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Abstract

This paper studies the quantitative impact of aging on the financing of social security and the public sector in Switzerland. Demographic projections forecast a doubling of the dependency ratio until 2050 as well as an increase of 10% in total population due to longer life expectancy. We use a computational growth model with overlapping generations, including labor market adjustment on five different behavioural margins: labor market participation, hours worked, job search, retirement, and on-the-job training. Starting with a passive fiscal strategy, our simulations show that a doubling of the old age dependency ratio might reduce per capita income by more than 20 percent and necessitate a long-run increase of wage taxes and social security contributions by 21 percentage points. A comprehensive reform package, including an increase in the effective retirement age to 68 years and several other measures, may limit the increase of the tax burden to 4 percentage points of the value added tax and reduce the decline of per capita income to 6% in the long-run. firms typically have a high growth potential, need external funds to finance investment, and rely on the key effort and know-how of inside entrepreneurs. Given the limited amount of tangible assets and the non-contractible nature of entrepreneurial effort, these firms are often financially constrained. Access to external funds becomes an important factor in the expansion of innovative industries. This paper models a two sector economy of innovative and standard industries and shows how the pattern of comparative advantage is shaped by factor endowments and variables relating to corporate finance. In particular, a larger equity ratio of young entrepreneurial firms and tough corporate governance standards relax the financing constraints and create a comparative advantage in innovative industries.

Keywords

Aging, social security, retirement, human capital, unemployment.

JEL Classification

D58, D91, H55, J26, J64

1 Introduction

Demographic change poses a big challenge to the welfare state. The impact of aging on the economy primarily results from the need to adjust the social insurance system in the face of a rising old-age dependency ratio. Keeping old-age insurance sustainable is the largest challenge. With current levels of pension benefits and a much larger number of retirees, spending and contribution rates will need to grow to unprecedented levels. Already now, social spending is a main driver of public sector growth in Switzerland. The size of the public sector increased from 26.2% of GDP in 1990 to 30.2% in 2007. The prime reason is spending on social insurance which grew from 7.2% to 10.8% of GDP (see Bundesrat, 2008). Given the projected rise in the old age dependency ratio, this trend is bound to accelerate over several decades if current policies are continued unreformed. In consequence, the burden of labor taxes and social security contributions would have to grow much larger, with obviously negative consequences for labor market performance. Since contributions to social insurance are basically proportional, they impose a substantial tax/contribution burden in the low and medium income tax brackets even if the income tax burden is low.

The financing of social insurance and labor market behavior are importantly interrelated. Aging necessitates higher contributions to finance constant replacement rates for benefit levels which negatively affect labor earnings and growth. Lower earnings, in turn, require a further increase in contribution rates and labor taxes. The present paper focusses on induced incentive effects of social security on several important margins of labor market behavior in general equilibrium. Specifically, we consider five different behavioral margins: (i) Employees can adjust intensive labor supply, consisting of hours worked or effort on the job. This incentive is measured by the effective tax rate on wage income which includes not only the income tax but also contributions to social security as well as consumption taxes. Only part of social security contributions must be considered as an effective tax, the remaining part is an actuarially fair price for individual insurance. The effective tax component adds to the general wage tax burden. If the pension system includes an operative tax benefit link, earning more today raises one's own benefits during retirement. Typically, the present value of these extra benefits is worth less than current contribution payments. The remaining part of the statutory contribution rate is an effective (implicit) tax, as was first pointed out by Feldstein and Samwick (1992). Many

economic studies confine themselves to this intensive margin of labor supply.

However, the size and quality of aggregate employment importantly depend on other margins of labor market behavior which also adjust to an increasing labor tax burden. (ii) Employees may invest in education and life-time training and, thereby, enhance their future skills and productivity on the job. Being an investment in human capital, training means to accept lower income today to raise future earnings. A progressive income tax tends to discourage training since the extra tax on higher future earnings is larger than the tax savings today when the individual gives up income to devote more time to training. On the other hand, the government often directly subsidizes current training costs. Training incentives are also importantly linked to policies for an aging society. Encouraging postponed retirement not only raises labor force participation among older workers, but also strengthens incentives for training among prime age workers as they can expect to consume the returns to training over a longer active working life.

These continuous margins are complemented by several discrete labor market decisions. (iii) Taxes and benefits influence individual decisions to enter the labor market and, thereby, affect participation rates among prime age workers. The larger the net of tax labor income from active employment is relative to the generosity of social assistance, the larger is the incentive to (re-)enter the labor market. Fiscal incentives are captured by so-called 'participation tax rates' which are typically large since they consist of the sum of tax and contribution rates and the replacement rate of social income when out of the labor force. (iv) The incentives of unemployed persons in the labor force to search for employment and accept a job opportunity are reduced by wage taxes and contribution payments as well as by the foregone benefits and assistance payments when leaving unemployment. (v) Finally, an individual's actual retirement date to a large part reflects a participation decision as well. When postponing retirement and continuing work, a person pays taxes and social security contributions over a longer period and, at the same time, may have to give up an eligible pension. The participation tax rate on continued work can be very high since it consists of the sum of the total effective tax burden plus the foregone pension benefit, and could be an important reason to retire early. The incentives for early retirement can be much reduced if the pension system includes significant pension discounts/supplements to punish/reward individuals for retiring earlier/later.

This paper aims to quantify the potential economic impact of aging in Switzerland. To this

end, we use a dynamic general equilibrium model with a particularly detailed modeling of labor market adjustment along five behavioral margins. The model replicates the demographic projections for Switzerland, including a doubling of the old-age dependency ratio over the next fifty years due to increased life-expectancy, and captures the fiscal implications of this development. It follows the transition from current initial conditions to a long-run balanced growth equilibrium with a new stationary population structure. Demographic change enters as an exogenous shock to the economy which requires a large adjustment of public sector institutions and triggers equally large changes in labor market equilibrium and economic growth. In particular, the model captures the intricate interactions between different dimensions of aggregate labor supply, including labor market participation, job search, hours worked, training, and retirement. As a base case scenario, we first simulate the consequences of a passive fiscal strategy which merely adjust labor taxes and contribution rates to keep public budgets balanced. In line with existing literature, the consequences for total labor taxes and per capita income turn out rather discouraging. We then turn to a comprehensive reform proposal which implements six important policy measures, ranging from structural reform of the pay-as-you-go (PAYG) pillar to an increase in statutory retirement age. Raising retirement age by effectively four years is by far the most important measure. The simulation results show that the reform can limit the increase of the tax burden to 4% of the value added tax (VAT) rate and the decline in per capita income to 6% in long-run. The key message of the paper is, thus, that a large part of the negative consequences of aging can be offset by a comprehensive reform package to boost the quantity and quality of aggregate labor supply and, thereby, the contribution base of social security.

An important point of our analysis is that the projections of the demographic dependency ratio (ratio of population older than 65 relative to working age population) should be complemented by an analysis of the economic dependency ratio (size of retired or passive population relative to active population). The difference is in the adjustment of the retirement age. A particular problem is the general tendency towards early retirement. The decline in labor force participation is partly due to the specific characteristics of current pension systems which, in many countries, imposes considerable negative accrual rates of pension wealth and discourages continued work. Retirement behavior was extensively analyzed in the theoretical and empirical literature, e.g. in Gruber and Wise (1999) who summarize results for a wide range of industrial

countries. Falta et al. (2003) and Balthasar et al. (2003) discuss the situation in Switzerland.

The demographic effects on the financing of pensions and on the economy are discussed in Miles (1999), Börsch-Supan and Winter (2001), and Bovenberg and Knaap (2005), for example.[1] Weil (2006) argues that the most important demographic effects on the economy occur via the financing of pay-as-you-go (PAYG) pensions. Recently, the debate in the U.S. has focussed on either assigning a more important role to capital funded systems (Kotlikoff, 1997, Feldstein, 2005a,b, Feldstein and Samwick, 2002) or reforming the existing PAYG systems (Diamond, 2004, Diamond and Orszag, 2005). Jaag et al. (2009), Grafenhofer et al. (2007) and Keuschnigg and Keuschnigg (2004) analyze aging and pension reform in Austria. Lieb et al. (2003) and Abrahamsen and Hartwig (2003) study the expected demographic effects on old-age insurance in Switzerland. We claim that our model and analysis is the most complete and innovative in assessing the potential labor market consequences of aging and social security reform.

The paper proceeds as follows. Section 2 presents the demographic projections for Switzerland and offers a first analytical assessment of the consequences of aging. Section 3 reviews the empirical evidence on labor market reactions. Section 4 shortly familiarizes the reader with the key features and parameterization of the numerical model, defines a comprehensive policy approach, and then discusses the quantitative results. Section 5 concludes.

2 Aging and Public Finances

2.1 Demographic Change

The demographic scenario published by the Swiss Federal Statistical Office projects population growth from 7.2m in 2005 to 8.1m in 2050. This increase is not due to immigration or higher fertility but rather to longer life-times. Lower mortality rates and higher life-expectancy result in a larger proportion of old people. The dependency ratio, measuring the ratio of people older than 65 and the population of 20 to 64 years old, must inevitably rise. The share of over 65 years old is expected to reach 28% of the total population, compared to 16% in 2005. Hence, the dependency ratio will almost double until 2050 (see Figure 1).

[1] Important survey articles include Feldstein and Liebman (2002), Bovenberg (2003), Lindbeck and Perrson (2003), and Fenge and Pestieau (2005).

Demographic change is governed by three important factors: mortality and life-expectancy, fertility, and migration. There are three official scenarios with respect to life-expectancy in Switzerland (see BFS, 2006). An intermediate scenario assumes that better prevention and continuous medical advancements raise life-expectancy at birth to 85.0 years for men and 89.5 years for women in 2050, compared to 78.6 and 83.7 years, respectively, in 2005. The average fertility was 1.4 children per woman in 2005. The intermediate scenario assumes that increased public awareness of the families' economic and social importance leads to increased support. As a result, the currently low fertility is expected to rise somewhat. Finally, the average scenario assumes that the current trends in net migration will be extended into the future. The free movement of persons will yield only transitory effects on the net immigration from new EU member states. According to the scenario, net immigration which was roughly 40'000 persons in 2005, will decrease from 2012 to 2020 to 10'000 persons and then remain unchanged.

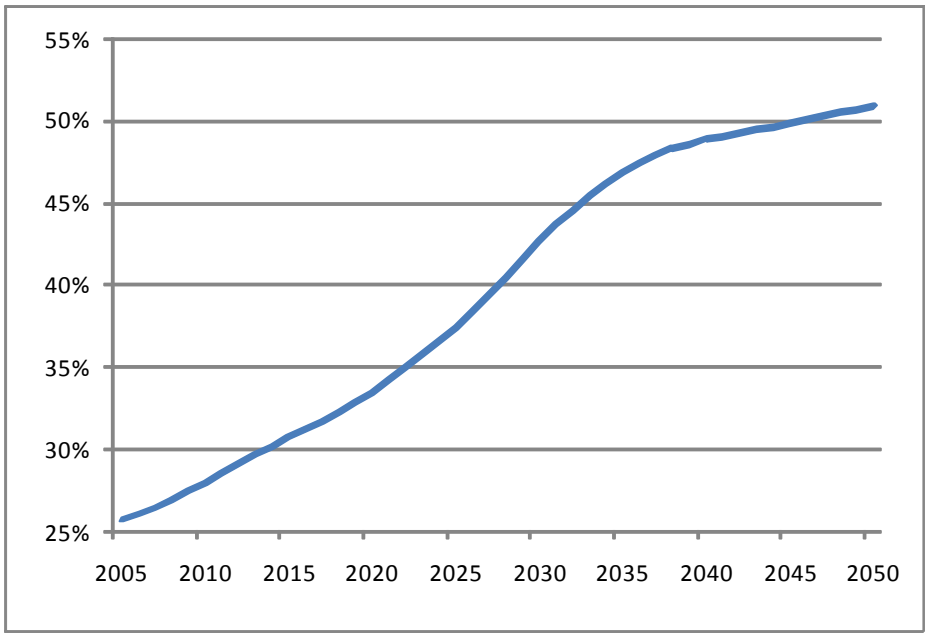

Figure 1: Old Age Dependency Ratio

Our overlapping generations model approximates these trends. A restriction in using a model of balanced growth is that simulations must assume the economy to start from an initial stationary state. Neither the economy nor the population structure is in a steady state at any point in time so that data must be averaged over time and adjusted to some degree to reconcile them with the requirements of a balanced growth equilibrium. However, the key macroeconomic and demographic indicators, such as the current dependency ratio, are correctly implemented

in the model. According to demographic forecasts, the old-age dependency ratio will double in the long-run and eventually reach a ratio of roughly 0.5. As Figure 2 shows, the survival rates increase already in earlier stages of the life-cycle. A 60 year old person will reach more probably the age of 70, a 70 year old is more likely to live until the age of 80, etc. The aging scenario in our model is based on the simplifying assumption that the maximum life-duration is 100 years and does not change so that the survival rate of the last group stays constant. However, lower mortality rates at younger ages imply that a much larger share of people reach the age of 90-100 years old.

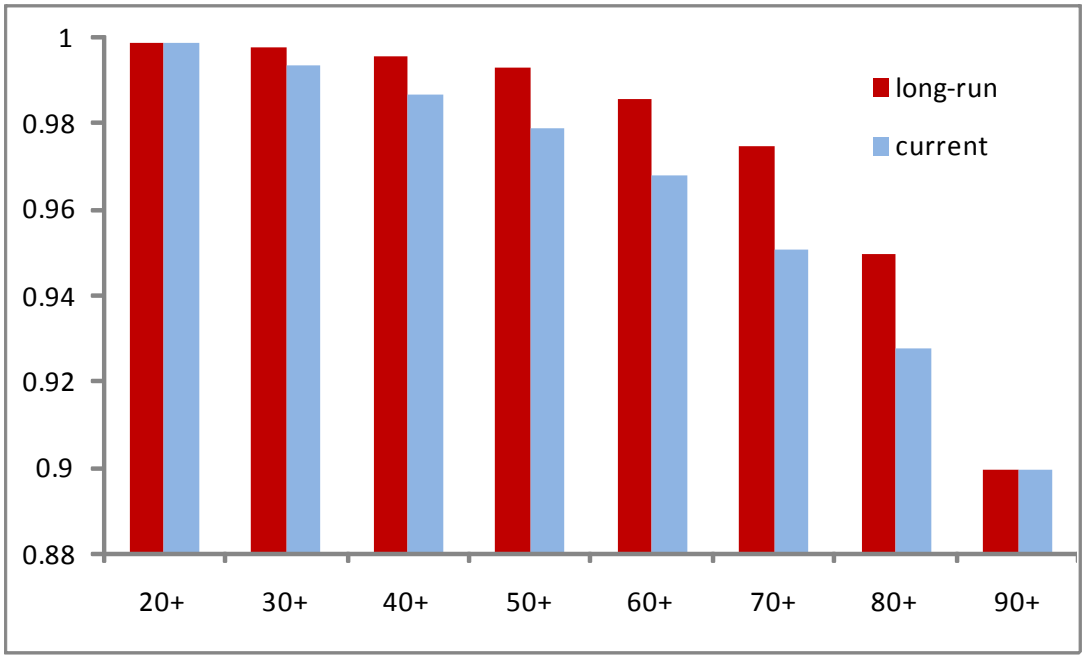

Figure 2: Survival Probabilities

For a given inflow of new borns, lower mortality rates change both the structure and the size of the population. Keeping the inflow of newborns constant, the size of the older population grows when mortality declines. Figure 3 shows how, in turn, the share of older age groups in the total population rises while the share of younger cohorts shrinks. The bars illustrate the relative weights of different age-groups. It is important to note that the long-run age composition of the population is determined exclusively by survival and mortality rates. A larger permanent inflow of new generations, brought about by a higher fertility rate or as a result of immigration, cannot change the demographic structure in the long-run but can only scale up the total population size. The inflow in the model is set such that population size grows by 10% in the long-run,

roughly in line with the above mentioned demographic projections for Switzerland.

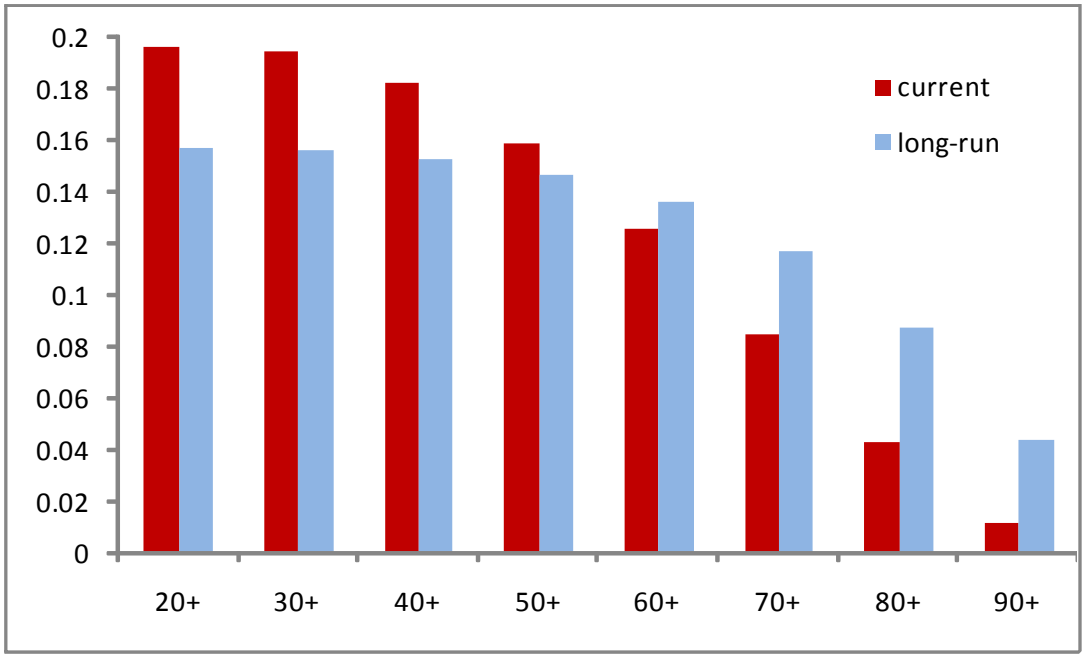

Figure 3: Population Structure

2.2 A Simple Estimate

To illustrate the economic and fiscal consequences of aging in a simple and transparent manner, we collapse the simulation model into two life-cycle stages. The total population over 20 divides into N^A active workers (20 to 65 years old) and N^R retirees (over 65 years old), $N = N^A + N^R$. To roughly replicate the current situation in Switzerland, we assume a dependency ratio of $\rho = N^R/N^A = .25$ and set total population size at $N = 8$m. These assumptions imply a population structure as in (1) below, consisting of $N^A = 6.4$m active workers $N^R = 1.6$m retired persons. Hence, 80% ($N^A/N = .8$) of the population are active and 20% are retired, implying a dependency ratio of 25%.

$$\begin{aligned} N^A &= \tfrac{1}{1+\rho} N, \quad T^A = \tfrac{1}{1+\rho} T^L, \\ N^R &= \tfrac{\rho}{1+\rho} N, \quad T^R = \tfrac{\rho}{1+\rho} T^L. \end{aligned} \tag{1}$$

The second column of (1) translates the cross-section into a life-cycle dimension where T^L denotes total years of life-time and T^A and T^R the duration of active and retired life. If 80% of the total population are active, then 80% of total life-span is spent in the active phase.

Retirement, on average, lasts T^R years. The ratio of retired to active working life is equal to the dependency ratio, $T^R/T^A = \rho$. If the working phase starts at 20 and retirement at 65, the active phase lasts $T^A = 45$ years. From (1), total life-span amounts to $T^L = (1+\rho)\,T^A$ on average which is $1.25 \times 45 = 56.25$ years and corresponds to a life-span of about 76 years, with $T^R = 11.25$ years spent in retirement. These numbers roughly capture the current demographic characteristics in Switzerland.

A steady state involves a continuous demographic change. Young generations turn old while old generations die and are replaced by new young people. This turnover process can be described by two parameters. A fraction γ of old people dies and is replaced by $n = \gamma N^R$ newborns so that inflow and outflow are equal. The parameter γ is the mortality rate among the old or, from an individual perspective, the instantaneous probability of dying. For simplicity, we abstract from mortality at young ages. Similarly, a parameter ω describes the rate with which people turn old and, thus, switch from the young to the old age state. A constant population structure requires that each subgroup remains constant as well. Hence, inflows must equal outflows in each group, $n = \omega N^A$ for the young and $\omega N^A = \gamma N^R$ for the old. The aging and mortality rates are equal to the reciprocal values of the average duration in each state. If a new generation spends T^A years in the active phase, and a new retiree expects to live for T^R more years, then

$$\omega = 1/T^A, \quad \gamma = 1/T^R. \tag{2}$$

In our example, the transition rates are $\omega = 1/45 \approx .022$ and $\gamma = 1/11.25 \approx .089$. With this information, we are able to compute the number of deceases and newborns: $n = \omega N^A = \gamma N^R \approx$ .1422m per year, which amounts to 1.78% of the total population (8m). Using $n/\omega = N^A$ and $n/\gamma = N^R$, the inflow of newborns yields a stationary population of $N = N^A + N^R = (1/\omega + 1/\gamma)\,n$. Having calibrated the demographic parameters from stationary population data, we find the dependency ratio to reflect the ratio of duration rates in old and young life-cycle stages, $\rho = T^R/T^A = .25$, while total population size is linked to total life-time, $N = nT^L = 8$. These numbers are consistent with the data stated above.

The main fiscal consequences of aging stem from old age insurance. Denoting the per capita earnings of the young by y and the per capita pension of the old by p, the budget constraint of

a PAYG pension system is

$$t \cdot yN^A = p \cdot N^R \quad \Rightarrow \quad t = \frac{p}{y} \cdot \frac{N^R}{N^A} = \rho^P \cdot \rho. \tag{3}$$

The pension replacement rate (for all pillars together) varies around a value of $\rho^P = p/y = .6$, i.e. retirement income amounts to around 60% of wage earnings. Given a dependency ratio of $\rho = .25$, the contribution rate must be roughly 15% ($t = .6 \times .25 = .15$) which is a realistic value. The rest of the public sector is ignored here, but is, of course, represented in detail in the simulation model. Finally, per capita income depends on the population structure. Labor productivity of active workers is y, yielding a GDP level of yN^A. Dividing by total population yields, on account of (1), average per capita income of

$$\bar{y} = yN^A/N = y/(1+\rho). \tag{4}$$

Fertility: With this simple model at hand, one can calculate in a straightforward manner the consequences of important demographic scenarios. Declining *fertility* is often considered an important reason for an increasing dependency ratio. In the long-run, this is not true. Only the size of the population is affected, but not its structure. If life-expectancy and duration of the active working period remain unchanged, meaning that the aging and mortality rates ω and γ are unaffected, the dependency ratio $\rho = T^R/T^A = \omega/\gamma$ remains constant. Because the size of the population is linked to the size of the inflow n by $N = n \cdot T^L$, a permanent decline in the number of newborns by 10% scales down total population and the size of each age group by the same percentage, without changing the dependency ratio and the required pension contribution rates in (3). However, increasing fertility affects the population structure in the short-run where the mass of active population increases *before* the mass of retired people starts to grow, i.e. before the 'baby boom' generation retires. In the same vein, immigration which might partly offset declining fertility of the native population, augments the active workforce faster than the retired population, and therefore leads to a temporary reduction in the dependency ratio. In contrast, declining fertility leads to a temporary increase in the dependency ratio.

Life-Expectancy: By 2050, *life-expectancy* in Switzerland will have increased by about 6 years. Progress in medical care reduces mortality almost exclusively among the old because

mortality for the young is close to zero anyway. Hence, the size of young cohorts and the number of women in child-bearing age remain unchanged. With fertility unchanged, the number of newborns is fixed, and the parameters n, N^A and $T^A = 1/\omega$ remain constant. The increase in overall lifetime by 6 years lengthens the duration of retirement from 11.25 to $T^R = 17.25$ years, resulting in population growth at the 'old end' and raising the dependency ratio from 25% to more than 38% ($\rho = T^R/T^A = .3833$). Total lifetime after 20 is prolonged to $T^L = 62.25$ and implies a life-expectancy of 82.25 years. The total population increases by 10.6% from 8 to 8.85m ($N = nT^L = .1422 \times 62.25$). This increase is determined only by the growth of the old population group from 1.6 to 2.45m ($N^R = \rho N^A = .3833 \times 6.4$). The Swiss Federal Statistical Office estimates a population increase from 7.2m today to 8.1m in 2050, which is an increase by .8m, similar to our example. Therefore, projected population growth mainly reflects higher life-expectancy while the decline in fertility is roughly offset by immigration.

This demographic change has at least three important economic consequences. First, population growth due to increased life-expectance strongly reduces per capita income. Given constant labor productivity y of the young, the level of GDP equal to yN^A is not affected. However, when the dependency ratio rising from 25 to 38% as noted above, average per capita GDP in (4) declines by $100 \times (1.25/1.38 - 1)\,\%$, or roughly 9.5%. The effect is certainly large and further magnified if a rising tax burden erodes earnings of the young. Second, the rising dependency ratio makes the pension scheme unsustainable in its current form. According to (3), the contribution rate would have to be raised from 15% at present to 23% ($t = .6 \times .3833$), i.e. by 8 percentage points, if the replacement rate is not adjusted. The fiscal consequences are probably further aggravated by rising pressure for other age related public spending such as health care. Third, an increase in the tax burden of this scale or a reduction in replacement rates will certainly trigger behavioral responses with important consequences for aggregate labor supply, labor productivity and per capita income. To quantify the labor market effects of aging is, of course, the prime purpose of the subsequent general equilibrium simulations.

Retirement Age: A much debated strategy to mitigate the fiscal effects of longevity is to raise the effective *retirement age*. By how much would retirement have to be postponed, so that the dependency ratio remains unchanged? Today, a person spends about 80% (T^A/T^L) of her adult life in the active workforce and 20% in retirement. If the average life-span is

extended by 6 years to over 82 years (i.e. to $T^L = 62.25$ years of adult life), the dependency ratio can stay constant at $\rho = .25$ only if the duration of working life rises from 45 to 49.8 years ($T^A = T^L/(1+\rho) = 62.25/1.25$, see 1) and retirement is postponed to the age of 69.8 instead of 65 years. When life-expectancy rises by 6 years, a constant 'economic dependency ratio' requires that people spend only $6/(1+\rho)$ or 1.2 additional years in retirement while the active phase is prolonged by $6 \times \rho/(1+\rho)$ or 4.8 years. Hence, retirement must be postponed from age 65 to 69.8 if the economic dependency ratio is to remain constant. In other words, every year of life extension must be split between work and retirement in the same way as is done prior to the increase in longevity. Today, a person works for about 4/5 of her total adult life and spends 1/5 in retirement. If life-expectancy rises by one year, households should thus work 9.6 months longer ($12 \times 4/5$) and afford 2.4 months of additional retirement time. With ρ constant, the pension budget in (3) remains balanced without any need to adjust either contribution or pension replacement rates, and average per capita income in (4) is untarnished. If the increase in retirement age is less ambitious, the 'economic dependency ratio' will rise which inevitably forces measures to rebalance the social security system and erodes average per capita income. Obviously, these stylized calculations are only a gross approximation but should suffice to illustrate some key effects and the principal magnitudes involved.

3 Incentive Effects of Social Security

The labor market effects of reforming social security depend on the tax character of contributions. PAYG contributions have a tax component which adds to negative incentive effects of labor taxes. If pension size at the margin is not at all linked to one's own contributions, as is the case in Switzerland with minimum or maximum pensions, the tax component is 100%. The more incomplete the tax benefit link is, the larger is the tax component. Further, PAYG contributions tend to be higher since they are not invested in the capital market and do not earn interest. The implicit return of the PAYG system equals the growth rate of the contribution base and is lower than the long-run interest rate. Households are forced to save for retirement by contributing to the PAYG system which offers a lower return than is possible on the capital market. The tax component of contributions reflects the foregone income due to a lower rate of return. Pensions in a funded system, in contrast, are fully linked to contributions, including (compound) interest.

Contributions thus reflect an actuarially fair price for later benefits and have (almost) no tax component.[2] The funded pillar thus distorts labor supply less than the PAYG pillar. We now review the empirical evidence on five different margins of labor supply over the life-cycle.

Hours Worked: The classical channel for labor supply is on the intensive margin. People respond by adjusting hours worked, or intensity of work effort on the job. They work more if the current real wage net of taxes is high and if current earnings create additional benefits such as higher unemployment benefits, or higher future pensions in an earnings linked system. The overall effective tax burden on work effort includes the wage tax, indirect taxes, and the implicit tax component of social security contributions. Feldstein and Samwick (1992) defined the concept of the implicit tax rate which summarizes the incentive effects of the pension system on intensive labor supply, and have calculated these tax rates for the U.S. As mentioned above, a strong tax-benefit-link reduces the tax component of contributions and strengthens labor market incentives. The econometric estimates of Disney (2004) show that men are not very responsive to a change in the effective contribution tax while women's activity rates are strongly affected. These findings are consistent with much of the empirical labor supply literature. Blundell and MaCurdy (1999) and Meghir and Phillips (2008) survey the large literature.

Job Search: Aggregate labor supply importantly depends on the incentives to search for jobs and actually accept an employment opportunity. Job search of workers and job creation by firms determine market tightness and equilibrium unemployment in a frictional labor market. Job search is driven by the difference in disposable incomes a worker can obtain in states of employment and unemployment. Search incentives thus depend on the expected net wage, the design of the unemployment insurance and pension systems and the value individuals attach to leisure (unemployment). The effective tax on job search tends to be large because it consists of the sum of wage and implicit contribution taxes plus foregone unemployment benefits. The pension system reduces search incentives via the implicit contribution tax. The stronger the tax-benefit-link, the lower is the implicit tax, and the stronger are incentives for job search.

[2] Given the higher risk of a funded system due to capital market fluctuations, diversification calls for a mixed multipillar system even if PAYG contributions offer a lower return and are partly a tax.

There is a large empirical literature on the influence of unemployment insurance on reservation wages and job-search intensity, see the reviews by Atkinson and Micklewright (1991) and Krueger and Meyer (2002). For example, Feldstein and Poterba (1984) find a positive correlation between the size of unemployment benefits and observed reservation wage: a 10% increase in unemployment benefits induces a 4% increase in the reservation wage. Clark and Summers (1982) show that a 10% benefit reduction reduces the U.S. unemployment rate from 6% to 5.92%. This result implies an elasticity of the unemployment rate with respect to unemployment benefits of .13. According to a study by Belot and van Ours (2001) for 18 OECD countries, a one percent increase in the replacement ratio results in a .7 percent increase in the unemployment rate. They also estimate that a one percentage point increase in the income tax rate shrinks the unemployment rate by .12 percentage points.

Labor Market Participation: People decide whether to participate in the labor market and to start active job search at all. Immervoll et al. (2007) summarize the recent literature. Eissa and Hoynes (2004) point out that participation elasticities differ substantially across different population groups. Low skilled households react strongly to participation incentives, and women have a much higher elasticity than men. Even though marginal tax rates are low for the bottom income classes, effective taxes on labor market participation may be large and have strong effects since agents give up substantial replacement income when entering the workforce. In contrast, skilled people with high wage expectations respond only weakly to participation incentives (see Blundell, 1995).

Retirement Decision: The most important distortion of the pension system probably relates to retirement behavior. To encourage continued work beyond the statutory retirement age, the PAYG system may reward postponed retirement with pension supplements and apply discounts to punish early retirement. When these supplements/discounts are low, the effective tax on continued work is high and leads people to retire earlier. A capital funded system sets pension supplements in an actuarially fair way so that the present value of future pensions over the remaining retirement period just corresponds to accumulated pension capital at the retirement date. The effective tax is then close to zero which largely avoids a distortion of retirement choice. In Switzerland, pension supplements and discounts are probably close to an actuarily fair level

also in the PAYG system. A key decision is, however, what the statutory retirement age should be when the normal benefit level is granted.

The design of the pension system determines the old age *participation tax* (effective tax on continued work). The participation tax measures the total fiscal burden on employees, as a share of last earnings from active employment, when they postpone retirement by another year. This measure has three components: (i) wage taxes and contributions paid for another year of continued work; plus (ii) foregone pension benefits that would have been received in case of immediate retirement; minus (iii) the present value of pension supplements acquired per year of postponed retirement. A high participation tax rate makes continued work less attractive and encourages workers to retire earlier.[3] The tax is strongly reduced by an actuarially fair adjustment of benefits. The pension supplements are meant to compensate for the additional taxes and contributions, as well as for the savings due to foregone pensions. The Gruber and Wise (1999, 2004, 2007) worldwide project and subsequent updates provide a documentation of participation tax rates and their impact on retirement behavior. Börsch-Supan (2000) estimates that a decrease in benefits by 12% would reduce the retirement probability of the 60 years old from 39.3 to 28.1%, implying a semi-elasticity of retirement equal to .93. However, this value falls with age and is estimated at .45 for 64 year-olds.

Life-Time Training: Old-age insurance can affect incentives for education and life-time training. Training investments become more attractive if they yield a larger present value of income gains and pay off over a longer working period. For this reason, postponing retirement age tends to encourage training. Lau and Poutvaara (2006), for example, analyze the impact of aging and the pension system on training. In particular, they emphasize that an increase in retirement age and a strong link between pensions and contributions encourage investment in education.[4]

[3] See Börsch-Supan (2000), Mitchell and Phillips (2000), Crémer and Pestieau (2003), Bütler et al. (2004) and Gruber and Wise (2004), among others. Fisher and Keuschnigg (2009) emphasize how the retirement decision interacts with labor supply incentives earlier in the life-cycle.

[4] De la Croix and Licandro (1999), Boucekkine et al. (2002), Kalemli-Ozcan (2002) and Soares (2005) find these effects in theoretical models, too. See Jaag (2009) for an analysis of aging on education decisions.

4 Quantitative Effects

4.1 The Computational Model

Model Structure: We use a calibrated general equilibrium model of a small open economy to study the quantitative impact of aging on the financing of social security and the public sector in Switzerland. For a sufficiently close approximation of the demographic structure (see Figures 2-3 for illustration), the individual life-cycle is decomposed into eight age states, resulting in eight different age-groups with constant transition rates from each state to the next. Individuals become economically active at the age of 20. The first group reflects the size and characteristics of the cohort of 20-29 year old individuals, the last group corresponds to the cohort of 90 to 99 years old (see Table 2 below). The first five age-groups are active while the last three are retired. The average retirement age reflects the retirement decision of people in group 5, the 60-69 year olds. This generalized overlapping generations model features a period length of one calender year and allows for realistic short- and long-run dynamics. Limiting number of different age-states greatly reduces the numerical complexity.[5]

The model captures demographic change and different dimensions of labor market behavior. Savings and investment result from intertemporal choice with perfect foresight. Households save to ensure smooth consumption in the face of uneven life-cycle income patterns. A larger pension replacement rate reduces private savings since agents do not need to save themselves when the pension system provides income. In contrast, a longer remaining lifetime and early retirement boost savings since individuals must accumulate more capital to be able to maintain their living standard over a prolonged retirement period. Higher net interest rates encourage savings. Smoothing consumption depends on the intertemporal elasticity of substitution with estimates fluctuating around .5. Capital accumulation results from intertemporal investment decisions of domestically owned firms. In the long-run, the elasticity of investment with respect to the user cost of capital varies around unity which is consistent with a substitution elasticity between capital and labor equal to around .8, see Altig and Carlstrom (1999) and Altig et al. (2001), among others. Adjustment costs imply that capital accumulation is a smooth process even in an open economy with a fixed interest rate.

[5] See Grafenhofer et al. (2007). The present version is documented in Keuschnigg and Keuschnigg (2008).

In a frictional labor market, not all newly created jobs can be filled with suitable workers. Firms must then create a larger number of vacant jobs to attain a given desired employment level. The overall job surplus to be earned by workers and firms together is the difference between the marginal product of labor and the workers' reservation wages. The wage follows from bargaining and splits the total job surplus between workers and firms. A high bargaining power of workers results in a high wage and, thereby, a high job rent of workers which boosts incentives for job search. A high wage, in contrast, reduces the job rent of firms and their incentives to create jobs. As a consequence, labor market tightness (i.e. the ratio of vacancies to job searchers) is low and unemployment is high since many workers will compete for few jobs. The higher is the bargaining power of workers, the higher is the equilibrium wage and the larger is the unemployment rate. Depending on the bargaining power of workers, high labor taxes as well as high unemployment benefits are partly shifted to firms so that both inflate the wage and lead to more unemployment. The estimate of Scarpetta (1996) implies that a 10% increase in the replacement ratio of unemployment benefits leads to an unemployment rate higher by about 1.3 percentage points. This coefficient compares with an estimate of 1.7 in Layard et al. (1991), 1.1 in Nickel (1997) and roughly the same in Blanchard and Wolfers (2000).[6]

Parameters: Table 1 shows key data and parameters of the simulation model. The numbers depict the growth trend of the Swiss economy with 2005 as reference year. The values of the key behavioral elasticities reflect the consensus of recent econometric research. We refer to Altig and Carlstrom (1999) and Altig et al. (2001) for standard parameter values not discussed here. The average unemployment rate is 3.6% in the initial steady state (ISS). It varies during the life-cycle, being larger for younger workers (see Table 2). The labor market participation rate is 74% on average. The average retirement age is about 64 in Switzerland which is relatively high in comparison with other countries. Approximately 40% of workers 60-70 years-old are still active in the labor market. Table 2 shows the age structure of the population: the 60-70 years-old represent roughly 13% of the total population. The old age dependency ratio (defined here as the ratio of workers to retirees) is 28% in the initial steady state (ISS).

[6]Readers may consult the project report and technical appendix for more detailed discussion of the model, parameter values and institutional features, see Jaag et al. (2008).

Table 1: Model Parameters

Households and Production:		
r	0.035	annual real interest rate
g	0.018	growth rate of labor productivity
δ	0.100	depreciation rate of capital
σ^K	0.800	elasticity of capital labor substitution
σ^C	0.350	intertemporal elasticity of substitution
$\bar{u}$	0.036	average unemployment rate
$\bar{\delta}$	0.740	average participation rate
x	0.400	retirement age/participation rate 60-69 years old*)
N^R/N^W	0.277	retiree-worker ratio
Welfare System:		
ρ^u	0.540	replacement rate of unemployment benefits
ρ^a	0.230	replacement rate of social assistance
τ_1^L	0.328	effective tax rate, hours worked
τ_1^P	0.373	effective tax rate, prime age participation
τ_1^S	0.693	effective tax rate, job search
τ^R	0.236	effective tax rate, continued work

Legend: *) The retirement date corresponds to the share of active households in the group of 60-70 years old.

The effective tax rates in the last four rows of Table 1 summarize the joint incentive effect of all taxes and relevant replacement incomes on different behavioral margins of labor supply. Except for the retirement decision, Table 1 shows these tax rates for the first age group, which corresponds to the 20-30 years old. The effective tax rate on intensive labor supply (hours worked by the employed) mirrors the wage tax burden that is 26% on average. In addition, the effective tax rate is inflated by the tax component of PAYG pension contributions and the consumption tax. Like wage taxes, consumption taxes also lower real wages. The resulting effective tax rate is about 33% for the youngest workers. The participation tax rate for prime age workers includes the employee tax burden plus the replacement income due to social assistance and other subsidies (as a share of an employees' gross income). According to Table 1, the effective participation tax rate at 37% is rather low and not much higher than the effective wage tax

burden, while the effective tax rate on job search is almost twice as big. There are two reasons for this pattern. First, unemployment benefits are much more generous than social assistance. When moving from unemployment into a job, workers thus face much higher opportunity costs in terms of foregone benefits, compared to giving up social assistance and other benefits when moving out of non-participation. Second, only a quarter of the non-participating are covered by social assistance so that, on average across all households, social benefits are less important for the participation decision.

Finally, the participation tax rate on the retirement decision equal to 24% seems to be rather low by international standards. The Swiss PAYG pillar includes pension supplements for each year of postponed (discounts per year of premature) retirement equal to 6.8% which seems close to an actuarially fair value. The supplements and discounts in the funded pillar are actuarially fair by definition. Therefore, the tax distortion against postponed retirement basically consists of the general wage tax burden only. This low participation tax rate may be interpreted as an important aspect of the high flexibility of the Swiss labor market which differs from unfavorable labor market incentives in the pension systems of many other countries.

Table 2 reports life-cycle parameters where the upper half refers to demographic parameters that were already discussed in the context of Figures 1 and 2. One of the most novel and policy relevant features of the computational model is that it captures the life-cycle incidence of earnings, skills and unemployment. We can thus contrast the unemployment experience of younger workers early in their career with the labor market status of older workers near retirement. The life-cycle income profile depicts the usual hump-shaped pattern where the incomes of retired groups mostly reflect net of tax pensions. Disposable income of active groups depends on their skills which endogenously adjust to training incentives and induce life-cycle wage profiles, and on a directly progressive wage tax which is highest for people with earnings at the peak of their career. As is typical for life-cycle models without bequests, the marginal propensity to consume out of life-time wealth increases with age so that the oldest persons have the highest consumption propensity because they expect the shortest remaining life-time.

Table 2: Demographic and Life-Cycle Parameters

Age Group	a	1	2	3	4	5	6	7	8
Cohort		20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99
Population share	N^a/N	0.20	0.19	0.18	0.16	0.13	0.09	0.04	0.01
Age retention rate	ω^a	0.90	0.91	0.91	0.92	0.93	0.95	0.97	1.00
Survival rate	γ^a	1.00	0.99	0.99	0.98	0.97	0.95	0.93	0.90
Marg.prop.consume	$1/\Delta^a$	0.03	0.04	0.05	0.05	0.06	0.08	0.10	0.12
Disp.wage income	$\bar{y}^a$	0.63	0.89	1.02	1.01	0.69	0.62	0.58	0.56
Wage tax rate	$t^{w,a}$	0.24	0.26	0.28	0.29	0.25	0.25	0.25	0.25
Labor productivity	$\bar{\theta}^a$	1.43	1.95	2.23	2.26	1.85	-	-	-
Participation rate	δ^a	0.65	0.75	0.80	0.80	0.65	-	-	-
Unemployment rate	u^a	0.04	0.04	0.03	0.03	0.03	-	-	-

Legend: $1-\omega^a$ is the transition rate to the next age state. $1-\gamma^a$ is the mortality rate in each age state.

Pension System: The model captures the institutional characteristics of the Swiss pension system with three pillars: the PAYG system, the mandatory private pension system, and voluntary private savings with preferential tax treatment as a third pillar. PAYG spending represents 6.6% of GDP, of which about 3/4 are covered by contributions. The gross replacement rate in the PAYG pillar is 40%. Only 60% of PAYG pensions are earnings-linked. The flat component reflects the fact that the tax-benefit-link is eliminated for minimum pensions of low income households and maximum pensions of people with earnings higher than the upper contribution ceiling. The division into a flat and a variable part is important for the size of the tax component of contributions: the larger the share of the flat part in the PAYG pension is, the higher is the contribution tax. The size of the tax component depends also on notional interest, equal to the growth rate of wages. The total effective average employee and employer contribution is about 8.3%, yielding an implicit tax rate of about 2% in the youngest age group.

Adding funded and mandatory PAYG pensions yields a gross replacement rate of about 60% of the last wage income in total. Of total pension income, 65% stems from the PAYG and 35% from the funded pillar. Funded pensions not only reflect accumulated contributions but also earned interest. The tax component of private pillar contributions is clearly lower. However, it

is still positive because of administrative costs. In our model, we assume that administrative costs consume 1% of the return on pension assets. Hence, pension funds generate an effective return of 2.5% which is lower than the market interest rate of 3.5%. Total pension assets amount to approximately 127% of GDP.

4.2 Long-Run Effects of Aging

With our calibrated model at hand, we now quantify the long-run economic effects of aging as described in Section 2.1. The demographic scenario consists of three elements: (i) the dependency ratio roughly doubles due to increased longevity; (ii) the total population increases by 10% in the long-run; and (iii) the working age population declines by about 6%. For a given inflow of new generations, increased longevity would actually expand the total population by substantially more than 10%. Hence, the inflow of new agents is scaled down to an extent that limits the population increase to the projected 10%. This smaller inflow therefore reduces the working age population. To provide a benchmark, it is assumed that the government follows a passive strategy, leaving current benefit rules unchanged and merely adjusting wage taxes and contribution rates to balance budgets. The long-run effects are reported in column 'Age' of Table 3. In section 2.2, we have argued that contribution rates and wage tax rates must strongly increase, and that the pure demographic effect implies a large decline in per capita income. The equilibrium results must be much larger for two reasons. First, the actual increase in the dependency ratio is larger than in the example of Section 2.2. Second, the required large increases in tax and contribution rates strongly discourage labor supply, leading to a further reduction in per capita income beyond the pure demographic effect.

Table 3 shows a large long-run impact of aging on public finances and the economy. Fiscal balance requires to add 7.4 percentage points to the wage tax schedule over the entire income range. For example, the wage tax rate of the 20-30 years old would increase from 24 to 31%, and similarly for all other groups. On top of that, contribution rates of both employees and employers must also be raised by 7.4 percentage points. Alltogether, the statutory labor tax burden rises by 22 percentage points. While employer contributions are a full factor tax, employee contributions only partly count as a tax. The effective tax on hours worked rises by almost 10 percentage points, and similarly the effective participation tax. Aggregate labor supply thus shrinks due

to fewer hours worked and lower participation of prime age workers. The effective tax rate on job search rises to a lesser extent since unemployment benefits are partly indexed to net wages so that a higher wage tax burden not only reduces the value of work but also the value of unemployment. Nevertheless, the tax distortion still increases substantially, from an already high level, which leads to a large increase in the unemployment rate, from 3.6% in the absence of aging, to 6.4%. This large effect is also due to higher employer contributions which inflate wage costs of firms and discourage job creation.

Aging induces a moderate tendency for early retirement which reflects offsetting forces. On the one hand, increased longevity leads to a large reduction in capital funded pensions which, other things equal, implies postponed retirement. On the other hand, the tax changes favor early retirement. Although higher wage taxes reduce both active earnings and pensions, higher contribution rates exclusively diminish income from continued participation and, thus, makes work relatively less attractive compared to retirement. This second effect dominates and induces early retirement which eventually reduces the participation rate among the 60-70 years old from .4 to .33. The scenario implies diverse training incentives for different life-cycle groups which overall result in moderately higher average labor productivity. With this exception, all labor market responses work to magnify substantially the demographically induced reduction of the workforce. Aggregate employment thus falls by 12.8% in absolute levels. Since aging has no consequences for long-run capital intensity in a small economy with a fixed interest rate, the GDP level shrinks by the same percentage. However, GDP is now divided over a 10% larger population so that per capita GDP declines by 21%. With this benchmark in mind, we now turn to the potential of several policy strategies to cushion the economic impact of aging.

4.3 A Comprehensive Policy Approach

Basically, there are three possibilities to offset the effects of aging on the financing of social security: reduced benefits, higher contributions, and an increase in the retirement age. From an individual's perspective, the common denominator of all these measures is a reduction of the benefit-contribution ratio. These adjustments refer not only to the PAYG, but also to the funded pillar. When pension funds must pay benefits over a longer remaining life, actuarial principles require either a lower replacement rate or larger reserves for annuities which must

be saved with higher contributions during active working life. Other ways to offset the labor market impact of aging are structural reforms that improve incentives and strengthen the wage base. Section 2.2 argued that an increase in retirement age must be a central policy response to avoid a large increase in tax rates or a decline in replacement rates. In the following, we present and quantitatively evaluate a comprehensive reform package which consists of seven elements: (i) raising the retirement age to increase the participation rate among older workers; (ii) strengthening the tax benefit link in the PAYG pillar by eliminating the upper income ceiling for pension assessment so that benefits become earnings linked also for incomes higher than this ceiling; (iii) eliminating unemployment benefits from the contribution base so that periods of unemployment no longer add to entitlements of PAYG pensions; (iv) taking measures to reduce administrative costs in the funded pillar which are rather high by international standards, by half a percentage point; (v) tighter monitoring of unemployed persons to cut the unemployment rate and strengthen the contribution base; (vi) measures to encourage life-long training to strengthen the contribution base but also to improve the employability of older workers to facilitate the increase in the retirement age. In all cases, the VAT is raised by 4 percentage points, and the wage tax schedule and PAYG contribution rates by both workers and firms are endogenously adjusted to assure fiscal budget balance at all dates. The VAT is considerably less harmful to incentives for extensive labor supply than wage taxes because it taxes the income in both active and inactive states while the wage tax reduces only the employed income. The higher VAT allows for smaller increases in wage taxes and contribution rates so that the financing of social security becomes less damaging for labor market performance. The last six columns in Table 3 present the cumulative impact of these policy measures so that the last column shows the *total* effects of aging and structural policy reform relative to the Status Quo growth equilibrium in the absence of aging and reform.

4.3.1 Raising Retirement Age

Raising the retirement age to keep older workers in the labor force is the central piece of the reform package. Raising the statutory retirement age by 3 years means that the regular pension will be received only at the age of 68 instead 65, with no additional pension compensation and an unchanged replacement rate. Pension supplements/discounts are kept at 6.8% per year so

that postponing retirement beyond 68 is rewarded and retirement earlier than 68 is discouraged. Column 'Late' in Table 3 reports long-run effects. Comparing to column 'Age' shows the differential impact of the reform while comparing to 'ISS' gives the total impact of aging and the higher retirement age. Recall that the (exogenous) long-run expected retiree-worker ratio as a result of aging is close to 0.5, almost twice as much as today's ratio of 0.27. Raising the retirement age reduces the number of pensioners and augments the active workforce, leading to a much smaller increase in the dependency ratio to 0.38. Still, the number of retirees is 40% higher than in the status quo. Hence, not only the VAT rate is up by 4%, but also the wage tax and contribution rates to the PAYG pillar have to rise by 2.4% to finance the large increase in pension spending due to longer life-spans.

The direct effect of raising retirement age is that the decline in the physical labor force by 7.2% is turned into a gain of 1.7% relative to the ISS (initial steady state). However, effective tax rates are higher for all margins of labor supply, although much less than in the pure aging scenario. Effective tax rates on hours worked and on participation of prime age workers are up by almost 5 percentage points, and somewhat less with respect to job search. Relative to the aging scenario, incentives for job search improve considerably and reduce the unemployment rate from 6.4 to 4.5%. The lower tax load also encourages participation of prime age workers. Importantly, training investments become more profitable since the returns to training accrue over a longer working life. Average labor productivity significantly improves by 1.3%, up from .7% in the aging scenario. To sum up, raising the retirement age provides a strong fiscal relieve, allows for a lower tax burden and strengthens incentives on all margins of labor supply. The measure thus offsets a large part of the negative economic incentives created by aging. Consequently, the decline in total labor demand is reduced to -.8%, a huge improvement relative to the loss of -13% in the aging scenario. While the level of GDP is down by a moderate -.8%, GDP per capita still declines by around -10% on account of a larger population due to longevity. The loss in per capita GDP as a result of aging is almost halved. Finally, a higher retirement age strongly reduces life-cycle savings and wealth per capita since individuals need to save for a shorter remaining retirement period.

Table 3: Aging and Comprehensive Social Security Reform

	ISS	Age	Late	Ceil	Un	Adm	Mon	Train
Absolute Changes:								
Tax Increase i)	0.000	0.074	0.024	0.020	0.017	0.010	0.009	0.006
Implicit Payg Tax ii)	0.019	0.083	0.032	0.018	0.015	0.011	0.010	0.007
Eff. Tax on Hours ii)	0.328	0.411	0.371	0.358	0.358	0.350	0.352	0.348
Eff. Particip.Tax ii)	0.373	0.461	0.416	0.403	0.402	0.394	0.395	0.391
Eff. Tax on Search ii)	0.693	0.738	0.715	0.709	0.687	0.683	0.683	0.681
Eff. Retirement Tax	0.236	0.202	0.202	0.053	0.052	0.026	0.027	0.024
Pension Repl.Ratio	0.600	0.568	0.606	0.589	0.579	0.583	0.584	0.580
Retirement Date	0.400	0.334	0.801	0.811	0.811	0.814	0.813	0.815
Participation Rate	0.740	0.721	0.725	0.728	0.728	0.730	0.730	0.730
Unemployment Rate	0.036	0.064	0.045	0.042	0.034	0.032	0.026	0.025
Percentage Changes:								
Labor Force		-7.232	1.748	1.933	1.946	1.998	1.990	2.026
Gross Wage		-4.541	-1.610	-1.489	-1.871	-1.406	-2.057	-1.851
Hours Worked		-1.363	-0.836	-0.652	-0.623	-0.483	-0.500	-0.501
Labor Productivity		0.668	1.270	1.285	1.298	1.306	1.285	2.602
Labor Demand		-12.835	-0.797	0.285	1.173	1.907	2.354	3.946
GDP p.cap.		-20.913	-9.990	-9.009	-8.202	-7.537	-7.131	-5.686
Consumption p.cap.		-20.896	-11.003	-10.027	-9.665	-7.838	-8.079	-6.688
Wealth p.cap.		9.067	-5.996	-5.009	-4.630	-5.742	-6.296	-7.494

Legend: Columns report cumulative effects. i) Financing through higher wage tax and PAYG contributions. In the reform scenarios, 4 percentage points of VAT are also added. ii) Tax rate for 20-30 years-old; (Age): Aging without reform (no use of VAT financing); (Late): increase in retirement age; (Ceil): eliminate contribution ceiling in PAYG pillar; (Un): no accumulation of pension entitlements of unemployed; (Adm): reduction of administrative costs in funded pillar; (Mon): monitoring of the unemployed; (Train): investment in training.

4.3.2 Strengthening the Tax-Benefit-Link

In Switzerland, the PAYG pillar limits benefits to a maximum amount so that contributions above an upper income threshold (equal to 79'560 Fr. per year) do no longer augment individ-

ual pensions. The existence of this income ceiling implies that pensions on incomes in excess of this threshold are no longer linked to individual earnings. In this upper income range, contributions are perceived as a full tax which adds to the general income tax and discourages labor market behavior. Currently, out of all pension payments from the PAYG pillar, 2% refer to minimum pensions, 60% to regular earnings linked pensions, and 38% on maximum pensions above the income ceiling. In the simulation model, 40% of pensions in the status quo are flat and 60% are earnings linked. The scenario specifically assumes that the share of earnings linked PAYG pensions is raised to 90% and the flat pension reduced to 10%, rather than to 2%. This conservative assumption should allow for somewhat higher minimum pensions to cushion other negative distributional effects such as the reduction of the real pension value due to a higher VAT rate. Finally, to avoid an increase in pension levels when a larger part of income enters the benefit assessment, the scenario also assumes a moderate reduction of the replacement rate.

Column 'Ceil' reports the total long-run effects where the differential effect of eliminating the income ceiling is seen by comparing to column 'Late'. The economic implication is to reduce the tax component in PAYG contributions and to reap efficiency gains by strengthening the tax-benefit-link. The required increase in wage tax and contribution rates is reduced from 2.4 to 2%. Effective tax rates fall on all margins, and rather strongly in case of the effective retirement tax on account of a somewhat lower replacement rate. The reform stimulates labor supply on all margins (relative to column 'Late'). As a result, total employment as measured by labor demand expands by one percentage point, turning a loss of -.8% to a gain of .3%. GDP per capita now falls by 9%. Hence, strengthening the tax-benefit-link by eliminating the income ceiling yields an income gain of almost one percentage point.

4.3.3 Eliminating Unemployment Benefits from Contribution Base

The PAYG pillar in Switzerland adds unemployment benefits like any other earned income to the pension assessment base. The problem with this rule is that it alleviates the consequences of unemployment and weakens job search incentives. Presumably, this rule is intended to prevent old-age poverty. This goal, however, is already addressed by the existence of minimum pensions which are raised as part of the preceding policy initiative. By eliminating this rule, pensions are linked exclusively to employment. Denying new pension entitlements during unemployment

strengthens search incentives and must favorably affect the unemployment rate and thereby total employment. As column 'Un' in Table 3 shows, the effective tax rate on search is reduced by 2 percentage points, leading to a significant reduction in the unemployment rate from 4.2 to 3.4%. Lower unemployment saves spending on unemployment benefits and allows a small reduction in residual wage tax and contribution rates, down from 2 to 1.7%. The gross wage falls more strongly since the reform cuts the workers' fallback option in wage bargaining. With higher job rents, firms expand labor demand by placing more vacancies, making possible the substantial reduction in the unemployment rate. The slight cut in the wage tax rate has positive side effects on the other margins of labor supply. Therefore, effective employment and the level of GDP now increase by 1.2%, where the differential effect amounts to almost 1 percentage point. Accordingly, the loss in GDP per capita is reduced from 9 to 8.2%.

4.3.4 Reducing Administrative Costs of Funded Pillar

The fragmentation and complexity of the funded pillar in Switzerland with a multitude of independent pension funds and relatively low returns have been criticized in the past, among others by the World Bank (Queisser and Vittas, 2000). Better supervision, more competition and more freedom of choice might yield a higher return. We cannot quantify the precise magnitude of the efficiency gain and instead assume, somewhat arbitrarily, that the administrative cost can be reduced from 1% to .5% of pension fund assets. Column 'Adm' reports the long-run effects. Due to lower administration costs, the return in the second pillar rises from 2.5 to 3% while the net interest in the capital market remains at 3.5%. The contribution rate to the funded pillar is kept constant but contribution capital earns a larger interest and, ceteris paribus, results in a larger funded pension. To keep the total pension replacement rate fixed, the PAYG pension is scaled down by the same factor as the private pension is scaled up. The budgetary saving is used to cut wage tax rates as well as employee and employer contributions to the PAYG system. In general equilibrium, these rates can be reduced in total by roughly 2 percentage points ($100 \times 3 \times (.017 - .01)$, see the first line in Table 3). Effective tax rates are thus reduced to a moderate extent which stimulates all margins of labor supply. The unemployment rate drops further to 3.2%. Alltogether, effective employment and per capita GDP expand by another .7%, as compared to the prior scenario.

4.3.5 Tighter Monitoring of Unemployed

Sanctions against shirking in job search and monitoring of unemployed job seekers are often used instruments of active labor market policy. To model monitoring and santions, we assume that unemployment also yields some leisure utility. We assume that monitoring and sanctions in case of observed inactivity in job search can reduce the value of being unemployed by a monetary equivalent of 5% of unemployment benefits. We also ignore additional administrative costs due to monitoring and assume that these activities are covered out of the existing budget for labor market policy. Column 'Mon' shows the quantitative, long-run impact. The direct effect is to reduce the worker's fallback option and, thus, the reservation wage. The intervention thus increases the total job rent which amounts to the difference between the marginal product of labor and the reservation wage. Wage bargaining splits the larger surplus between workers and firms so that the wage rate must fall (by 2% instead of 1.4%) which, in turn, boosts the job rent of both firms and workers. As a result, workers search more intensively, and firms find it more profitable to create jobs. The unemployment rate, in turn, shrinks from 3.2 to 2.6% and ends up being 1 percentage point lower than in the ISS. The repercussions on the wage tax burden and on other dimensions of labor supply are basically insignificant. Overall, effective employment and GDP expand by half a percentage point and grow by 2.4% relative to ISS. The loss in GDP per capita is further reduced to 7.1%.

4.3.6 Incentives for Life-Time Training

In an aging society, life-time training may be an important means to compensate, at least partly, for the decline in labor supply resulting from a reduced inflow of young workers. Households reallocate time from work to training and spend on books and other equipment to improve on their skills or simply to keep up with changing work requirements. In the model, real spending on training is government controlled but privately paid for. The scenario assumes that government mandates an increase in training expenditures by one percent. Households then endogenously respond by augmenting training time. Both the time opportunity cost and the larger spending on training equipment is accounted for. As a result of more active training, average labor productivity rises by an additional 1.3% and ends up 2.6% higher than in the ISS. The higher quality of the workforce boosts effective employment by an extra 1.6%. All in all, the levels of

effective employment and GDP are 3.9% higher than in the status quo. The loss in per capita income is limited to 5.7%, down from 7.1%. The repercussions on other components of aggregate labor supply are not important. One may conclude from the results of Table 3 that training is an important policy area to cushion the economic impact of aging.

4.4 Life-Cycle Effects

Aging and structural social security reform may have an uneven impact on the life-cycle. Figure 4 reveals that strengthening training incentives may disproportionately benefit older workers in the long-run. The effects of training accumulate if workers respond to improved incentives over the entire working life. Postponed retirement also sharpens training incentives since it allows workers to consume the returns over a longer working life. The strongest effect is probably with the oldest workers near retirement. The skills of older workers are also of special interest since they affect their employability. In an aging society, it is important to keep older workers longer in the labor force. Many observers are concerned, however, that an increase in the retirement age could be ineffective because older workers may be difficult to employ. However, the simulations show a more optimistic picture. Postoned retirement boosts training incentives disproportionately more for older workers which favors their skills and employability.

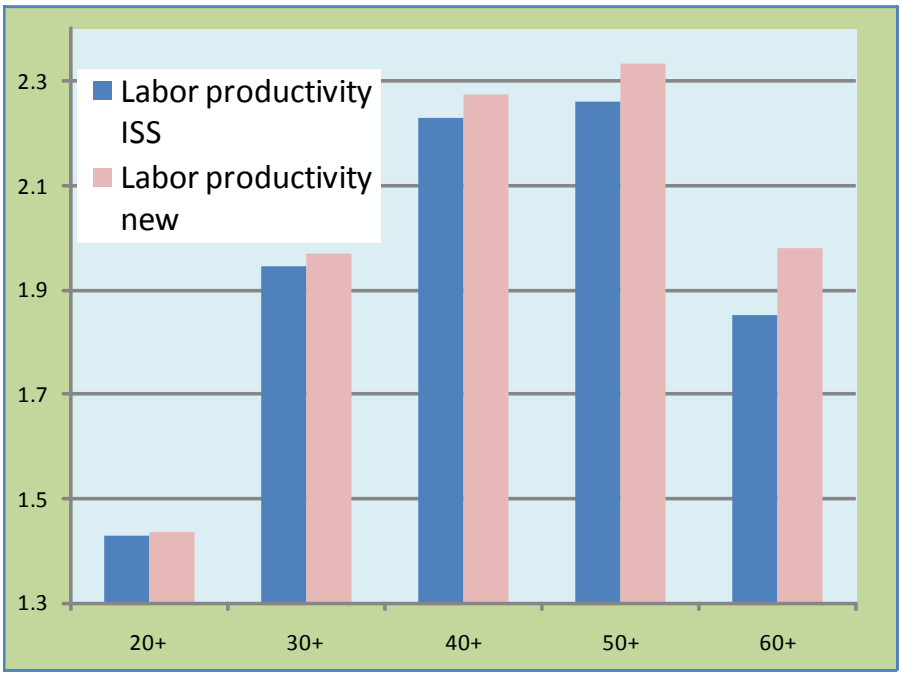

Figure 4: Life-Cycle Training

The life-cycle pattern in Figure 5 points to the different unemployment incidence for young and old workers. Unemployment among younger workers falls quite sharply, by 1.5 percentage points for the 20-30 years-old. The main reason is the elimination of unemployment benefits from the contribution base as well as stronger monitoring as part of active labor market policy. A stronger tax-benefit link also encourages job search and reduces unemployment. However, the employability of older workers near retirement is negatively affected even though the effect is rather negligible. Delaying actual retirement by about four years amounts to a strong increase of labor supply. The unemployment rate thus rises in this group but remains very low in absolute terms, especially by international comparison. The present framework does not lend support to the view that postponing retirement is ineffective since older workers are difficult to employ.

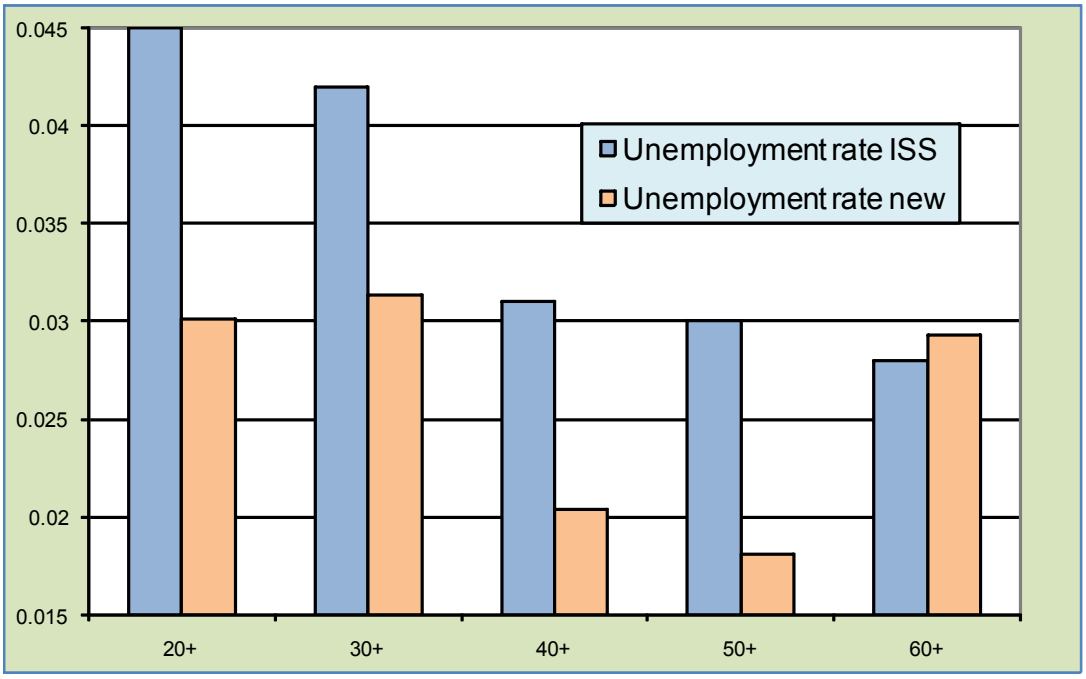

Figure 5: Life-Cycle Unemployment Rates

4.5 Transitional Adjustment

Table 3 shows the long-run equilibrium to which the economy eventually converges. However, short- and medium-run effects are of special interest to policy makers. Additional assumptions about the temporal implementation of the policy measures are necessary. We refrain here from any elaborate transition strategies. The policy shocks in Table 3 are instantaneously and permanently implemented as a total reform package. Public debt and real public spending are kept

constant in per capita terms. The response to the demographic and policy shocks can easily lead to non-monotonic adjustment since demographic change with overlapping generations proceeds at a slow pace while economic adjustment occurs at a much faster speed. Figure 6 shows that the old-age dependency ratio may take 6 to 10 decades to fully adjust. The horizontal axis measures the time (in years) after the reform. Economic variables such as tax rates and employment in Figure 7 are also determined in the demographically induced equilibrium and need similarly long time periods to approach steady state values.

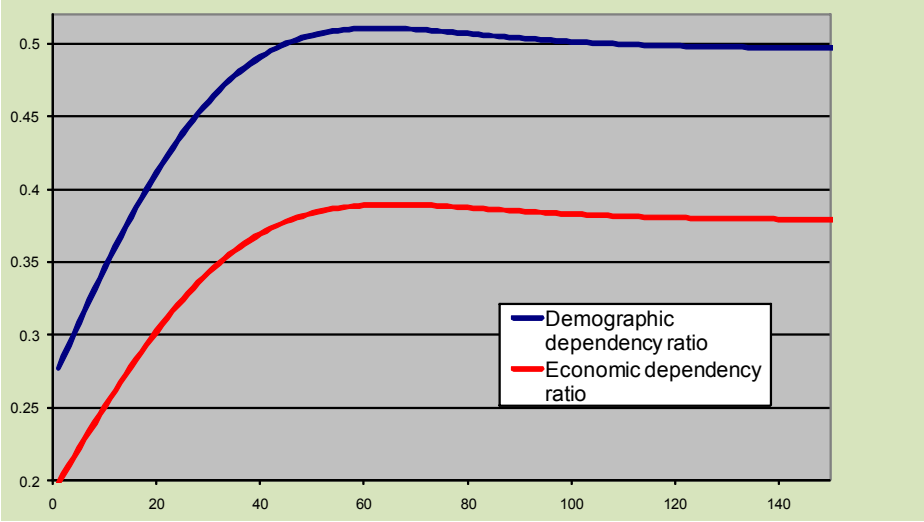

Figure 6: Demographic and Economic Dependency Ratio

The economic dependency ratio is the ratio of retired to active persons and is rather more important for fiscal balance and economic performance than the demographic dependency ratio which is the ratio of older than 65 over younger people. As Figure 6 illustrates, the relatively large increase in retirement age adds additional workers and shrinks the number of retired persons and, thereby, squeezes the economic dependency ratio by about 12 percentage points. Since the policy shock is instantaneously implemented, the retirement age rises fast and leads to a rather sudden increase in the participation rate of the 60-70 years old. As a result, the economic dependency ratio declines substantially in the short-run (to 20 instead of 27%) which creates large fiscal savings and allows considerable cuts in tax and contribution rates in the short-run, see Figure 7. This reduction also mirrors the instantaneous rise in the consumption tax rate of 4 percentage points. Consumption taxes are rather less damaging for the labor market because not only wage income, but also replacement incomes are taxed. With substantially lower taxes, labor market performance is quite strong in the early phase of demographic change. Effective employment

rises much stronger than in long-run equilibrium. As demographic change proceeds, the ratio of tax payers to benefit receivers worsens so that taxes and contributions must be continuously increased to assure budget balance. After five decades, taxes and contributions reach a higher level than in the initial situation. Effective employment, in turn, falls back again and yields a much more moderate long-run gain. GDP per capita rises in the short-run, too, before the negative impact of aging sets in. In principle, it would be possible to use the fiscal surpluses in the early phase not to cut tax rates but to reduce government debt in order to save debt service and keep the tax burden lower in the future. Such intergenerational redistribution would reduce the short-run income gains but also cut the long-run income losses per capita. Alternatively, the increase in retirement age and in VAT rates could be stretched over longer time periods.

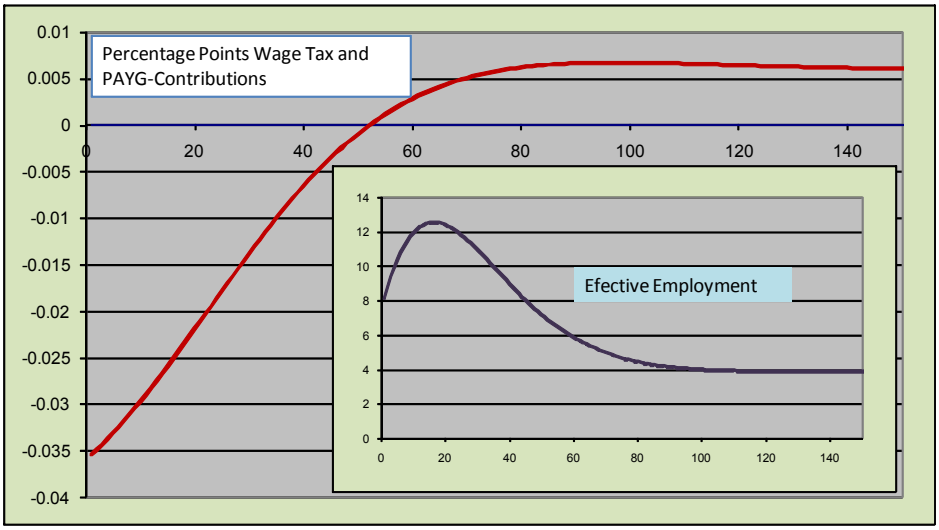

Figure 7: Wage Tax, PAYG Contributions and Employment

5 Conclusions

A longer life-time in good health is one of the great gifts of medical advancement. At the same time, increased longevity induces a large demographic change which creates huge challenges for financing social security and could substantially reduce per capita income in the future. According to official demographic projections, the old-age dependency ratio will approximately double and the population is expected to grow by 10% until 2050. One may safely expect that a shock of this scale will have important repercussions on economic performance. In this study, we have used a rich computational model of life-cycle labor supply, unemployment and retirement

to quantify the potential impact of aging on economic performance in Switzerland. When benefit rules are kept constant and the government follows a passive policy of raising wage taxes and social security contributions to achieve fiscal balance, the consequences might be rather bleak. Taking account of economic adjustment, simulations show that the labor tax burden might need to rise by 20 percentage points and per capita income could fall by roughly the same amount, compared to the status quo without aging and reform.

Such a scenario is neither politically realistic nor reasonable but may be used as a reference point. We have found that a comprehensive policy approach can largely alleviate the unfavorable consequences of aging on per capita income. The financing of social security with largely the same replacement rates as today might require only a moderately higher tax burden. By far the most important measure is an increase in retirement age by about 4 years so that longer lived future generations roughly split their extended total life-time between work and retirement in the same way as present generations must do. The comprehensive policy approach investigated in this paper includes further structural reform of the pension system and other measures to stimulate training and labor market performance. All in all, the simulation results show that this reform package could limit the increase of the tax burden to 4 percentage points of value added tax and keep the loss in per capita income to a moderate 6%. To put this number into perspective, a period of zero growth over 3-4 years relative to continued trend growth would yield the same decline in per capita income.

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