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How Much Do Means-Tested Benefits Reduce the Demand for Annuities?

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Abstract

We analyze the effect of means-tested benefits on annuitization decisions. Availability of means-tested payments creates an incentive to cash out pension wealth for low and middle income earners, instead of taking the annuity. Agents trade off the advantages from annuitization, receiving longevity risk insurance, to the disadvantages, giving up "free" wealth in the form of means-tested supplemental income. Our simulated life-cycle model demonstrates that the availability of means-tested benefits substantially reduces the desire to annuitize, especially for low and intermediate levels of pension wealth. In our empirical analysis we show that the model's predicted fraction of retirees choosing the annuity is able to match the annuitization pattern of occupational pension wealth observed in Switzerland.

Jel–Classification: D14, D91, G23, J26

Keywords: Means-Tested Benefits, Occupational Pension, Annuity, Life-Cycle Model

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1 Introduction

Virtually all industrialized countries guarantee a certain minimum income in old age. To do so, they provide supplemental benefits that are typically means-tested and whose eligibility is determined by both income and assets. In OECD countries means-tested retirement benefits provide almost 22% of average earnings; approximately 17% of individuals above age 65 claim such supplemental benefits (OECD (2011)).

In this paper we show that the availability of means-tested benefits can substantially reduce the propensity to annuitize pension wealth at retirement. Because means-tested benefits guarantee a minimum income in retirement, they not only provide additional free income, but also an implicit insurance against the financial consequences of longevity similar to an annuity contract. This generates a strong incentive to cash-out accumulated pension wealth at retirement even if full annuitization was optimal in the absence of means-tested benefits. A unique dataset of individual cash-out decisions at retirement validates the predictions form our life-cycle model.

Yaari's (1965) seminal paper demonstrates that a life-cycle consumer without a bequest motive should choose to annuitize his entire wealth to insure longevity risk. Davidoff et al. (2005) show that positive, but not necessarily complete annuitization remains optimal even with market incompleteness, liquidity constraints, as well as in the presence of bequest motives and under habit formations. However, when international numbers are analyzed, it is apparent that when given a choice, only a minority annuitizes voluntarily even in countries in which the pre-existing annuitization by the public pension system is small. A great amount of literature has attempted to shed light on the "annuity puzzle".[1] Nonetheless, the low observed annuitization rates remain hard to reconcile with economic theory.[2]

Given the size of means-tested social insurance programs in many industrialized countries, low annuitization rates may not be that surprising. Although the Swiss system stands out somewhat in terms of generosity, its supplementary benefit scheme nicely illustrates the incentives generated by means-tested benefits to cash out pension wealth. Maximal first pillar benefits amount to roughly \$2,000 (= CHF 2,000) per month.[3] At the same time, there are also means-tested supplements to

[1] Adverse selection and administrative loads (Mitchell et al. (1999), Finkelstein and Poterba (2002), Finkelstein and Poterba (2004), Rothschild (2009), and Direr (2010)) and the existence of first-pillar annuities (Brown et al. (2001), Dushi and Webb (2004)) can rationalize the preference for a lump sum over an annuity to some degree. Further arguments against annuitization include intra-family risk-sharing (Kotlikoff and Spivak (1981) and Brown and Poterba (2000)), incomplete annuity markets (Peijnenburg et al. (2012)), bequest motives (Friedman and Warshawsky (1990), Bernheim (1991), Brown (2001), Lockwood (2012)), and a desire to insure against expenditure spikes (Peijnenburg et al. (2012)). Recent work includes behavioral explanations of individuals low annuitization behavior (Hu and Scott (2007), Brown et al. (2008), and Brown et al. (2012)). Benartzi et al. (2011) provide a comprehensive overview of this literature.

[2] An exception is Inkmann et al. (2011) who find that a standard life-cycle model with reasonable preference parameters predicts annuity demand levels comparable to data from the U.K.

[3] The numbers presented in the paper are based on a parity between the dollar and the Swiss Franc at the time of

first pillar benefits that lift the effective minimum income to roughly \$3,000 a month. An individual with a monthly second pillar benefit of less than \$1,000 a month, which corresponds to accumulated occupational pension wealth of approximately \$170,000, is always better off withdrawing the money upon retirement, spending it down in the years after retirement and then applying for means-tested benefits. While the incentives are clear for individuals with low pension wealth and no other form of wealth, for middle-income individuals there is a tradeoff. The retiree weighs the benefits from taking the lump sum, "free" means-tested benefits after withdrawal, against the disadvantages, a lower degree of longevity insurance and a non-flat consumption pattern.

We quantify the impact of means-tested benefits on optimal annuity demand and consumption/savings decisions using a realistic life-cycle model with a social security scheme in which means-tested benefits can be claimed if income and wealth fall below a certain level. The model also includes inflation risk and equity risk, and allows for differential tax treatments of annuity payments versus lump sum withdrawals.

The model is calibrated to Switzerland, which is an interesting case study for a number of reasons. First, it combines a relatively low level of pre-existing annuitization by the first pillar, with generous means-tested benefits that exceed first pillar benefits by roughly 50%. Second, most individuals have accumulated a large capital stock at retirement through the mandatory occupational pension scheme. The average Swiss retiree has a capital stock of approximately \$300,000 to \$400,000 which translates into a second pillar income that approximately equals first pillar benefits. Third, there is a considerable variability of cash-out decisions against which the theoretical predictions can be compared. Bütler and Teppa (2007) and Bütler et al. (2012) show with micro data from pension providers that the propensity to annuitize increases in pension wealth, which is consistent with the incentives generated by means-tested benefits.

The main contributions of our paper are threefold. First, we calibrate a life-cycle model to an existing pension scheme with a sizeable means-tested component. We show that means-tested benefits have a quantitatively important impact on the propensity to annuitize. The effect is especially large for agents with a low income and wealth level. If these retirees could not claim means-tested benefits, they would annuitize their second pillar pension wealth, while the optimal annuity level is often zero when means-tested supplemental income is available to them. Second, we compare observed annuity decisions of individuals to the optimal annuitization rate predicted by our model. The administrative data we compiled from Swiss occupational pension providers confirm the model's clear pattern: Agents with low pension wealth levels tend to take the lump sum while agents with higher second pillar pension wealth annuitize more often. Means-tested benefits can thus provide a potential explanation for the low voluntary annuitization of second pillar pension wealth and financial wealth of individuals. Third, we analyze the costs and welfare implications of

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different policies for poverty alleviation. We focus on alternative poverty-alleviation schemes that guarantee the same (means-tested) income level, such as stricter asset test rules, a minimum income requirement policy restricting cash-out decisions, and mandatory annuitization. We find that stricter eligibility tests or requiring individuals to annuitize a certain but limited amount of their pension wealth can reduce the costs of these schemes substantially, while not reducing welfare greatly.

Our paper relates to several studies that have examined the effect of means-tested social insurance programs on savings, purchase of private insurance, and labor supply. Theoretical work by Hubbard et al. (1995) and Sefton et al. (2008) demonstrate that means-tested welfare programs discourage savings by households with low expected lifetime income. Empirical evidence for this prediction is provided by Neumark and Powers (1998) and Powers (1998) using U.S. data. Using variation across U.S. states in supplementary SSI benefits, Neumark and Powers (2000) demonstrate that generous SSI benefits reduce pre-retirement labor supply of older men. However, the existing literature has largely ignored the role of means-tested social insurance programs on the decision to annuitize pension wealth. The only exception, to our knowledge, is the paper by Pashchenko (2010) who investigates different determinants of the annuitization decision using a simulation model parameterized for the U.S. In contrast to her study, we perform an empirical analysis to validate our conjecture and show that a life-cycle model with means-tested benefits matches empirical annuity decisions well.[4]

In contrast to many other papers, our analysis looks at annuity demand in mandated fully-funded pension plans. These schemes play a growing role in the provision of retirement income in most industrialized countries. Annuitization in such plans is thus a more pressing concern for public policy than in voluntary annuity markets, which traditionally have a low annuitization rate. Furthermore, our paper is one of the few papers on annuity demand that employ individual level data to explore determinants of annuity choices. Our dataset lends itself well for testing the effects that means-tested benefits can have on optimal annuity decisions. However, as the means-tested benefits are lower in many other countries, the measured impact on annuity decisions in Switzerland is likely to form an upper bound.

The paper proceeds as follows. Section 2 describes the life-cycle model used for the simulations of annuitization decisions in the presence of means-tested benefits. Section 3 gives an overview of the Swiss pension system to which the model is calibrated and which serves as an

[4]Pashchenko (2010) demonstrates that a minimum consumption floor (implying very stringent asset test rules) reduces the participation rate in voluntary annuity markets, particularly at the bottom of the income distribution. The guaranteed income in Pashchenko (2010) is very low at only $2,663 per year (an estimate taken from De Nardi et al. (2010), which reflects a mixture of minimum income level and value placed on different nursing home arrangements.) A guaranteed income level of $2,663 is substantially smaller than the levels in countries with a similar GDP and some U.S. states (for example, it is $20,000 in Australia and $36,000 in Switzerland). More generous guaranteed income is likely to affect annuitization decisions for a much larger fraction of the population.

illustration for the quantitative impact of means-tested benefits. The data used to verify the predictions of our model is presented in Section 4. Section 5 presents the results of the empirical analysis and discusses alternative interpretations of a positive relationship between pension wealth and the propensity to annuitize. Implications for income policy in old age are discussed in Section 6. Section 7 concludes.

2 A life-cycle model during retirement with means-tested benefits and optimal annuitization

Means-tested supplemental benefits create an incentive to cash out accumulated second pillar wealth because an annuity, even small, is detrimental to the eligibility for income- or asset-tested benefits. If the combined income from the first and second pillar is below the minimum income guaranteed by means-tested benefits, an individual can increase the present value of his income choosing the lump sum, spending the money, and later applying for means-tested benefits. While the incentives for individuals with low pension and non-pension wealth are straightforward, for middle-income individuals there is a tradeoff. The retiree weighs the benefits from taking the lump sum – "free" means-tested benefits after withdrawal – against the disadvantages, a decrease in consumption once the capital is depleted and a lower level of longevity insurance.

Institutional features, which are often specific to a country, also influence annuitization decisions. First, in Switzerland, the eligibility for means-tested benefits usually depends on *total* wealth and not only on pension wealth. Therefore, even for low levels of pension wealth, taking the annuity may be optimal if non-pension wealth is high. Second, differences in taxation may either favor one of the two polar options (100% annuitization versus 100% lump sum) or induce a certain optimal split between the two. In the Swiss case, our illustrative example for the calibration, the annuity is subject to normal income tax rates, while the lump sum is taxed only once (at retirement). Due to the differential tax treatment the present value of the lump sum's total tax bill is almost always smaller than the annuity's tax burden. Third, since annuities are typically not indexed to inflation, uncertainty about future prices may reduce the demand for these annuities. People might be induced to keep a certain amount of wealth liquid to smooth consumption due to inflation shocks, and more equal real consumption levels over the life-cycle.

The next section presents a life-cycle model that incorporates several important aspects of the annuitization decision, including means-tested benefits, non-pension wealth, differential taxation of the annuity income compared to the lump sum, and a stochastic asset return process in the presence of inflation. To facilitate the analysis, we focus on single individuals.

2.1 Individual's preferences and constraints

Our analysis focuses on the retirement phase of the life cycle. There is no active decision with respect to the retirement timing. At the beginning of his retirement period the agent decides on the fraction of pension wealth to be annuitized. The amount withdrawn as a lump sum is subject to an immediate tax.[5] For his entire remaining life the agent receives an annuity income from the first and second pillar on which regular income taxes are levied. The individual decides optimally how much to consume and how to divide the remaining wealth between stocks and bonds. In each period, he also takes into account the possibility of claiming means-tested benefits. More formally, we examine an agent during retirement with age $t = 1, ..., T$, where $t = 1$ is the retirement age and T is the maximum age possible. Let p_t denote the probability of surviving to age t, conditional on having lived to period $t-1$. The individuals' preferences are presented by a time-separable, constant relative risk aversion utility function and the individual derives utility from real consumption, C_t. Lifetime utility equals

$$V = E_0 \left[\sum_{t=1}^{T} \beta^{t-1} \left(\left(\prod_{s=1}^{t} p_s \right) \frac{C_t^{1-\gamma}}{1-\gamma} \right) \right], \tag{1}$$

where β is the time preference discount factor, γ denotes the level of risk aversion, and C_t is the level of date t real consumption. Nominal consumption is given by $\overline{C_t} = C_t \Pi_t$, where Π_t is the price index at time t.

At retirement, second pillar wealth, W^{pw}, can be transformed into an annuity income, taken as a lump sum, or a combination of both:

$$W^{pw} = W^{ls} + W^{a}. \tag{2}$$

W^{ls} is the amount taken as a lump sum, while W^{a} is the part of the pension wealth annuitized. Second pillar pension wealth taken as a lump sum is subject to a tax τ_{ls} once. ,. The tax rate is increasing n the amount withdrawn. Total net wealth at time $t = 1$, W_1, is the sum of after-tax pension wealth plus non-pension financial wealth, W^{npw}:

$$W_1 = (1 - \tau_{ls}) W^{ls} + W^{npw}. \tag{3}$$

The annuity income, Y_t^{II}, is given by

$$Y_t^{II} = W^{a} c, \tag{4}$$

[5] In Switzerland, not only lump sum taxes are levied but also annual wealth taxes. In the analysis we abstract from wealth taxes because these tax are quantitatively unimportant.

with c being the conversion rate. The second pillar annuity income provides a nominal income, while the first pillar income is inflation protected. The income tax, τ_i, is progressive and levied over the sum of first and second pillar pension income.

Net means-tested benefits M_t equal

$$M_t = \max(\tilde{M}_t - Y_t^I - Y_t^{II} - rW_t - gW_t, 0) \tag{5}$$

where $\tilde{M}_t$ is the guaranteed consumption level. The applicable income for the determination of means-tested benefits consists of first pillar pension income Y_t^I, second pillar pension income Y_t^{II}, investment income (wealth times a fictitious investment return r), and a fraction g of wealth. The income numbers Y_t^I and Y_t^{II} are defined net of taxes.

There are two assets individuals can invest in, stocks and a riskless bond. w_t is the fraction invested in equity, which yields a gross nominal return of R_{t+1}. The nominal return on the riskless bond is denoted by R_t^f. The intertemporal budget constraint of the individual is, in nominal terms, equal to

$$W_{t+1} = (W_t + Y_t^I + Y_t^{II} + M_t - \overline{C_t})(1 + R_t^f + (R_{t+1} - R_t^f)w_t), \tag{6}$$

where W_t is the amount of financial wealth at time t. If the agent receives means-tested benefits, his consumption is always at least as high as the guaranteed income level, $\tilde{M}_t$.

The individual faces a number of constraints on the consumption and investment decisions. First, we assume that the retiree faces borrowing and short-sales constraints

$$w_t \geq 0 \text{ and } w_t \leq 1. \tag{7}$$

Second, we impose that the investor is borrowing constrained

$$\overline{C_t} \leq W_t, \tag{8}$$

which implies that the individual cannot borrow against future annuity income to increase consumption today.

2.2 Financial market

The asset menu of an investor consists of a riskless one-year nominal bond and a risky stock. The return on the stock is normally distributed with an annual mean nominal return μ_R and a standard deviation σ_R. The interest rate at time $t+1$ equals

$$r_{t+1} = r_t + a_r(r_t - \mu_r) + \epsilon_{t+1}^r, \tag{9}$$

where r_t is the instantaneous short rate and a_r indicates the mean reversion coefficient. μ_r is the long run mean of the instantaneous short rate, and ϵ_t^r is normally distributed with a zero mean and standard deviation σ_r. The yield on a risk-free bond with maturity h is a function of the instantaneous short rate in the following manner:

$$R_t^{f(h)} = -\frac{1}{h}\log(A(h)) + \frac{1}{h}B(h)r_t, \tag{10}$$

where $A(h)$ and $B(h)$ are scalars and h is the maturity of the bond. The real yield is equal to the nominal yield minus expected inflation and an inflation risk premium.

For the instantaneous *expected* inflation rate we assume

$$\pi_{t+1} = \pi_t + a_\pi(\pi_t - \mu_\pi) + \epsilon_{t+1}^\pi, \tag{11}$$

where a_π is the mean reversion parameter, μ_π is long run expected inflation, and the error term $\epsilon_t^\pi \sim N(0, \sigma_\pi^2)$. Subsequently the price index Π follows from

$$\Pi_{t+1} = \Pi_t \exp(\pi_{t+1} + \epsilon_{t+1}^\Pi), \tag{12}$$

where $\epsilon_t^\Pi \sim N(0, \sigma_\Pi^2)$ are the innovations to the price index. We assume there is a positive relation between the expected inflation and the instantaneous short interest rate, that is the correlation coefficient between ϵ_t^r and ϵ_t^Π is positive. The benchmark parameters are presented in Section 3.3.

3 Calibration: Case study Switzerland

The availability of means-tested benefits obviously reduces the demand for an annuity. The more important question is its quantitative impact on the cash-out decision at retirement, especially for individuals who would have sufficient means to finance their own retirement. In this respect Switzerland is an interesting case to study. First, it combines a relatively low level of pre-existing annuitization by the first pillar with a generous income guarantee exceeding first pillar benefits by roughly 50%. Individuals whose income is below the guarantee can claim means-tested benefits. Second, as a consequence of a mandatory occupational pension scheme, individuals with middle and higher incomes have accumulated a large capital stock at retirement. The average Swiss retiree can expect a second pillar income approximately equal to first pillar benefits if he annuitizes his pension wealth.

3.1 The Swiss pension system: the first and the second pillar

Switzerland's pension system mainly consists of two pillars. The *first pillar* is a publicly financed pay-as-you-go scheme, which provides a basic level of income to all retired residents in Switzerland. The *second pillar* is an employer-based, fully funded occupational pension scheme, which aims to maintain the pre-retirement living standard in addition to benefits from the first pillar. It is compulsory for all employees with annual earnings above roughly CHF 20,000. In July 2012, the CHF-$ exchange rate was CHF 1 to roughly $1.02.

The first pillar is financed by government revenues and a payroll tax which is proportional to labor income (without any upper bound). Benefits are strongly dependent on the number of years contributed, but only to a limited degree on average labor income. In particular, individuals whose income is high enough to qualify for the second pillar usually get a first-pillar income between 90 and 100% of the maximal first pillar benefits. The statutory retirement age is 64 for women and 65 for men. Working beyond age 64/65 is possible, but most work contracts specify a retirement age that coincides with the statutory retirement age.

The second pillar covers around 96% of working men and 83% of working women. As non-working individuals are not covered, the lowest income quartile – and thus the individuals with the lowest life expectancy – are only marginally included in these schemes. Occupational pension plans are heavily regulated, and although they typically work as a defined contribution system, far reaching income guarantees are included. Including income from the first pillar, the target replacement rate of most pension funds is approximately 50-60% of insured income, corresponding to a net replacement rate of 70-80%.

Income above CHF 80,000 is covered by the so-called super-mandatory part of the system. Although employers are not obliged to offer super-mandatory coverage, a large majority do as occupational pensions are viewed as an important tool to attract qualified workers in a tight labor market. Individuals are automatically enrolled in both the mandatory and super-mandatory part of the plan. They only have very limited if any investment choice during the accumulation phase. Contributions to the pension plan correspond to a certain fraction of the covered salary (usually 7-18% depending on age) of which the employer has to pay at least half. The capital is fully portable; when an employee starts working at another company, he receives all of the accumulated contributions (including the employer's part). The full sum has to be paid into the new fund.

The accrued retirement capital can be withdrawn either as a monthly life-long annuity (including a 60% survivor benefit), a lump sum or a mix of the two options. In a minority of plans the cash-out limit is equal to 50 or 25% (the legal minimum) of accumulated capital. Depending on insurer regulations the individual must declare his choice between three months and three years prior to the effective withdrawal date. Many pension insurers define a default option for the case when the beneficiary does not make an active choice.

Nominal occupational pension annuities are strictly proportional to the accumulated retirement assets. The so-called conversion rate is independent of marital status, but depends on retirement age and gender. In the mandatory part the law stipulates a minimum conversion rate which is currently 6.85%, but was 7.2% during the period we have the data for. This conversion rate is far more generous than the conversion rate in the unregulated market, which is around 5.5% for a 65-year-old single man. We find that the actuarially fair conversion rate for a nominal single-person annuity is 8.1%, which we calculate using nominal interest rates and male survival probabilities from mortality.org. Comparing this value to the conversion factor of 7.2% used in the analysis leads to a pricing load of about 12%. As we abstract from survivor benefits in our analysis and do not take into account mortality differences between single and married men, the load is overestimated for married men (who have an annuity that includes survivor benefits) and somewhat underestimated for singles.[6]

3.2 Means-tested supplemental benefits in Switzerland

If the total income does not cover basic needs in old age, means-tested supplemental benefits may be claimed as part of the first pillar. Like in most OECD countries, these benefits are means-tested so that only individuals whose income and assets are below a certain threshold are eligible. In Switzerland, the value of these benefits corresponds to around 47% of average earnings, which is considerably above the average in OECD countries of 22% (OECD (2011)).

Around 12% of the population in retirement age receives means-tested benefits.[7] The share of benefit recipients is increasing with age which is consistent with our hypothesis of spending down assets. Means-tested benefits in Switzerland are determined by subtracting an individual's income from the so-called applicable expenditures. The income used in the calculations of means-tested supplemental benefits is the sum of pension income from first and second pillars, investment income, and earnings plus one tenth of the wealth exceeding a threshold level of CHF 25,000. The relevant annual expenditures consist of a cost-of-living allowance, a health insurance premium, and rent or interest payments for the mortgage. Summing up all the applicable expenditures, means-tested supplemental benefits guarantee a gross income of approximately CHF 36,000 for singles.

As shown in Table 1, average annual means-tested supplemental benefits, conditional on claiming, for retired beneficiaries in 2008 were CHF 9,600 for single beneficiaries. The cost-of-living

[6]Pension funds are required to index pension benefits to inflation if the financial situation of the fund allows for this. At present, however, few funds are able to index pensions to inflation mainly due to high liabilities created by the high conversion factor in the mandatory part.

[7]In OECD countries around 17% of the population above age 65 receives means-tested benefits, although there is a considerable variation across countries depending on how low the eligibility threshold is set. For example, in Denmark and Australia between 70 to 80% of all retirees claim means-tested benefits, compared to less than 2% in Germany and Japan (OECD (2011)).

allowance, the health insurance premium, and rent payments are the largest categories on the expenditure side, while interest payments on mortgages are negligible. Because the value of a home is taken into account in the calculation of means-tested benefits, home owners rarely qualify for means-tested benefits. The main source of income, other than means-tested benefits, are first pillar benefits.

Table 1

3.3 Benchmark parameters

The chosen parameter values for our specification of the life-cycle model are displayed in Table 2. Following related literature (Pang and Warshawsky (2010), and Yogo (2009)) we set the time preference discount factor, β, equal to 0.96. Like Ameriks et al. (2011), we set the risk aversion coefficient γ to 3. We only consider individuals after retirement from age 65 ($t = 1$) to age 100 ($t = 1$). For all other parameters we aim to be as close as possible to the Swiss case to facilitate a comparison of the simulation results with actual choices.The survival probabilities are the current male survival probabilities in Switzerland and are obtained from the Human Mortality Database.[8] We assume a certain death at age 100.

The equity return is normally distributed with a mean annual nominal return, μ_R, of 6.5% (corresponding to a equity premium of 4%) and an annual standard deviation, σ_R, of 20%, which is in accordance with historical stock performance. The mean instantaneous short rate is set equal to 2.5%, the standard deviation to 1%, and the mean reversion parameter to -0.15. The correlation between the instantaneous short rate with the expected inflation is 0.4. The parameters for the inflation dynamics are estimated with data from the Swiss National Bank. Mean inflation is equal to 1.79%, the standard deviation of the instantaneous inflation rate is equal to 1.12%, the standard deviation of the price index equals 1.11%, and the mean reversion coefficient equals -0.165.

Pillar I annuity income, Y_1^I, is set to CHF 24,000, and is indexed to inflation. This number approximately corresponds to the average first pillar income of individuals covered by occupational pensions. The gross guaranteed income level to determine the means-tested benefits, $\tilde{M}_t$, is CHF 36,000 in real terms. Under this assumption the maximum amount of means-tested benefits, M_t is CHF 12,000.[9] The fraction of wealth g that is taken into account when calculating means-tested benefits is 0.1.[10]

[8] We refer for further information to the website, www.mortality.org.

[9] In many cases only a fraction of the maximum means-tested benefits is paid out, because agents still have positive pension wealth and/or non-pension wealth. For example, in 2008 the average means-tested benefits actually paid out, conditional on means-tested benefits being positive, was CHF 9,600.

[10] We abstract from the threshold for wealth over which the fraction g is calculated. Taking into account the wealth threshold would add another maximization function ($\max(0; 25,000 - W)$) in the budget constraint which would complicate the numerical optimization procedure even more. Moreover, this assumption has only a small effect on the

The conversion rate c used to translate the accumulated capital into a yearly nominal annuity income is set to 7.2%, which is the rate applied to second pillar wealth for the period of our data. The actuarially fair conversion rate for a single-life nominal annuity would be 8.1%. However, the implicit load on the annuity, 12% of pension wealth, overstates the average effective load as the same conversion rate is applied for married individuals. Taking into account survivor benefits, the effective load would be much smaller, even negative. The values taken for the progressive lump sum tax τ_{ls} and the income tax τ_Y are displayed in Appendix B. They represent the applicable tax rates of the largest Swiss city, Zurich. Zurich's tax burden lies in the middle of all Swiss regions.

Table 2

4 Data

4.1 Data description and limitations

The predictions from our simulated life-cycle model are compared with *administrative individual records* from several Swiss companies. We compiled this unique dataset from records provided by autonomous pension schemes as well as large insurance companies. While the former are typically sponsored by large companies, the latter provide occupational pension plans for small and medium sized companies. For all companies in our sample, all individual retirement decisions for the period 1996 to 2006 are recorded. Each individual is observed only once at retirement. The data contain information on the date of birth, the retirement date, annuitization decision, amount of accumulated pension wealth, conversion factor as well as company specific pension scheme information such as default and cash-out options.

Since the amount of means-tested benefits depends on *total* wealth, information on non-pension wealth is important. Unfortunately, this information is not recorded in the administrative data. Therefore, we utilize asset data from the first wave of the *Survey of Health, Aging and Retirement in Europe* (SHARE) in 2003 to estimate a distribution of liquid and illiquid non-pension wealth separately. We do not use a joint distribution as the correlation is very low (correlation coefficient: -0.014). As Tables 3 and 4 illustrate, the distributions of both liquid and illiquid non-pension wealth are very heterogeneous. We will use the distributions of liquid and illiquid non-pension wealth to calculate a weighted average of the optimal annuitization levels, as described in detail in section 5.3.

Table 3

results, given that the threshold is just CHF 25,000.

Table 4

We restrict the data on annuitization decisions of men only for three reasons. A number of social security reforms affected women during the sample period (such as an increase in the retirement age for women from 62 to 64 and the introduction of child care credits). Moreover, neglecting spousal income has larger consequences for women than for men, thereby making the difference in decisions across (unobserved) marital status more pronounced. Women also have much smaller balances in the second pillar for the birth cohorts considered.

Our data usually does not record marital status, age, or income of the spouse. We are well aware of the importance of both marital status per se and socio-economic characteristics of the spouse (in particular age and income/wealth). We expect the qualitative impact to be similar for married and single men. Our data span a time period in which wives did not work much and thus the additional pension wealth in the second pillar for married men is likely to be small. Moreover, the additional income of the first pillar for the spouse just covers the additional expenditures that are credited against means-tested benefits. Hence, for a given second pillar income, a married and a single man face very similar tradeoff. Consistent with this view, Bütler and Teppa (2007) find little difference in annuitization patterns between married and single men for those pension funds that do provide information about marital status. The higher money's worth of the annuity for married individuals (due to survivor benefits and higher life expectancy) seems to be offset by a lower demand for insurance of married couples and/or bequest motives.

4.2 Summary statistics

Table 5

Table 5 reports key statistics for the variables of interest. Early retirement, starting at age 55, as well as working beyond planned retirement is possible. However, the average retirement age is close to the statutory retirement age of 65 for men. Average total pension wealth is about CHF 250,000. Furthermore, Table 5 reveals that a large fraction of the beneficiaries chose a polar option, either full lump sum or full annuity. Mainly as a consequence of early retirement adjustments, the mean conversion rate in the mandatory part is 6.9, slightly lower than in the rated used in the life-cycle model.

Figure 1

Figure 1 illustrates the relationship between pension wealth and the annuitization level of pension wealth for wealth levels below 700,000 CHF.[11] The solid line represents the fraction of retirees

[11] Individuals with higher pension wealth often have access to management pension plans that are subject to different conditions.

who annuitize fully for different levels of pension wealth.[12] As 95% of retirees choose one of the polar options, we consider the annuitization as a binary decision even for the remaining 5% of the sample. Annuitization rates of 50% or more were set to 100%, those below 50% to 0%. In the simulations, the fraction of people choosing a polar option is also very high, and of course dependent on the grid size chosen for the annuity level.

The fraction of individuals who annuitize is low for small levels of pension wealth and increases continuously for higher levels of pension wealth. Heterogeneity in non-pension wealth leads to some retirees choosing the annuity, while for the rest taking the lump sum is optimal. As pension wealth increases, the propensity for retirees to take the annuity instead of the lump sum increases.

Figure 2

Since companies can set different default options, it is interesting to investigate how annuitization levels vary with the default option. Out of the twelve companies in our sample, ten companies have the annuity as a default (16,514 observations), one large company has no default (5,747 observations) and one small company (25 observations) has the lump sum as a default. Figure 2 shows how annuitization levels vary with pension wealth for companies who have the annuity as default versus all other companies (lump sum or no default). The fraction of individuals who annuitize is on average 17 percentage points higher in companies that have the annuity as default, but as Figure 2 illustrates, the propensity to annuitize increases with the accumulated pension wealth independent of the company's default option.

The annuity is treated as normal income and therefore subject to income taxes. The lump sum, on the other hand, is taxed only once and treated independently of other income. Due to the differential tax treatment the present value of the lump sum's total tax bill is almost always smaller than the annuity's tax burden, especially for larger capital stocks.

5 Results: How means-tested benefits affect annuitization

Our results are organized as follows. First, we illustrate the impact of means-tested benefits on optimal annuity demand using the most basic life-cycle model. Second, we show how the optimal annuity demand changes when inflation and equity risk, non-pension wealth, and taxes are taken into consideration. Third, we compare the simulation results from our model with observed annuitization decisions from administrative data. Finally, we discuss and test alternative explanations why the observed propensity to annuitize increases with pension wealth.

[12] We calculate the values in the solid line by splitting the sample into different bins according to the level of pension wealth and then calculate the mean fraction of retirees that annuitize within each bin. The bins are (in CHF 1,000): 150-250, 250-350, 350-450, 450-550, 550-650, 650-750.

5.1 Optimal annuity demand: The baseline model

To isolate the impact of means-tested benefits, we start with a baseline annuity model that includes first pillar benefits, but abstracts from equity markets, taxes, inflation, and interest rate risk. The model serves as an illustrative example that highlights the main mechanisms at work. Figure 3 displays the optimal consumption levels in case the entire pension wealth is annuitized or cashed-out, respectively, for two different levels of pension wealth.[13] The left panel (pension wealth level of CHF 200,000) shows that for the first 10 years of retirement the consumption stream is much higher when the lump sum is taken than if the pension wealth is annuitized. Thereafter consumption is slightly higher in the case of the lump sum compared to full annuitization. The annuity income that can be generated by annuitizing all wealth (CHF 38,000) only marginally exceeds the guaranteed income (CHF 36,000). As a consequence, it is optimal to take the lump sum, spend it down in the first years of retirement, and subsequently apply for means-tested benefits.

The right panel illustrates that for a higher wealth level (CHF 350,000 in the illustration) the lump sum option still generates a higher consumption level during the first 10 years. However, once the lump sum is depleted, the difference between the annuity income (CHF 49,000) and the guaranteed level due to means-tested benefits (CHF 36,000) is much higher. As a consequence, it is optimal to annuitize everything because the benefits from annuitization, consumption smoothing and a higher insured income late in life, outweigh the benefits from a lump sum, receiving "free" wealth in the form of means-tested benefits.

Figure 3

The simple example illustrates that means-tested benefits reduce the value of an annuity because they replace the benefits the annuity would have provided otherwise. The simulations also show that even those individuals who strategically choose to cash out to qualify for means-tested benefits take some time (11 years in the example) to spend down their entire pension wealth. The utility benefits of consumption smoothing still play some role in the individuals' decisions. As a consequence, one would expect the number of beneficiaries of means-tested benefits to go up only later during the retirement period.

Means-tested benefits also increase the likelihood of polar choices. The additional benefits are highest when annuity levels are 0%. Any annuity income would just reduce the means-tested benefits dollar for dollar. In a similar vein, annuitization is most beneficial (in the absence of differential taxation) when the entire capital is annuitized. A partial annuity reduces the value of

[13] In this example the optimal consumption strategy is to consume the entire annuity income. As the only risk individuals face is longevity risk, a downward sloping consumption pattern, sustained by borrowing against future income, would be optimal in the absence of borrowing constraints.

longevity insurance without increasing the probability of receiving means-tested benefits later in life.

To quantify the impact of means-tested benefits on the value of an annuity, we compute the willingness to pay for access to an annuity market with means-tested benefits. The willingness to pay is defined as the monetary equivalent of the utility gain from following an optimal consumption path in the presence of an annuity market relative to an optimal consumption path in the absence of an annuity market. In a second step, we calculate the willingness to pay for access to an annuity market without means-tested benefits. The difference in the willingness to pay between these two cases measures both the reduction in the insurance value of the annuity and the additional income due to means-tested benefits. We use the same baseline annuity model as above, but assume that the single-life annuities we consider are actuarially fair.[14]

Table 6 summarizes the results. Means-tested benefits reduce the optimal annuitization level from 100% to 0% for retirees with less than CHF 300,000 pension wealth (columns 1 and 2), while the willingness to pay for access to the annuity market is always larger in the case retirees cannot claim means-tested benefits (columns 3 and 4 shows). The difference in the willingness to pay is substantial in both absolute and relative terms, as shown in columns 5 and 6. For example, for a retiree with CHF 100,000 pension wealth means-tested benefits reduce the insurance value of the annuity by 13.5%. The fall in the insurance value is highest for retirees with CHF 300,000 pension wealth (17%) and then declines continuously for higher levels of pension wealth.

Table 6

5.2 Optimal annuity demand: The full model

Table 7 displays optimal annuity demand for different levels of means-tested benefits using a life-cycle model that includes equity and interest rate risk, inflation and taxes but ignores non-pension wealth. We use the benchmark conversion factor of 7.2%, implying an implicit load on the (single-life) annuity of 12%. In the absence of means-tested benefits the optimal annuitization level increases with pension wealth from 40% for CHF 100,000 pension wealth to around 80% for CHF 700,000 pension wealth. Recall that this annuitization is on top of an annuity from the first pillar (the annual first pillar annuity of CHF 24,000 is equivalent to a net present value of more than CHF 300,000).

In the augmented model annuitizing 100% of pension wealth is no longer optimal, because individuals want to keep part of their wealth liquid to smooth inflation shocks. Moreover, progressive rates in both the income tax (which is levied on the annuity) and the tax on the cash-out, in

[14] As outlined before, focusing on single-life annuities underestimates the attractiveness of the annuity due to neglecting spousal benefits. For singles, the actuarially fair nominal annuity conversion rate is slightly higher at 8.1%. Based on the same parameter choices the real annuity conversation rate would be 6.7%.

combination with a preferential tax treatment on the lump sum, induce a shift towards a higher cash-out rate for a given capital stock.

Table 7

If means-tested benefits are available, the optimal annuity demand falls sharply for low to intermediate levels of pension wealth. For the maximum means-tested benefits of CHF 12,000, the annuity is no longer optimal for pension wealth below CHF 700,000. A higher utility level can be achieved by cashing-out pension wealth, spending it down, and subsequently applying for generous means-tested benefits. Wealthier retirees still prefer to annuitize the bulk of retirement balances because a smooth consumption pattern sustained by the annuity dominates the receipt of "free wealth" in the form of means-tested benefits. Table 7 also clearly demonstrates that the availability of means-tested benefits makes the annuitization decision basically a 0-1 decision: Individuals either do not annuitize at all or they nearly fully annuitize their pension wealth. The intuition behind this result is the same as in the baseline case: An intermediate degree of annuitization cuts individuals off from means-tested benefits, but does not give them the full benefits of an annuity. In a similar vein, the optimal annuitization level also increases with the level of liquid non-pension. An additional Swiss franc in non-pension wealth has the same impact as an after-tax franc of pension wealth.[15]

Means-tested benefits create an implicit tax on annuities, as means-tested benefits are foregone by buying the annuity contract.[16] To quantify the implicit tax, we calculate the average amount of means-tested benefits received when an agent annuitizes optimally and compare this number to the average amount of means-tested benefits received when an agent does not annuitize. The implicit tax of means-tested benefits corresponds to the benefits forgone due to choosing the annuity. Recall that our analysis is restricted to male retirees. Using a uniform conversion as in the Swiss scheme has different implications on actuarial fairness for singles and married individuals. The money worth of married men's annuity is much larger than the corresponding figure for singles as spouses are entitled to survivor benefits. Moreover, there are also some mortality differences between single and married men. Nonetheless in the absence of information on whether the individual is married and on the age of the spouse, we compute the loads for single males only. Using a conversion

[15] We distinguish between *liquid* and *illiquid* non-pension wealth: Liquid non-pension wealth can be drawn down just as easily as pension wealth leaving the option to apply for means-tested benefits. Illiquid non-pension wealth mainly consists of housing, which is more difficult to deplete. Many people prefer to keep living in their own home even if they would be better off in financial terms by selling it. Reverse mortgages have hardly been available during the period of the analysis. They also involve pretty large transaction costs. As a consequence few home owners qualify for means-tested benefits.

[16] This exactly mirrors the impact of means-tested Medicaid benefits of the purchase of long-term care insurance as analyzed in Brown and Finkelstein (2008)

factor of 7.2% leads to a *prima facie* pricing load of about 12%, but taking into account spousal benefits, the annuities are much better value for married individuals. The computed load is thus overestimated for married men (who have an annuity that includes survivor benefits) and somewhat underestimated for singles.

The results of this analysis for two different levels of non-pension wealth are summarized in Table 8. Column 1 shows the gross load, which is the pricing load (again assuming single-life annuities). Columns 2 and 3 report the implicit tax on the annuity in absolute terms and relative to pension wealth. The relative implicit tax is declining with pension wealth, which is consistent with optimal annuitization levels rising with pension wealth. A comparison of panel A and B shows that the implicit tax rate is lower for individuals with more liquid non-pension wealth, because wealthier individuals are less likely to be eligible for mean-tested benefits. Columns 4 and 5 document the net load in absolute terms and relative to pension wealth. The net load is the gross load plus the implicit tax on the annuity. We find that due to the implicit tax net loads for individuals at the lower end of the pension wealth distribution are substantial. This explains why few individuals with low pension wealth annuitize their retirement balances.

Table 8

5.3 Comparing optimal annuity demand with observed decisions

Our simulated life-cycle model predicts that annuitization levels increase with accumulated pension wealth. The data also show a positive relationship between the accumulated pension wealth at retirement and the fraction of individuals who choose the annuity (see Section 4.2). The question is whether the annuitization pattern found in the data is quantitatively consistent with the theoretical model.

In order to calculate the optimal annuity demand we also take into account that individuals differ in their liquid and illiquid non-pension wealth. We calculate a weighted average of optimal annuitization rates as a function of second pillar pension wealth levels. The weights are derived from the empirical distributions of liquid and illiquid non-pension wealth using SHARE data (see Tables 3 and 4).[17] We assume that individuals can never transform illiquid into liquid non-pension wealth. This rather conservative approach, which is tantamount to infinite liquidation costs, potentially underestimates the incentive to spend down non-pension wealth in order to

[17] The weights depend on the fraction of agents that fall into a certain category with respect to the amount of liquid and illiquid non-pension wealth. The SHARE data do not display any correlation between non-pension wealth and pension wealth - the correlations between pension wealth and total non-pension wealth, liquid non-pension wealth, and illiquid non-pension wealth are 0.04, 0.16, and 0.14 respectively. A possible interpretation for the independence is that individuals with low pension wealth may compensate by saving more outside the second pillar. Alternatively, individuals with high levels of non-pension wealth may choose to work less and thus accumulate less pension wealth.

claim means-tested benefits.[18] There are two ways to calculate and interpret the optimal annuity demand: (1) the percentage of individuals who primarily opt for the annuity, i.e., they choose to annuitize more than to cash out; or, (2) the percentage of pension wealth invested into annuities as a function of pension wealth. In what follows below we focus on (1) - the percentage of individuals who choose the annuity instead of the lump sum - because in the data almost all individuals either choose full annuitization or zero annuitization.[19] Hence, we round up the optimal annuity demand to 100%. The numbers in the case we do not round up the annuity level to 100% are included as a robustness check.

Figure 4 compares the optimal annuitization pattern predicted by the calibrated life-cycle model with its empirical counterpart. The solid line shows the data: the observed fraction of individuals who take an annuity as a function of pension wealth. We first focus on case (1) in which agents are assumed to either fully annuitize or not at all. The dashed line and the solid line with squares illustrate the predicted likelihood to annuitize in the presence or absence of means-tested benefits, respectively. In both the data and the model the likelihood to take the annuity increases with pension wealth. If means-tested benefits are unavailable, all individuals with pension wealth of CHF 150,000 or more are predicted to choose (close to) full annuitization, which is clearly at odds with the data. The fraction of individuals who are expected to annuitize drops dramatically when agents have access to means-tested benefits. The predicted propensity to annuitize in the presence of means-tested benefits (dashed line) is remarkably close to the data (solid line). Hence, the empirical annuitization pattern in Switzerland seems to be consistent with the proposed explanation of means-tested benefits creating a strong incentive to cash-out pension wealth. The match between the data (solid line) and simulations (dotted line) remains similarly close if we focus on the predicted fraction of pension wealth taken as an annuity instead (case 2).

Figure 4

5.4 Alternative explanations

The literature shows that wealthier people tend to live longer than poorer individuals (De Nardi et al. (2010)). For the U.S. De Nardi et al. (2010) find a difference in life expectancy at age 70 of 4.6 years between the lowest and the highest income quintile. Annuities are relatively more attractive

[18] In particular, we assume that the 48.4% of all individuals in the data whose illiquid non-pension wealth exceeds CHF 145,000, will never be eligible for means-tested benefits. The cutoff is CHF 145,000 since means-tested benefits will be reduced by one-tenth of wealth over a threshold of CHF 25,000 and the means-tested benefits are CHF 12,000 (0.1*(145,000-25,000)=12,000).

[19] Only 5% choose a mix as shown in Table 5. In the simulations, 60% of people choose one of the polar options: 100% annuitization or 0% annuitization. However, due to the availability of equity, inflation risk, and taxes, it can be optimal to annuitize less than 100%. In the simulations, 95% of people choose annuitization levels above 70% or exactly equal to 0%.

for people with a longer life expectancy and thus for wealthier individuals. This can potentially result in a similar annuitization pattern as the one observed in the Swiss case: high annuitization for people with high pension wealth and low annuitization for people with low pension wealth. In this section, we test the validity of this competing explanation.

Unfortunately, data on mortality differences by (pension) wealth are not available in Switzerland. We therefore use a very conservative test of the importance of differential mortality as a competing explanation, based on the U.S. mortality difference of 4.6 years (De Nardi et al. (2010)). This difference is likely to be larger than the mortality difference in Switzerland because the lowest income quintile is typically not covered by occupational pension plans. To isolate the effect of differential mortality we assume that agents cannot apply for means-tested benefits.[20] The optimal annuitization pattern is computed assuming that longevity depends on pension wealth. To do so, we divide agents into four groups: 50 and 100 pension wealth, 200 and 300 pension wealth, 400 and 500 pension wealth, and 600 and 700 pension wealth.[21] Following De Nardi et al. (2010) we then assume that the difference in life expectancy between the poorest and the richest is 4.6 years. More specifically, we adjust the life expectancy in each bin as follows:

1^{st} group's difference in life expectancy relative to average: - 2.3 years
2^{nd} group's difference in life expectancy relative to average: - 0.77 years
3^{rd} group's difference in life expectancy relative to average: + 0.77 years
4^{th} group's difference in life expectancy relative to average: + 2.3 years

Thus individuals in the lowest quartile of pension wealth live 4.6 years less than individuals in the highest quartile. Figure 5 shows (1) the empirical annuitization pattern (solid line), (2) the optimal annuitization patterns assuming uniform mortality rates and means-tested benefits (dashed line), and (3) the optimal annuitization pattern assuming differential mortality rates but no means-tested benefits (dot-dashed line). The pattern generated by differential mortality deviates substantially from the observed annuitization pattern: while only 40% of individuals in the first quartile of pension wealth annuitize, 100% of individuals annuitize in the second to fourth quartile. Thus, differential mortality alone cannot match the empirical annuitization pattern.

In reality, the case for differential mortality is even weaker for the Swiss case. First, as mentioned above, the Swiss occupational scheme does not cover the poorest individuals. This latter group usually accounts for the bulk of mortality differences between wealth groups. Second, differential mortality is typically far less prevalent in European countries than in the US. Using Dutch

[20] As in the baseline case, people still have a first pillar pension wealth of CHF 24,000 per year.

[21] We use simulation to determine the optimal fraction of agents that annuitize for these different pension wealth levels. We group together, for instance, individuals with pension wealth between CHF 250,000 and CHF 350,000 in the data, and compare that to the simulation results for a pension wealth of CHF 300,000.

data, Kalwij et al. (2009) find that the difference in life expectancy between 65-year old men with a low income (defined as minimum income or no income) and 65-year old men with high income (defined as two times the median) is at most 3 years, which is substantially less than in the US.[22]

Figure 5

Home equity could be another competing explanation for the positive correlation between the fraction of individuals who take an annuity and pension wealth. As shown by Davidoff (2009), home equity can reduce the demand for annuities and long-term care insurance if people sell their homes only if they live a long time or require long-term care. The reduction in annuity demand due to housing is likely to be strongest among the poor compared to the rich because housing wealth usually accounts for a larger share of total wealth. However, this aspect should play a smaller role in the Swiss context. Homeownership rates are low by international comparison, at approximately 40% (2010) they are far lower than the U.S. homeownership rate. Moreover, for the wealth range we consider in our analysis home equity as a share of total wealth is relatively constant, as shown in Figure 6. For retirees with a second pillar pension wealth above CHF 50,000 housing wealth as a fraction of total wealth is roughly constant at 30%. Only for retirees at the very bottom of the pension wealth the share is larger.

Figure 6

6 Policy implications and discussion

Means-tested programs in old age differ in both generosity (guaranteed income in old age) and the strength of the asset test. In Switzerland the supplemental income is on top of first pillar pension income and guarantees a much higher level of income than in other countries such as the U.S. or Australia. Agents who have CHF 24,000 of pension income can still apply for an additional CHF 12,000 of supplemental income. Only one tenth of the wealth above a threshold level of CHF 25,000 is taken into consideration. In the U.S. program people are only eligible if they have less than CHF 1,840 of assets. For this reason only 5% of the population over age 65 receives supplemental income in the US. This number underestimates the impact of means-tested benefits as it ignores means-tested benefits via Medicaid, but the impact of the U.S. program on annuitization choices seems more limited.

[22]Kalwij et al. (2009) use data from the Netherlands, which is a country that resembles Switzerland in terms of income distribution and health care. Kalwij et al. (2009) also cite similar studies for other European countries that find a difference in life expectancy of only 2 years. The divergence in life expectancy across income levels between the U.S. and Europe could be attributed to the more equal income distribution and universal health care coverage in most continental European countries.

Motivated by the large differences between the U.S. SSI program and the Swiss means-tested benefits in terms of the level of the supplemental income, we explore the impact of a difference in asset eligibility rules (conditional on the same level of guaranteed income). Furthermore, we assume that the means-tested benefits are reduced dollar for dollar with income.[23] Figure 7 compares the effect of means-tested benefits (dashed line) and the more stringent asset test (consumption floor, dotted line). The propensity to annuitize is lower when agents have access to means-tested benefits with less stringent rules compared to more stringent rules. More generous means-tested benefits not only offer more protection against longevity risk, but also more income in expected terms

Figure 7

Means-tested benefits can be very costly for society both directly and/or indirectly via behavioral changes, including annuitization decisions. Taking means-tested benefits into account, individuals annuitize a smaller fraction of their pension wealth than they would do otherwise. We quantify the costs and utilities of offering means-tested benefits by comparing the benchmark case, (1) means-tested benefits as in the Swiss example, with alternative poverty-alleviation schemes in old age: (2) mandatory annuitization (as for example in the Netherlands), (3) a minimum income requirement (MIR, as in the UK) and (4) a stricter asset test (comparable to the U.S. case).

All schemes we compare in this section guarantee the same gross minimum income in old age (CHF 36,000 per year), but do this in different ways. The benchmark case is the Swiss scheme to which our model is calibrated. Recall that this *means-tested benefits* scheme does not put any restrictions on the individual's annuitization choice and retirees are allowed to keep a certain amount of wealth and can still be eligible for supplemental income. As a first alternative, we compute the costs for the government with *mandatory full annuitization*. As a second alternative, individuals are also required to fully annuitize pension wealth, but only up to the amount that would guarantee a nominal income equal to the level provided by means-tested benefits just after retirement. This is the so-called *minimum income requirement* (MIR) which is used in the UK. To guarantee an income equal to the guaranteed income level, agents need to annuitize at least CHF 167,000 of their pension wealth.[24] In all three schemes, individuals are eligible for the same supplemental income schemes (including less strict assets tests as in the Swiss case) in case their combined income falls short of the guaranteed income. As a final alternative we consider stricter asset tests to qualify for

[23] Pashchenko (2010) tests the implications of means-tested benefits with more stringent asset tests (compared to our baseline case) on optimal annuity decisions. She uses $2,663 per year as a minimum income level and means-tested benefits are reduced dollar for dollar with income and assets, and finds that the participation level in the annuity market decreases for higher levels of the consumption floor. Similarly, Peijnenburg et al. (2012) show that the level of annuitization is a decreasing function of a minimum consumption level.

[24] A pension wealth income of approximately CHF 167,000 generates an income of CHF 12,000, using a conversion rate of 7.2%.

additional benefits, also called *consumption floor*. The minimum income is the same as the income guaranteed by means-tested benefits in the Swiss benchmark case. It puts no restrictions on the cash out decision and thus ensures that a retiree will always receive an amount deemed necessary to finance a decent living. In contrast to the benchmark case it requires individuals to run down their entire wealth before applying for supplemental financial assistance. Hence the supplemental income will be reduced dollar for dollar with income and assets.

In a first step we compare the impact of the different policy alternatives on individuals' utility. Figure 8 shows the certainty equivalent consumption as a function of accumulated pension wealth. The benchmark policy obviously dominates all other options in terms of individual utility as it (1) puts the least restrictions on individual choice and (2) offers the most generous protection (the level of transfers to retirees is the highest because the asset tests are less strict). Using the same argument, the minimum income requirement scheme dominates the mandatory full annuitization system. The ranking of a stricter asset test policy relative to the minimum income requirement and the mandatory full annuitization case is not clear a priori. Furthermore, the utility from the stricter asset test scheme (but with unrestricted cash-out decision) is very close to the utility when imposing a minimum income requirement.

Figure 8

In a second step, we quantify the public costs of the different schemes by calculating the average net present value of means-tested benefits a person claims over a lifetime for different levels of pension wealth. Because we assume that non-pension wealth is zero, our numbers form an upper bound for these costs.

Table 9 shows the average net present value of means-tested benefits per person for the four policies and the willingness to pay to have one policy compared to another policy. In the benchmark case an individual with CHF 100,000 pension wealth generates average costs of CHF 146,000 due to supplemental income. For an individual with the same wealth level mandatory full annuitization decreases the net present value of costs to CHF 101,000, and a stricter resource test policy to CHF 95,000.

Table 9

The difference in costs between poverty-alleviation schemes is relatively small for low levels of pension wealth because individuals with low levels of pension wealth can claim supplemental income regardless of the scheme in place. The difference in costs for the government is higher in both absolute and relative terms for intermediate levels of pension wealth (CHF 200,000 to 400,000). For wealthier individuals the difference in costs is declining; for these retirees the value of a flat consumption plan exceeds the value of potential supplemental income.

The more cash-out is restricted, the lower are the public costs. Note, however, that the restriction of choice might have second order effects (for example on retirement timing) that we could not consider. Imposing stricter resource tests substantially decreases public costs without restricting cash-out decisions. However, it is generally impossible to rank the costs of stricter asset and income tests with respect to the other alternatives. The positive effect of the stricter resource test is offset by the possibility to strategically under-annuitize to qualify for supplemental benefits.

Column 2 in Table 9 shows that an agent with CHF 100,000 pension wealth would be willing to pay CHF 84,000 to have access to the benchmark scheme instead of a minimum income requirement policy (which is equivalent to mandatory annuitization in this case). The willingness to pay for the benchmark scheme is almost twice that of the cost differential between the benchmark and MIR (CHF 146,000 - CHF 101,000). Combining Table 9 and Figure 8, it is obvious that neither of the policies can generate similar utilities without being also more costly, hence no poverty-alleviation policy is strictly dominated by another.

It is possible to provide income protection in old age at substantially lower costs than in the benchmark case. This can either be achieved by using stricter eligibility tests or requiring individuals to annuitize a certain amount of their pension wealth. Both policies impose less restriction on individual choice than mandatory annuitization and at the same time reduce the negative impact generated by individuals strategically reducing the fraction of pension wealth annuitized. However, lowering the costs for the government has distributional consequences: It reduces the redistribution from the wealthy to the less wealthy among the retired.

While empirical annuitization patterns are consistent with optimal decisions in the presence of means-tested benefits, causality is much more difficult to establish. To the best of our knowledge there are no within country variation (i.e., a policy changes) that could be explored. Cross country variations in means-tested benefits programs are unlikely to deliver clear results. Large differences between countries are bound to confound the analysis.[25] We are thus convinced that despite the shortcomings mentioned, our approach is able to demonstrate that means-tested benefits are quantitatively important for annuitization. Switzerland is an ideal case study as its generous means-tested benefits program allows to come up with an upper bound of the impact of poverty alleviation schemes on annuity demand.

[25] In the model more generous means-tested benefits decrease optimal annuitization levels, while a crude comparison, for example, between the US and Switzerland shows the opposite pattern. The conjecture looks right, however, when considering Australia which has both a very generous MTB scheme and extremely low annuitization rates

7 Conclusions

We analyze the impact of means-tested benefits on the optimal annuitization level at retirement. Means-tested benefits, which are typically thought of as poverty protection in old age, act like an additional free insurance against the financial consequences of longevity. They may thus induce retirees to cash out pension wealth as a lump sum, draw it down to consume out of it, and subsequently apply for means-tested benefits when the lump sum is (largely) depleted. To quantify the impact of means-tested benefits on an individual's cash-out decision, we construct a rich life-cycle model in which individuals can rely on means-tested benefits in case their income is below a certain level. The model is calibrated to Switzerland, a country in which means-tested benefits incentives for cashing-out retirement balances are particularly strong due to a combination of generous income guarantees and sizeable levels of pension wealth that can be cashed out.

The results from our life-cycle model indeed demonstrate that means-tested benefits substantially decrease the optimal annuity demand. Not surprisingly the effect is more pronounced for individuals at the lower end of the wealth distribution for whom the annuity does not differ much from (or may even be smaller than) the guaranteed income. For these individuals taking the lump sum in view of applying for means-tested benefits later generates a higher lifetime utility. For higher pension wealth levels, on the other hand, the desire for a smooth consumption path and the value of the longevity insurance implied by the annuity dominate the incentives of the free means-tested supplemental benefits.

In the second part of our analysis we compare the results from the model with observed annuitization behavior. Our data consist of 22,000 individual annuitization decisions provided by a number of Swiss pension funds. The predictions from the life-cycle model with means-tested benefits are close to the empirically observed pattern in Switzerland. The optimal annuity demand not only decreases due to means-tested benefits, but also generates a pattern that is close to the data both in terms of level and the correlation with pension wealth.

Although we derived the quantitative impact of means-tested benefits on the decision to annuitize for a single country, our results have further-reaching implications for the adequacy of income provided in old age. A partial shift from first to second pillar income provision in old age, as discussed in many countries, has to be evaluated carefully with respect to incentives that are created when allowing individuals to cash out second pillar wealth. A generous protection against poverty in old age may generate a strong tendency to deplete pension wealth in the years after retirement and then apply for means-tested benefits – and thus potentially high costs for the welfare system. Policy makers will have to tradeoff the benefits of leaving the annuitization choice to the individuals and the costs from doing so.

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A Web Appendix of ”How much do means-tested benefits reduce the demand for annuities?”

A.1 Numerical method for solving the life-cycle problem

Due to the richness and complexity of the model it cannot be solved analytically hence we employ numerical techniques instead. We use the method proposed by Brandt et al. (2005) and Carroll (2006) with several extensions added by Koijen et al. (2010). Brandt et al. (2005) adopt a simulation-based method which can deal with many exogenous state variables. In our case $X_t = (R^f_t, \pi_t)$ is the relevant exogenous state variable. Wealth acts as an endogenous state variable. For this reason, following Carroll (2006), we specify a grid for wealth *after* (annuity) income, and consumption. As a result, it is not required to do numerical rootfinding to find the optimal consumption decision.

The optimization problem is solved via dynamic programming. We proceed backwards to find the optimal investment and consumption strategy. In the last period the individual consumes all wealth available. The value function at time T equals:

$$J_T(W_T, R^f_T, \pi_T) = \frac{(W_T + Y^I_t + Y^{II}_t + M_T)^{1-\gamma}}{1-\gamma}. \tag{13}$$

The value function satisfies the Bellman equation at all other points in time,

$$V_t(W_t, R^f_t, \pi_t) = \max_{w_t, C_t} \left(\frac{C_t^{1-\gamma}}{1-\gamma} + \beta p_{t+1} E_t(V_{t+1}(W_{t+1}, R^f_{t+1}, \pi_{t+1})) \right). \tag{14}$$

In each period we find the optimal asset weights by setting the first order condition equal to zero

$$E_t(C^{*-\gamma}_{t+1}(R_{t+1} - R^f_t)/\Pi_{t+1}) = 0, \tag{15}$$

where C^*_{t+1} denotes the optimal real consumption level. Because we solve the optimization problem via backwards recursion we know C^*_{t+1} at time $t+1$. Furthermore we simulate the exogenous state variables for N trajectories and T time periods hence we can calculate the realizations of the Euler conditions, $C^{*-\gamma}_{t+1}(R_{t+1} - R^f_t)/\Pi_{t+1}$. We regress these realizations on a polynomial expansion in the state variables to obtain an approximation of the conditional expectation of the Euler condition

$$E\left(C^{*-\gamma}_{t+1}(R_{t+1} - R^f_t)/\Pi_{t+1}\right) \simeq \tilde{X}'_p \theta_h. \tag{16}$$

In addition we employ a further extension introduced in Koijen et al. (2010). They found that the regression coefficients θ_h are smooth functions of the asset weights and consequently we approximate the regression coefficients θ_h by projecting them further on polynomial expansion in the asset weights:

$$\theta_h' \simeq g(w)\psi. \tag{17}$$

The Euler condition must be set to zero to find the optimal asset weights

$$\tilde{X}_p'\psi g(w)' = 0. \tag{18}$$

Due to the maximization function in the budget constraint, see (5) and (6), there are two Euler conditions for the optimal consumption level. One for when the agent *does* receive means-tested benefits and a second for when the agent *does not* receive means-tested benefits:

$$C_t^{*-\gamma} = \beta p_{t+1} E_t \left(\frac{\Pi_t}{\Pi_{t+1}} C_{t+1}^{*-\gamma} R_{t+1}^{P*} \right) \text{ if } M_t = 0, \tag{19}$$

$$C_t^{*-\gamma} = \beta p_{t+1}(1-r-g) E_t \left(\frac{\Pi_t}{\Pi_{t+1}} C_{t+1}^{*-\gamma} R_{t+1}^{P*} \right) \text{ if } M_t > 0. \tag{20}$$

This complicates the optimization procedure for consumption and details describing the method are in Appendix A.

A.2 Optimal consumption and investment decisions

We optimize over consumption and asset allocation dynamically. The exogenous state variables are the risk free rate and inflation, the endogenous state variable is wealth. Agents receive means-tested benefits and the amount depends on wealth and income.

The objective is to maximize the expected lifetime utility which is equal to

$$V = E_0 \left[\sum_{t=1}^{T} \beta^{t-1} \left(\left(\prod_{s=1}^{t} p_s \right) \frac{C_t^{1-\gamma}}{1-\gamma} \right) \right] \tag{21}$$

where β is the time preference discount factor, γ denotes the level of risk aversion, and C_t is the real amount of wealth consumed at the beginning of period t. The probability of surviving to age t, conditional on having lived to period $t-1$ is indicated by p_t. We define the nominal consumption as $\overline{C_t} = C_t \Pi_t$ and Π_t is the price index. The gross nominal equity returns are denoted by R_t and the riskless bond yields a constant gross nominal return of R_t^f.

The budget constraint of the individual is equal to

$$W_{t+1} = (W_t + Y_t^I + Y_t^{II} + M_t - \overline{C_t})(1 + R_t^f + (R_{t+1} - R_t^f) w_t). \tag{22}$$

w_t denotes the weight invested in stocks and M_t are the means-tested benefits at the beginning of period t. The individuals nominal consumption is indicated by $\overline{C_t}$ and Y_t^I is the after tax income from first pillar pension wealth and Y_t^{II} from second pillar pension wealth. Net means-tested benefits equal:

$$M_t = \max(\tilde{M}_t - Y_t^I - Y_t^{II} - rW_t - gW_t, 0), \tag{23}$$

where $\tilde{M}_t$ is the net amount of consumption/income guaranteed by the government. If income plus return on wealth plus a fraction of wealth g is lower than $\tilde{M}_t$, agents receive means-tested benefits. Rewriting the budget constraint:

$$W_{t+1} = (W_t + Y_t^I + Y_t^{II} + \max(\tilde{M}_t - Y_t^I - Y_t^{II} - rW_t - gW_t, 0) - \overline{C_t})(1 + R_t^f + (R_{t+1} - R_t^f)w_t). \tag{24}$$

The timing is as follows, first an individual receives income and (possibly) means-tested benefits, after which the individual consumes. Subsequently the remaining wealth is invested.

The individual faces a number of constraints on the consumption and investment decisions. First, we assume that the retiree faces borrowing and short-sales constraints

$$w_t \geq 0 \text{ and } w_t \leq 1. \tag{25}$$

Second, we impose that the investor is borrowing constrained

$$\overline{C_t} \leq W_t, \tag{26}$$

which implies that the individual cannot borrow against future annuity income to increase consumption today. Furthermore, the agent cannot save out of its means-tested benefits, but has to consume them:

$$C_t = \min(C_t^*, \tilde{M}_t) \text{ if } M_t > 0 \tag{27}$$

where C_t^* is the optimal consumption resulting from the optimization procedure.

The optimization problem is solved via dynamic programming and we proceed backwards to find the optimal investment and consumption strategy. In the last period the individual consumes all remaining wealth, hence we exactly know the utility from terminal wealth. Specifically the value at time T is equal to

$$J_T(W_T, R_T^f, \pi_T) = \frac{(W_T + Y_t^I + Y_t^{II} + M_T)^{1-\gamma}}{1-\gamma} \tag{28}$$

The value function satisfies the Bellman equation

$$V_t(W_t, R_t^f, \pi_t) = \max_{w_t, C_t} \left(\frac{C_t^{1-\gamma}}{1-\gamma} + \beta p_{t+1} E_t(V_{t+1}(W_{t+1}, R_{t+1}^f, \pi_{t+1})) \right) \tag{29}$$

We define the portfolio return as:

$$R_{t+1}^P = 1 + R_t^f + (R_{t+1} - R_t^f) w_t \tag{30}$$

Furthermore we denote the wealth level after annuity income, consumption, and means-tested benefits as:

$$A_t = W_t + Y_t^I + Y_t^{II} - \overline{C_t} + \max(0, M_t) \tag{31}$$

A.3 First order conditions

In order to find the optimal consumption and investment decisions we derive the Euler conditions. The optimal asset allocation follows from

$$\frac{\partial V_t}{\partial w_t} = E_t \left(\frac{1}{\Pi_{t+1}} C_{t+1}^{*-\gamma} (R_{t+1} - R_t^f) \right) = 0. \tag{32}$$

To obtain the consumption policies we take the first order condition with respect to C_t

$$\frac{\partial V_t}{\partial C_t} = C_t^{*-\gamma} - \beta p_{t+1} E_t \left(\frac{\partial V_{t+1}}{\partial W_{t+1}} \Pi_t R_{t+1}^{P*} \right) = 0 \tag{33}$$

and calculate the derivative of the value function with respect to W_t

$$\frac{\partial V_t}{\partial W_t} = \beta p_{t+1} E_t \left(\frac{\partial V_{t+1}}{\partial W_{t+1}} R_{t+1}^{P*} \right)$$
$$\text{if } \max(\tilde{M}_t - Y_t^I - Y_t^{II} - rW_t - gW_t, 0) = 0 \tag{34}$$
$$\frac{\partial V_t}{\partial W_t} = \beta p_{t+1}(1 - r - g) E_t \left(\frac{\partial V_{t+1}}{\partial W_{t+1}} R_{t+1}^{P*} \right)$$
$$\text{if } \max(\tilde{M}_t - Y_t^I - Y_t^{II} - rW_t - gW_t, 0) > 0. \tag{35}$$

To solve for the optimal consumption, substitute (34) and (35) into (33) to get the following first order condition

$$C_t^{*-\gamma} = \beta p_{t+1} E_t \left(\frac{\Pi_t}{\Pi_{t+1}} C_{t+1}^{*-\gamma} R_{t+1}^{P*} \right)$$
$$\text{if } \max(\tilde{M}_t - Y_t^I - Y_t^{II} - rW_t - gW_t, 0) = 0 \tag{36}$$
$$C_t^{*-\gamma} = \beta p_{t+1}(1-r-g) E_t \left(\frac{\Pi_t}{\Pi_{t+1}} C_{t+1}^{*-\gamma} R_{t+1}^{P*} \right)$$
$$\text{if } \max(\tilde{M}_t - Y_t^I - Y_t^{II} - rW_t - gW_t, 0) > 0 \tag{37}$$

Due to the complexity of the model it cannot be solved analytically. Instead we use numerical optimization techniques to solve the problem. The procedure for the optimal asset allocation is described in Section A.1 and below we elaborate on the method used to obtain optimal consumption levels.

A.4 Optimization procedure for optimal consumption

Similar when calculating the optimal asset weights, we regress the realizations of the Euler condition on a polynomial expansion in the state variables to obtain an approximation of the conditional expectation of the Euler condition. However, now we calculate two potential optimal consumption levels, for both Euler conditions (36) and (37), corresponding to whether or not the agent receives means-tested benefits. Note that $C_t^{*mtb} > C_t^{*nomtb}$, where C_t^{*mtb} is the optimal consumption if an agent receives means-tested benefits and C_t^{*nomtb} if the agent does not receive means-tested benefits. It can be seen from (36) and (37) that the optimal consumption with means-tested benefits derived from the maximization procedure is always higher due to the additional factor $(1-r-g)^{-(1/\gamma}$, which is always higher than 1. The means-tested benefits can be calculated if we know the optimal consumption levels:

$$M_t^{mtb} = \frac{\tilde{M}_t - Y_t^I - Y_t^{II} - (r+g)(A_t + C_t^{*mtb} - Y_t^I - Y_t^{II})}{1-r-g} \tag{38}$$
$$M_t^{nomtb} = \tilde{M}_t - Y_t^I - Y_t^{II} - (r+g)(A_t + C_t^{*nomtb} - Y_t^I - Y_t^{II}). \tag{39}$$

Hence for every time period and every trajectory we have a set of optimal consumption and means-tested benefits: (C_t^{*mtb}, M_t^{mtb}) and $(C_t^{*nomtb}, M_t^{nomtb})$. However, we need to determine which set is the optimal set. We know that if the income level is higher than the guaranteed consumption level, then an agent does not receive means-tested benefits and the optimal consumption level is

C_t^{*nomtb}. In case $Y_t < \tilde{M}_t$, then the optimal consumption result from applying the following rules:

$$\text{If } M_t^{mtb} > 0 \cap M_t^{nomtb} > 0 \text{ then } C_t^{*mtb} \tag{40}$$

$$\text{If } M_t^{mtb} > 0 \cap M_t^{nomtb} < 0 \text{ then } C_t^{*mtb} \tag{41}$$

$$\text{If } M_t^{mtb} <= 0 \cap M_t^{nomtb} < 0 \text{ then } C_t^{*nomtb} \tag{42}$$

$$\text{If } M_t^{mtb} <= 0 \cap M_t^{nomtb} > 0 \cap |M_t^{nomtb}| < |M_t^{mtb}| \text{ then } C_t^{*nomtb} \text{ else } C_t^{*mtb}. \tag{43}$$

These rules are based on whether the implied means-tested benefits due to the optimal consumption level are viable. Focusing on 40, we see that $M_t^{mtb} > 0$ and $M_t^{nomtb} > 0$. However, it should not be that the means-tested benefits implied by the no-means-tested benefits consumption level are positive; M_t^{nomtb} should not be positive. Hence C_t^{*mtb} is optimal.

B Tax rates in Switzerland

We use the tax rates for singles, which are displayed in Table 10.

Table 10

Figure 1: Empirical annuitization levels of second pillar pension wealth
We show retirees' annuitization decisions of second pillar pension wealth in Swiss pension funds. The dots are the individual decisions and the solid line is the fraction of retirees that choose the annuity instead of the lump sum.

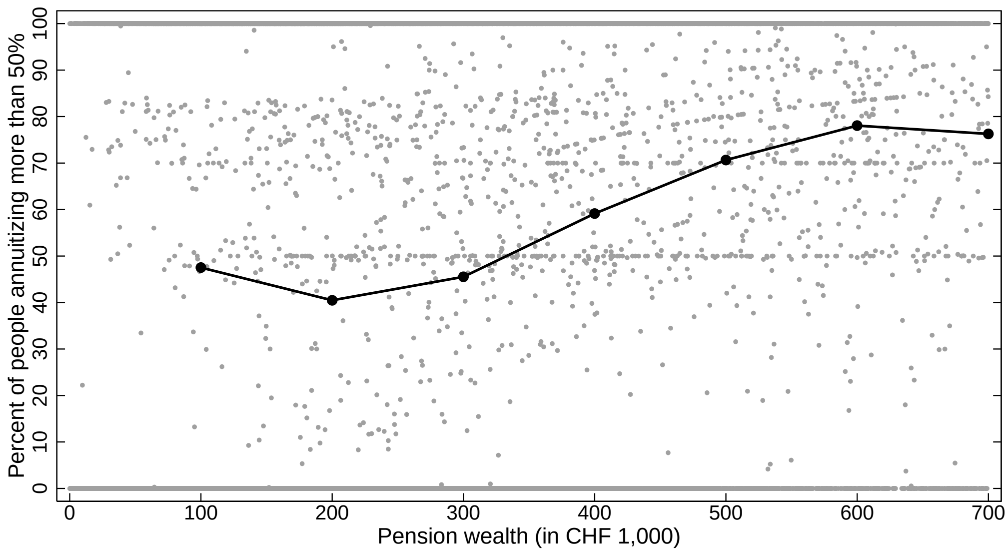

Figure 2: Influence of the default option on empirical annuitization levels
We show the annuitization levels for companies who have the annuity as default (solid line) and companies who have the lump sum as default or no default (dashed line).

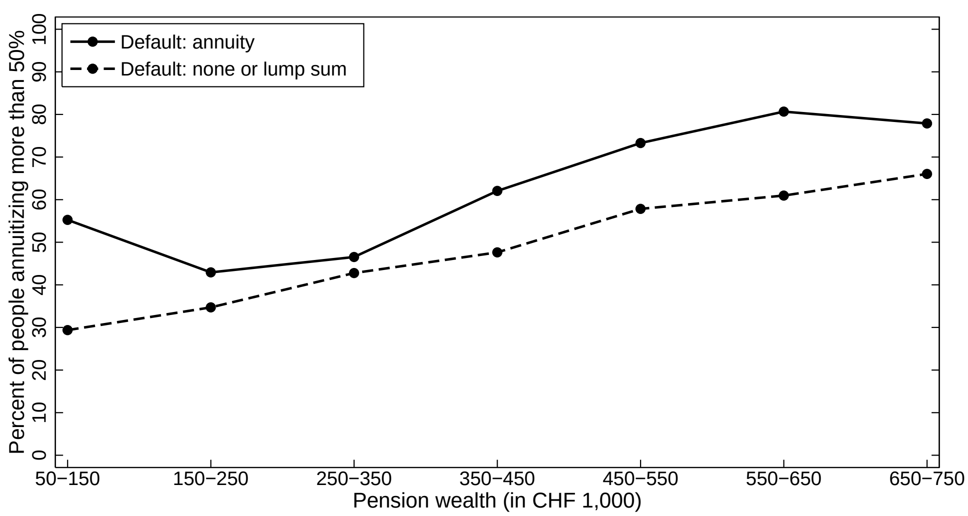

Figure 3: Optimal consumption patterns: Illustrative example
The figure displays the consumption pattern if an individual (1) annuitized his entire pension wealth or (2) took the lump sum. Equity, inflation, non-pension wealth, and taxes are excluded from the model, the only risk that agents face is longevity risk. The 7.2% conversion rate of Switzerland is used, which means that the implicit load on the annuity is 12%. If the pension wealth level equals CHF 200,000, it is optimal to choose the consumption stream from the lump sum. If the wealth level is CHF 350,000, the consumption stream from full annuitization is preferred. The guaranteed income equals CHF 36,000.

(a) wealth CHF 200,000 (b) wealth CHF 350,000

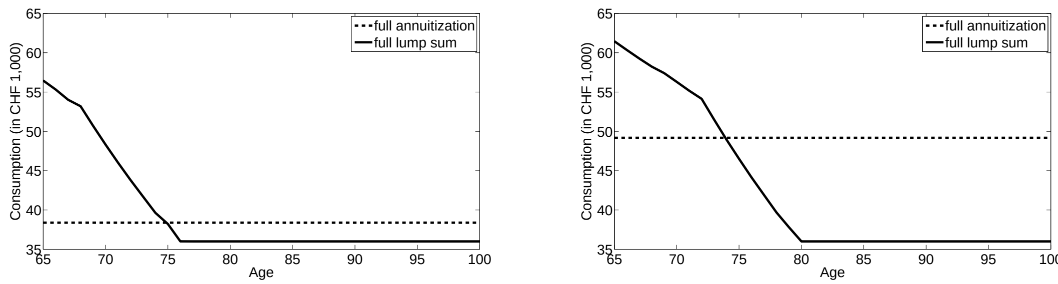

Figure 4: Comparison optimal annuitization pattern and empirical annuitization pattern
The figure displays the optimal and the empirical average percentage of people that annuitize for different wealth levels. The optimal annuity level is displayed for two cases: (1) agents can apply for means-tested benefits (MTB) and (2) agents cannot apply for means-tested benefits. The optimal percentage is the weighted average of all the optimal annuitization levels for different levels of liquid-non pension wealth and illiquid non-pension wealth. Weights derived from the SHARE dataset are used, assuming independency between pension wealth, illiquid non-pension wealth, and liquid non-pension wealth. There are two ways we calculate and interpret the optimal annuity demand: (1) the percentage of individuals who primarily opt for the annuity, i.e., they choose to annuitize more than to cash out; or, (2) the percentage of pension wealth invested into annuities as a function of pension wealth. The first is the baseline case, in which we round up all annuity levels above 50% to 100%. All the parameters are as in the benchmark case.

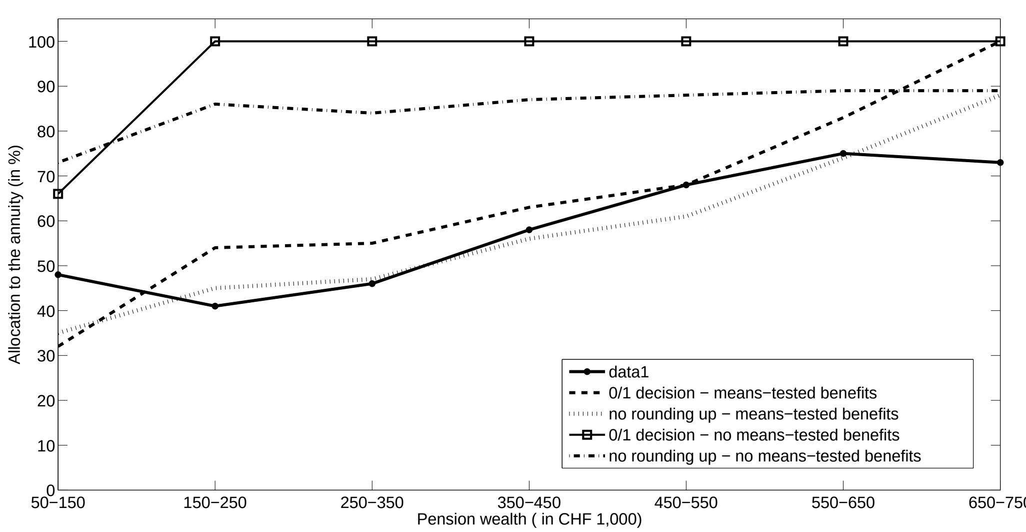

Figure 5: Can differential mortality explain annuitization pattern?
Individuals are divided into 4 bins: 50-100 pension wealth, 200-300 pension wealth, 400-500 pension wealth, and 600-700 pension wealth. The survival probabilities correspond to differences to average life expectancy as follows: 1^{st} bin's average - 2.3 years, 2^{nd} bin's is average -0.77 years, 3^{rd} bin's average +0.77 years, and 4^{th} bin's average +2.3 years

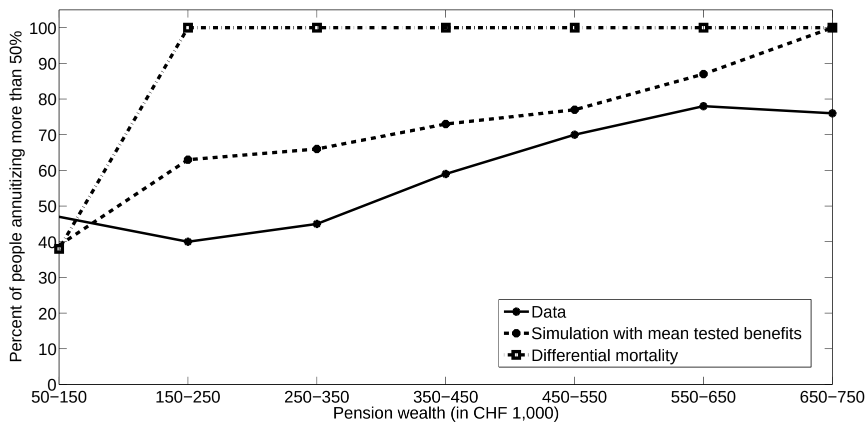

Figure 6: Housing wealth as a share of total wealth
The figure displays housing wealth as a share of total wealth for different levels of pension wealth. Housing wealth, pension wealth, and total wealth are calculated using asset data from SHARE.

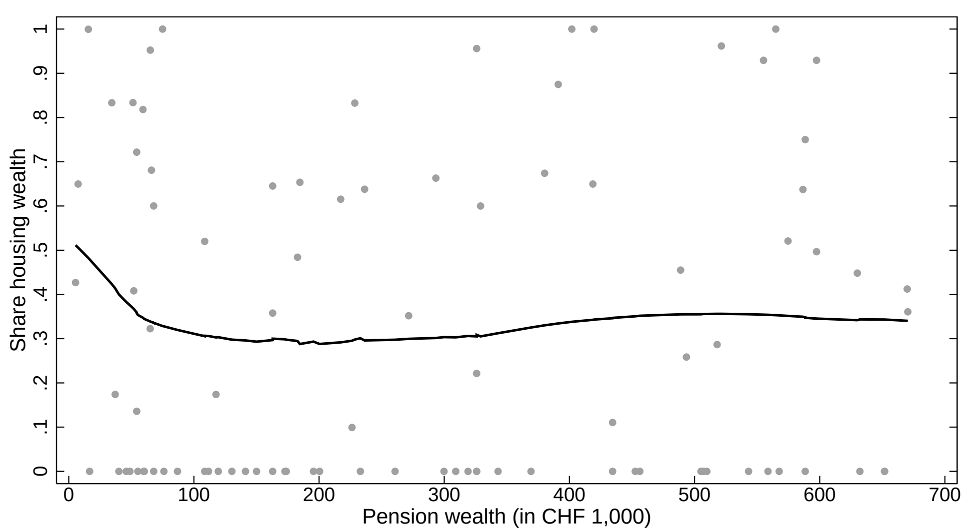

Figure 7: Comparison of the influence of (1) means-tested benefits with less strict asset rules (benchmark case) and (2) means-tested benefits with strict asset rules (dollar for dollar reduction) on optimal annuitization levels

The figure displays the optimal and the empirical average fraction annuitized for varying wealth levels. The optimal fraction is displayed assuming agents can receive (1) means-tested benefits facing less strict asset rules a (2) means-tested benefits with strict asset rules (dollar for dollar reduction). The optimal fraction is the weighted average of all the optimal annuitization levels for varying liquid-non pension wealth and illiquid non-pension wealth. Weights derived from the SHARE dataset are used, assuming independency between pension wealth, illiquid non-pension wealth, and liquid non-pension wealth. All the parameters are as in the benchmark case.

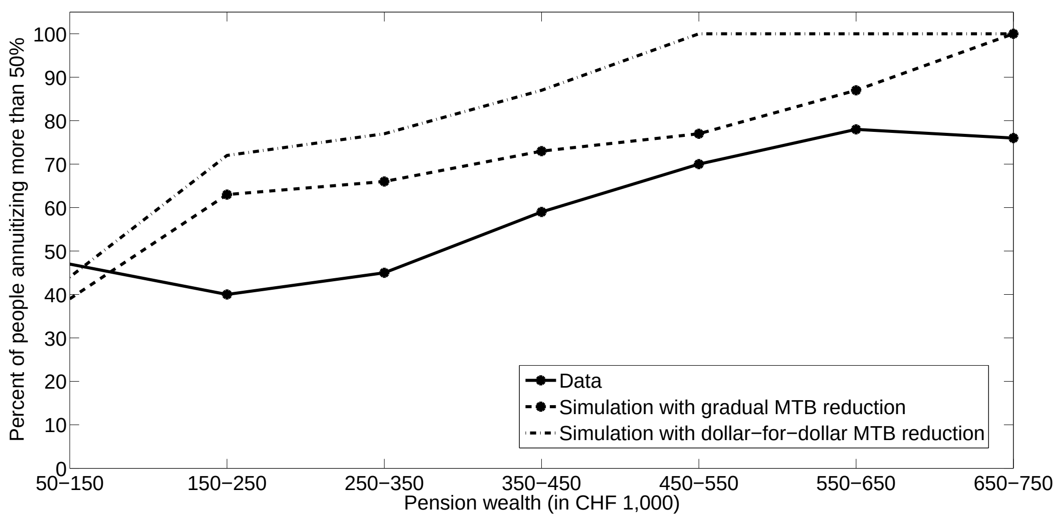

Figure 8: Certainty equivalent consumption for different old-age poverty alleviation schemes assuming zero liquid non-pension wealth (in CHF 1,000)

All the parameters are as in the benchmark case.

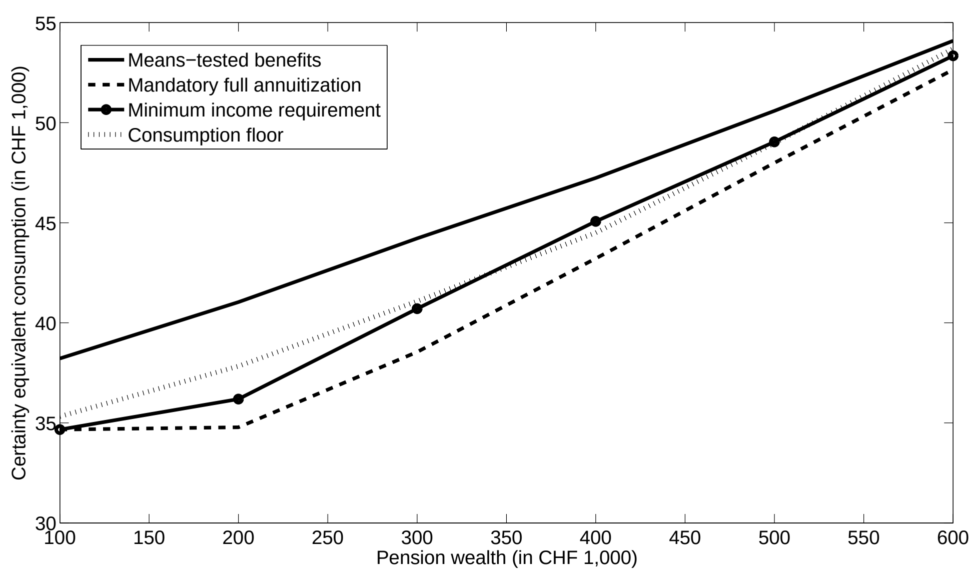

Table 1: Maximum and average means-tested benefits of single retired recipients in 2008

Means-tested benefits correspond to the difference between applicable expenditures and income but cover at least the health insurance premium.

Components	Maximum (1)	Average (2)
Applicable expenditures		
Cost-of-living allowance	18,144	18,144
Rent/Interest on mortgage	13,200	10,212
Health insurance premium	4,500	3,996
Other expenses	-	84
Total	35,844	32,436
Applicable income		
First pillar benefits	26,520	19,944
Other pension benefits	-	1,524
Wage income	-	84
Own rent	-	504
Investment income	-	288
Wealth consumption	-	636
Other income	-	180
Total	-	23,160
Means-tested benefits	35,844	9,612
Net wealth	-	20,140
Wealth (after deduction)	-	6,411

Table 2: Benchmark parameters

Description	parameter value
Time preference discount factor (β)	0.96
Risk aversion coefficient (γ)	3
Mean return on stocks (μ_R)	6.5%
Standard deviation stock returns (σ_R)	20%
Mean interest rate (μ_r)	2.5%
Standard deviation interest rate (σ_r)	1%
Mean reversion parameter interest rate (a_t)	0.15
Mean inflation (μ_π)	1.79%
Standard deviation instantaneous inflation (σ_π)	1.12%
Standard deviation price index (σ_Π)	1.11%
Correlation interest rate and expected inflation	0.4
Mean reversion coefficient expected inflation (a_π)	0.165
I pillar income at $t = 1$ (Y_1^I)	CHF 24,000
Guaranteed consumption level at $t = 1$ ($\tilde{M}_1$)	CHF 36,000
Fraction of wealth taking into account to calculate MTB (g)	0.1
Conversion rate (c)	7.2%

Table 3: Distribution of liquid non-pension wealth (NPW)

The distribution is derived using SHARE-Swiss data from 2003. We use information from all retired men with second pillar wealth below CHF 700,000 (93 observations). Liquid non-pension wealth is the sum of values of bank accounts, bonds, stocks, mutual funds, individual retirement accounts, contractual savings for housing, cars and life insurance policies minus financial liabilities. The mean liquid non-pension wealth is CHF 197,265.

liquid NPW	% in wealth category
0 - 50,000	33.3
50,000 - 150,000	28.0
150,000 - 250,000	10.8
250,000 - 350,000	10.8
350,000 - 450,000	3.2
450,000 - 550,000	3.2
550,000 -	10.8

Table 4: Distribution of illiquid non-pension wealth (NPW)

The distribution is derived using SHARE-Swiss data from 2003. We use information from all retired men with second pillar wealth below 700,000 CHF (93 observations). Illiquid non-pension wealth is the sum of the values of the primary residence net of the mortgage, other real estate, and the owned share of own business. The mean illiquid non-pension wealth is CHF 231,987.

illiquid NPW	% in wealth category
0	39.8
1 - 96,000	11.8
96,000 -	48.4

Table 5: Summary statistics of pension funds data, men

Variable	Mean (1)	Median (2)	S.D. (3)	Min (4)	Max (5)
Age at retirement	63.9	65.0	1.8	55.0	70.7
Conversion rate					
Mandatory Part	6.928	7.150	0.424	5.210	8.043
Supermandatory Part	6.740	6.863	0.523	4.816	8.043
Pension wealth	249,797	212,591	165,387	102	699,892
Share Annuity	44.3	0	49.7	0	100
Share Lump Sum	49.9	0	50.0	0	100
Share Mixed	5.8	0	23.4	0	100
Observations	22,261				

Table 6: Reduction in the annuity value due to means-tested benefits

The table presents the willingness to pay (WTP) for access to the annuity market for different pension wealth levels. We use a baseline-type annuity model that includes first pillar benefits and actuarially fair annuities, but abstracts from equity markets, taxes, inflation, and interest rate risk.

pension wealth	optimal annuitization with MTB (1)	optimal annuitization without MTB (2)	WTP for annuity access with MTB (3)	WTP for annuity access without MTB (4)	reduction WTP (absolute) (5)	reduction WTP (in % pension wealh) (6)
100K	0%	100%	0	13,500	13,500	13.5
200K	0%	100%	0	31,000	31,000	14.8
300K	0%	100%	0	51,000	51,000	17
400K	100%	100%	21,000	73,000	52,000	13
500K	100%	100%	55,000	95,000	40,000	8
600K	100%	100%	85,000	117,000	32,000	5.3
700K	100%	100%	112,000	140,000	28,000	4

Table 7: Influence of means-tested benefits on optimal annuity levels

The figure displays the optimal annuitization levels for varying levels of means-tested benefits. We assume that the agent has zero non-pension wealth. The rest of the parameters are as in the benchmark case.

	MTB 0	MTB 6,000	MTB 12,000
100K	40%	0%	0%
200K	70%	0%	0%
300K	70%	0%	0%
400K	75%	75%	0%
500K	80%	80%	0%
600K	80%	80%	0%
700K	80%	80%	80%

Table 8: The implicit tax of means-tested benefits on annuities

The gross load is the pricing load, which in the Swiss case is equal to 12.1% of pension wealth. The MTB forgone is the average amount of means-tested benefits received when an agent does not annuitize minus the average amount of means-tested benefits when an agent annuitizes optimally. The net load is the MTB forgone plus the gross load.

pension wealth	gross load	MTB forgone (implicit tax)		net load	
		absolute	% of pension wealth	absolute	% of pension wealth
	(1)	(2)	(3)	(4)	(5)
Panel A: liquid NPW 0					
100K	12,100	45,400	45.5	57,500	57.50
200K	24,200	82,500	41.3	106,700	53.35
300K	36,300	74,200	24.7	110,500	36.83
400K	48,400	56,600	10.9	105,000	26.25
500K	60,500	43,500	5.6	104,000	20.80
600K	72,600	33,500	2.8	106,100	17.68
Panel B: liquid NPW 200					
100K	12,100	27,900	27.9	40,000	40.00
200K	24,200	40,200	20.1	44,300	22.15
300K	36,300	36,400	12.1	48,400	16.13
400K	48,400	29,800	7.5	55,900	13.97
500K	60,500	24,100	4.8	65,300	13.06
600K	72,600	19,400	3.2	75,800	12.63

Table 9: Comparison different poverty alleviation policies

The table displays the average net present value (NPV) of means-tested benefits received by the agents and the willingness to pay (WTP) to have a different policy. Liquid non-pension wealth is set to zero. The MTB column displays the NPV of means-tested benefits when the benchmark means-tested benefits policy is in place. The MIR column displays the NPV of means-tested benefits when the minimum income requirement policy is in place. Under the MIR policy, agents are obliged to annuitize pension wealth at least up to the amount that would guarantee a nominal income equal to the level provided by means-tested benefits. The dollar for dollar MTB reduction column displays the NPV of means-tested benefits when this policy is in place. The dollar for dollar MTB reduction column is a strict asset test policy under which means-tested benefits are reduced dollar for dollar with wealth.

pension wealth	MTB	WTP MTB instead of MIR	MIR	WTP MIR instead of dollar for dollar	dollar for dollar MTB reduction	WTP dollar for dollar instead of mandatory	mandatory
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
100K	146	84	101	-84	95	11	101
200K	106	90	38	-47	51	47	24
300K	77	61	20	-2	28	37	3
400K	57	41	14	16	12	20	0
500K	44	29	11	4	1	13	0
600K	34	20	8	-10	0	15	0

Table 10: Tax rates for the lump-sum and income
The tax rates are for singles.

community and cantonal lump-sum tax		federal lump sum tax	
amount	tax rate (in%)	amount	tax rate (in%)
up to 118,500	4.66	up to 12,600	0
next 41,000	6.99	next 14,800	0.154
next 67,000	9.32	next 8,500	0.176
next 82,000	11.65	next 12,000	0.528
next 95,000	13.98	next 15,000	0.594
next 109,000	16.31	next 4,800	1.188
next 149,000	18.64	next 22,100	1.32
next 286,000	20.97	next 27,000	1.76
next 285,000	23.3	next 35,900	2.2
next 449,000	25.63	next 502,300	2.64
next 584,000	27.96	above 655,000	2.3
above 2,265,500	30.29		

community and cantonal income tax		federal income tax	
amount	tax rate (in%)	amount	tax rate (in%)
up to 7,750	0	up to 12,600	0
next 4,100	4.66	next 14,800	0.77
next 4,100	6.99	next 8,500	0.88
next 6,700	9.32	next 12,000	2.64
next 8,200	11.65	next 15,000	2.97
next 9,500	13.98	next 4,800	5.94
next 10,900	16.31	next 22,100	6.6
next 14,900	18.64	next 27,000	8.8
next 28,600	20.97	next 35,900	11
next 28,500	23.3	next 502,300	13.2
next 44,900	25.63	above 655,000	11.5
next 58,400	27.96		
above 226,550	30.29		

Table B.1: Maximum and average means-tested benefits of single retired recipients in 2008

Means-tested benefits correspond to the difference between applicable expenditures and income but cover at least the health insurance premium.

Components	Maximum	Average
Applicable expenditures		
Cost-of-living allowance	18,144	18,144
Rent/Interest on mortgage	13,200	10,212
Health insurance premium	4,500	3,996
Other expenses	-	84
Total	35,844	32,436
Applicable income		
First pillar benefits	26,520	19,944
Other pension benefits	-	1,524
Wage income	-	84
Own rent	-	504
Investment income	-	288
Wealth consumption	-	636
Other income	-	180
Total	-	23,160
Means-tested benefits	35,844	9,612
Net wealth	-	20,140
Wealth (after deduction)	-	6,411

Table B.2: Benchmark parameters

Description	parameter value
Time preference discount factor (β)	0.96
Risk aversion coefficient (γ)	3
Mean return on stocks (μ_R)	6.5%
Standard deviation stock returns (σ_R)	20%
Mean interest rate (μ_r)	2.5%
Standard deviation interest rate (σ_r)	1%
Mean reversion parameter interest rate (a_t)	0.15
Mean inflation (μ_π)	1.79%
Standard deviation instantaneous inflation (σ_π)	1.12%
Standard deviation price index (σ_Π)	1.11%
Correlation interest rate and expected inflation	0.4
Mean reversion coefficient expected inflation (a_π)	0.165
I pillar income at $t = 1$ (Y_1^I)	CHF 24,000
Guaranteed consumption level at $t = 1$ ($\tilde{M}_1$)	CHF 36,000
Fraction of wealth taking into account to calculate MTB (g)	0.1
Conversion rate (c)	7.2%

Table B.3: Distribution of liquid non-pension wealth
The distribution is derived using SHARE-Swiss data from 2003. We use information from all retired men with second pillar wealth below CHF 700,000 (93 observations). The mean liquid non-pension wealth is CHF 197,265.

liquid non-pension wealth	% in wealth category
0 - 50,000	33.3
50,000 - 150,000	28.0
150,000 - 250,000	10.8
250,000 - 350,000	10.8
350,000 - 450,000	3.2
450,000 - 550,000	3.2
550,000 -	10.8

Table B.4: Distribution of illiquid non-pension wealth
The distribution is derived using SHARE-Swiss data from 2003. We use information from all retired men with second pillar wealth below 700,000 CHF (93 observations). The mean liquid non-pension wealth is CHF 231,987.

illiquid non-pension wealth	% in wealth category
0	38.7
1 - 96,000	3.2
96,000 -	58.1

Table B.5: Summary statistics of pension funds data, men

Variable	Mean	Median	S.D.	Min	Max
Age at retirement	63.9	65.0	1.8	55.0	70.7
Conversion rate					
Mandatory Part	6.928	7.150	0.424	5.210	8.043
Supermandatory Part	6.740	6.863	0.523	4.816	8.043
Pension wealth	249,797	212,591	165,387	102	699,892
Share Annuity	44.3	0	49.7	0	100
Share Lump Sum	49.9	0	50.0	0	100
Share Mixed	5.8	0	23.4	0	100
Observations	22,261				

Table B.6: Costs of the means-tested benefits, non-pension wealth CHF 0 (in CHF 1,000).

The graph displays the average net present value of the means-tested benefits payed out to agents. To calculate the net present value we use the Vasicek model for the term structure of interest rates. The non-pension wealth is *liquid* non-pension wealth.

pension wealth	MTB	mandatory full annuitization	MIR	consumption floor
100	146	101	101	95
200	106	24	38	51
300	77	3	20	28
400	57	0	14	12
500	44	0	11	1
600	34	0	8	0

Table B.7: Costs of the means-tested benefits, non-pension wealth CHF 200,000 (in CHF 1,000).

The graph displays the average net present value of the means-tested benefits payed out to agents. To calculate the net present value we use the Vasicek model for the term structure of interest rates. The non-pension wealth is *liquid* non-pension wealth.

pension wealth	MTB	mandatory full annuitization	MIR	consumption floor
100	68	40	40	23
200	50	10	14	11
300	39	2	10	3
400	30	0	8	1
500	0	0	0	0
600	0	0	0	0

Table B.8: Tax rates for the lump-sum and income

The tax rates are for singles.

community and cantonal lump-sum tax		federal lump sum tax	
tax rate (in%)	amount	tax rate (in%)	amount
4.66	up to 118500	0	up to 12600
6.99	next 41000	0.154	next 14800
9.32	next 67000	0.176	next 8500
11.65	next 82000	0.528	next 12000
13.98	next 95000	0.594	next 15000
16.31	next 109000	1.188	next 4800
18.64	next 149000	1.32	next 22100
20.97	next 286000	1.76	next 27000
23.3	next 285000	2.2	next 35900
25.63	next 449000	2.64	next 502300
27.96	next 584000	2.3	above 655000
30.29	above 2265500		
community and cantonal income tax		**federal income tax**	
tax rate (in%)	amount	tax rate (in%)	amount
0	up to 7750	0	up to 12600
4.66	next 4,100	0.77	next 14,800
6.99	next 4,100	0.88	next 8,500
9.32	next 6,700	2.64	next 12,000
11.65	next 8,200	2.97	next 15,000
13.98	next 9,500	5.94	next 4,800
16.31	next 10,900	6.6	next 22,100
18.64	next 14,900	8.8	next 27,000
20.97	next 28,600	11	next 35,900
23.3	next 28,500	13.2	next 502,300
25.63	next 44,900	11.5	above 655,000
27.96	next 58,400		
30.29	above 226,550		