerical overlapping generations model of the type originated by Auerbach and Kotlikoff (1987). It is modified to describe a small open economy and calibrated to the Finnish economy. The model consists of five sectors and three markets. The sectors are households, enterprises, a government, two pension funds and a foreign sector. The labor, goods and capital markets are competitive and prices balance supply and demand period-by-period. There is no money or inflation in the model. The unit period is five years, and the model has 16 adult generations living in each period. The model is described in more detail e.g., in Lassila and Valkonen (2007).

We assume that the pre-tax rate of return on saving and investments is determined in global capital markets. In trade of goods the country has, however, some monopoly power, which makes the terms of trade endogenous. Foreign economies are assumed to grow with the trend growth rate of the domestic labor productivity.

The driving forces of the model economy are the transitions in the demographic and educational structure of the population and the trend growth of labor productivity. Population is ageing due to longer lifetimes, low fertility rates and the transition of baby boomers from working age to retirement. Educational level improves in the future since the current middle-aged generations have on average much lower level education than the young ones. The improvement raises productivity of labor. Each household generation is divided to three educational groups with different lifetime productivity profile determined by empirical observations of recent wage profiles. The educational shares are supposed to develop in future in line with the official projections.

Labor input is determined partly by exogenous assumptions and partly due to endogenous adjustments in the model. Hours of work are decided by households. Average retirement age follows the period life expectancy at 30 as described earlier, and in the model this is achieved by changing in each age group the share of those retired. Exogenous factors are trend growth of labor productivity (1.75 % per annum in private goods production), educational gains and unemployment rate. The model is calibrated so that the trend labor productivity growth and the following higher wages do not affect the otherwise endogenous labor/leisure choice of the households.

The growing number of people in old age and near death increases the demand for health and old age care, as described earlier. We assume that these demography-driven additional services are produced in private sector, but production costs are paid totally by the public sector. These services are produced using labor and intermediate goods as inputs. There is no productivity growth in the production. The shares of employees in private and public sector are kept constant.

Real wage adjusts to equalize the value of marginal product of labor and labor costs in the production of private goods and services. The rest of the workers, who provide tax-funded services produced in private and public sector, earn the same wage. Our model includes thereby the Baumol effects.

Public expenditures have strong connection to the age of individuals in Finland. Provision of public services is allocated mainly either to the early part of the life cycle (day care and education) or to the last years (health care and old age care). Similarly, income transfers are distributed mainly either to young families or to retired individuals. This is why the changes in the demographic structure are so important for the public expenditures. We assume that all income transfers (except the earning-related pensions) are fully indexed to wages because any other assumption would have dramatic consequences to income distribution in the very long term analysis. Other than age-related expenditure is assumed to grow at the same rate as the GDP.

Revenues of the public sector originate from two types of sources in the model. The majority of the receipts are accumulated by income taxes, consumption taxes and social security contributions. Another noteworthy revenue source is the yield of the public sector wealth. The yield of the wealth is important especially for the pension funds, but also the central government has substantial amount of financial assets. These features follow the Finnish facts.

We assume that the modeled main subsectors of the general government, such as the municipal sector, the public and the private sector pension fund and the national social security institute, have their own budgets, which are balanced either by social security contributions or earned income taxes. The only exception is the state budget, which is balanced by borrowing until 2145, and after that by using a lump sum transfer. Earned income tax brackets are adjusted with the growth of the economy. The pension funds follow their current prefunding plans, and pension contributions are endogenous. Households are modeled to react to the income and substitution effects of taxation and social security contributions.

CALCULATING THE SUSTAINABILITY GAP

In the OLG model, state tax rates are fixed. The tax accrual varies due to the extent of tax bases and the progressiveness of earnings. The financial assets of the state are kept in constant ratio to GDP, and the net debt and the gross debt are flexible. Local government debt remains in standard ratio to GDP. The pension funds of the private sector fluctuate in accordance with current funding regulations. The ratio of the state and municipal pension fund to the public wage sum has been fixed. The municipal tax rate is endogenous and balances the economy of municipalities together with state aid to municipalities. Earnings-related pension contributions are endogenous. As a whole, the tax rate and net indebtedness of the large public sector are determined based endogenously.

The sustainability gap is calculated from the model simulation results. The calculation looks at the expected long-term disparity between public revenues and expenditure determined according to current tax rates and current procedures, and consolidates that into a single figure. The gap is the difference between the current tax rate (the situation at the time of the calculation) and a hypothetical constant tax rate. The hypothetical tax rate is such that, if it were transferred to immediately, it would be sufficient to cover the expected public expenditure and to keep public net indebtedness at the desired level.

More precisely put, the sustainability gaps presented in this report describe how much higher than the current tax level such a constant tax level is, if taxes were raised to said level immediately and permanently, they would be sufficient to finance public expenditure for the next 100 years and return the public net debt in relation to GDP to the initial level. This would occur when 1) surplus collected during different years are invested in government bonds, and deficits are covered by selling bonds, 2) the discounted surpluses and deficits cancel each other out, 3) the financial assets of the state and the net assets of local governments remain in standard ratio to the overall production, and 4) pension funds develop in accordance with current funding rules.

The deficit calculation is based on a hypothetic total tax rate. It does not take into account the effect that the immediate and permanent raising of taxes – necessary for reaching a standardized tax rate – would have on the labour supply, household savings and the decisions of companies. If one wanted to take these effects into account, the size of the sustainability gap would depend on which taxes would be raised to close the deficit gap. Since the model is a general equilibrium model, the gap estimates exclude any structural deficits that may exist in the start period. The gap does include an effect from the recession that started in 2008 only in the form of an exogenous increase in the public debt in the period 2013 – 2017. This effect is very small, and the gap figures can interpreted as the effects of changes in the demographic and educational structure of the population.

The GDP in period *t* is marked *Y(t)* and the total tax rate with the term $\tau(t)$, public net debt (i.e. the debt of the central and local governments) at the end of the period is marked *V(t)* and the net tax rate at the starting point is marked with the term $\tau(t(0))$. The interest rate *r* is assumed to be constant. The forward-looking sustainability gap *(s2)* calculated from period *t(0)* to *T* by period is then

$$(1)\quad s2(t(0),T)=\frac{\sum_{t=t(0)}^{t(0)+T}\left[\tau(t)-\tau(t(0))\right]Y(t)D(t)\ +\left[V(t(0)+T)-V(t(0)-1)\frac{Y(t(0)+T)}{Y(t(0))}\right]D(t(0)+T)}{\sum_{t=t(0)}^{t(0)+T}Y(t)D(t)}$$

where the discount term D(t) is

$$(2)\quad D(t)=(1+r)^{-(t-t(0))}$$

The first term of the numerator in the first formula describes the effect that changing pension contributions and municipal taxes have on the sustainability gap, and the second term describes the contribution of the change in net public debt.

Figure 8 and Tables 1 and 2 present simulation results from the Finnish overlapping-generations general equilibrium model. The simulations are based 500 population projections in which mortality differs from Statistics Finland’s 2012 projection. The model has been run with three different work career developments. In two of them the career length (measured by average effective retirement age) varies endogenously with the total life expectancy at 30, as described earlier. In ‘No change in careers’ the average effective retirement age is always the one shown in Figure 5.

The model is run with two types of modeling the health and long-term care expenditure (proximity to death included and naïve). With three career types, the total number of simulations is 3000.

In Figure 8 each dot represents one population path. With constant length of working lives, i.e. the ‘No change in careers’ alternative, sustainability gaps would be the larger the longer the life expectancy would become. Under current pension rules working lives would be extended, and gaps would rise less with life expectancy. With pension reform it appears that sustainability gaps would not react to life expectancy.

Figure 8. Total life expectancy at 30 in 2063 and sustainability gaps under different working lives. Proximity of death influences care need.

We note that the relationship between sustainability gaps and life expectancy in Figure 8 has variations. Life expectancy does not uniquely define what happens in different age groups in the population, and using expectancy calculated for one period leaves out variations in other periods. To concentrate on average dependencies, we put the data in Tables 1 and 2.

The numbers in the cells in Tables 1 and 2 are averages and standard deviations within quartiles of life expectancy. In each quartile Q1, … , Q4 there are 125 observations, of which the means and standard deviations are calculated.

Table 1 shows that if life expectancy increases but working lives do not, public finances will certainly be in difficulties, even if proximity of death is fully accounted for. In this alternative the higher the life expectancy, the larger the sustainability gap will be. In Finland the costs would mostly be financed by higher municipal taxes and pension contributions, so public debt would not necessarily be a problem, but total tax ratio would be 3 – 5 % points higher than before the current recession.

But even with current retirement rules (if disability rules are adjusted for better health) the lengthening of the careers would make the sustainability situation much better. And with the described retirement age reform, the sustainability gap would not be sensitive to life expectancy.

If health and long-term care expenditure would depend entirely on age, as the naïve modelling assumes, Finnish public finances would be in deep trouble, see Table 2. Sustainability gaps would be higher in alternative work career scenarios, and they would be increasing with longevity even if the retirement age reform is carried out. Although naïve modeling is against the research results discussed earlier, this type of outcomes could be interpreted to come from income elasticity that exceeds unity, or the use of new expensive technologies. It is important to note that these other explaining factors are easier to control by policy than changes in demography.

Table 1. Selected economic variables under different working lives, by life expectancy quartiles. Care need estimates take account of proximity of death.

Total life expectancy at 30 in 2063 (TLE)	Q_1		Q_2		Q_3		Q_4	
	TLE < 87.3		87.3 < TLE < 89.3		89.3 < TLE < 90.9		90.9 < TLE	
	Mean	*Std*	Mean	*Std*	Mean	*Std*	Mean	*Std*
Average effective retirement age								
No change in careers	60.9	*0.0*	60.9	*0.0*	60.9	*0.0*	60.9	*0.0*
Current retirement rules	61.6	*0.23*	62.0	*0.11*	62.3	*0.10*	62.7	*0.22*
Retirement age reform	62.4	*0.52*	63.2	*0.26*	63.8	*0.21*	64.7	*0.48*
Sustainability gap, %								
No change in careers	2.5	*0.22*	2.8	*0.18*	3.0	*0.16*	3.4	*0.22*
Current retirement rules	2.0	*0.15*	2.2	*0.16*	2.3	*0.14*	2.4	*0.13*
Retirement age reform	1.5	*0.09*	1.4	*0.10*	1.4	*0.09*	1.4	*0.09*
Public debt/GDP, %, 2067								
No change in careers	40.9	*3.18*	39.7	*3.15*	39.9	*2.93*	40.9	*2.68*
Current retirement rules	38.4	*3.48*	35.4	*3.04*	34.3	*2.73*	33.3	*2.70*
Retirement age reform	33.9	*3.92*	28.7	*2.41*	26.1	*2.20*	23.4	*2.61*
Total taxes/GDP, %, 2063-67								
No change in careers	45.7	*0.44*	46.4	*0.34*	46.8	*0.30*	47.5	*0.41*
Current retirement rules	45.3	*0.36*	45.7	*0.33*	46.0	*0.30*	46.4	*0.35*
Retirement age reform	44.7	*0.25*	44.9	*0.29*	45.0	*0.29*	45.3	*0.31*

Table 2. Selected economic variables under different working lives, by life expectancy quartiles. Naïve care need estimates.

Total life expectancy at 30 in 2063 (TLE)	Q_1		Q_2		Q_3		Q_4	
	TLE < 87.3		87.3 < TLE < 89.3		89.3 < TLE < 90.9		90.9 < TLE	
	Mean	*Std*	Mean	*Std*	Mean	*Std*	Mean	*Std*
Average effective retirement age								
No change in careers	60.9	*0.0*	60.9	*0.0*	60.9	*0.0*	60.9	*0.0*
Current retirement rules	61.6	*0.23*	62.0	*0.11*	62.3	*0.10*	62.7	*0.22*
Retirement age reform	62.4	*0.52*	63.2	*0.26*	63.8	*0.21*	64.7	*0.48*
Sustainability gap, %								
No change in careers	4.2	*0.65*	5.2	*0.53*	5.9	*0.47*	7.0	*0.67*
Current retirement rules	3.8	*0.56*	4.5	*0.48*	5.1	*0.41*	5.9	*0.53*
Retirement age reform	2.8	*0.44*	3.4	*0.41*	3.9	*0.35*	4.4	*0.38*
Public debt/GDP, %, 2067								
No change in careers	67.8	*10.38*	78.6	*9.67*	88.0	*9.23*	102.6	*10.89*
Current retirement rules	64.9	*9.63*	73.4	*9.11*	80.7	*8.49*	92.3	*9.42*
Retirement age reform	58.2	*8.25*	64.8	*7.97*	70.4	*7.30*	79.2	*7.83*
Total taxes/GDP, %, 2063-67								
No change in careers	46.9	*0.84*	48.2	*0.67*	49.2	*0.58*	50.6	*0.87*
Current retirement rules	46.5	*0.73*	47.5	*0.64*	48.2	*0.56*	49.3	*0.75*
Retirement age reform	45.6	*0.63*	46.5	*0.58*	47.0	*0.52*	47.8	*0.62*

6. CONCLUSIONS

It is quite possible that longer working lives bring sufficient increases to tax revenues to offset the negative effects of growing health and care expenditure that longer lifetimes cause. It requires active policies and also, to some degree, good luck.

The needed policies include adjustments to rules and admission practices, so that better health can be fully reflected in longer working lives. The policies also include retirement age reforms to ensure that healthy individuals have good incentives to work longer when they can expect to live longer also. Our results confirm the result of several other studies that proximity of death is important factor for public health and old age costs. It means that the link between age and expenditure is much weaker than we are used to think. The future cost increases are therefore less unavoidable and cost-containing policy has more room.

Good luck is needed in the sense that in any case quantitative estimates and guestimates of future expenditure are very uncertain. Uncertainty can probably be reduced by better continuous monitoring, data collecting and research, and that should definitely be done. Currently, however, we cannot be sure of the magnitudes to say with any confidence that longer working lives can in practice fully pay for longer lifetimes in a welfare state. But it is not implausible and should be tried, because longer working lives seem to be an especially apt response to many economic issues brought about by longer lifetimes.

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