Do savers respond to tax incentives?

The case of retirement savings*

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Abstract

This article exploits a large micro-file tax return data to test whether savers respond to the presence of tax incentives by contributing more in saving accounts that mandate annuitization at retirement. A frictionless model of demand for annuity is first set, which highlights the phenomenon of bunching of savers around tax thresholds when consumers' budget set is kinked. Using French households income tax data, we do not find any bunching, which is consistent either with the absence of behavioral responsiveness to tax incentives or optimization frictions. We investigate the implications of the second hypothesis and propose an alternative test in which discontinuity in marginal rate of return on the two sides of tax thresholds is exploited. We find that the deduction scheme is effective in boosting the demand for annuity of the richest savers whose marginal tax rate is the highest, especially for the oldest savers (aged 45 and above). In most cases, it fails to raise contributions of younger and less wealthy savers.

1 Introduction

Defined contribution pension schemes have been launched in many countries to help future retirees compensate the decline of public pensions. Tax incentives have generally been granted by making contributions tax-deductible and allowing pension wealth to accumulate tax-free. In France for instance, the

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so-called Loi Fillon, enacted in 2003, has created an individual savings contract (Plan d'Epargne Retraite Populaire) with mandatory annuitization and whose payments are deductible from taxable income. In Germany, savers may lower their income tax liability by deducting part of their contribution under the Riester scheme introduced in 2002.

The adequacy of the tax regime applied to retirement savings is a critical policy choice in the transition from a public sector, pay-as-you-go system to one in which part of pensions are provided through individual, privately managed pension accounts. As retirement saving plans are a particular type of saving products, it is worth recalling how saving may be taxed at a general level. The most common method consists in taxing personal income out of which savings are made, taxing partly or fully the accrual return on funds accumulated and allowing assets to be withdrawn free of tax. Such arrangement is labeled a "taxed-taxed-exempt" (TTE) scheme. Another way consists in exempting contributions from the personal income tax during the accumulation phase, exempting the accrual return on funds and adding withdrawals to taxable income. This alternative arrangement, called an "exempt-exempt-taxed" (EET) scheme, has been applied to retirement saving by the vast majority of OECD countries (Yoo and de Serres 2004). In the US, Individual Retirement Accounts and 401(k) plans conform to this structure, as do Personal Pensions in the UK and Plan d'Epargne Retraite Populaire in France.

The way an EET scheme affects the plan's return rate depends on the comparison of present and future marginal income tax rates (MTR) (Yoo and de Serres, 2004). The scheme impacts positively the return rate if the MTR is reduced after retirement as people save more tax when they contribute than they pay tax after retirement. Since the tax schedule is typically progressive, many people earn more income during the accumulation phase than during retirement and hence are likely to be favored by an EET scheme. Nevertheless, for savers whose MTR remains constant throughout their life cycle, an EET scheme does not alter the plan's rate of return. In this case, taxes are merely deferred at the time of retirement.

For tax incentives to encourage retirement savings, it must be the case that individuals react by saving more in tax-favored savings accounts. This is a crucial condition upon which the raison d'être of savings subsidies depend. Otherwise the scheme would simply redistribute wealth from those who do not invest in tax-favored products to those who do, with possible anti-redistributive consequences. Even if individuals respond positively to tax incentives, savings subsidies may still be questioned. First, the policy distorts relative prices of present and future consumption and may entail a deadweight loss. In particular, people may be induced to over-save in tax-advantaged accounts that do not meet their actual need in terms of risk, liquidity or investment horizon. Second, the subsidy is a cost for the government that must be financed by distorting taxes. Third, distributional consequences may be undesirable if high-income individuals are better able to take advantage of tax reliefs. Fourth, tax incentives may reduce savings if the income effect induced by the return rate variation dominates the price effect. On the other hand, savings subsidies may be justified by the presence of market imperfections or departure from consumers' full rationality. If the annuity market is affected by adverse selection, the government may improve its functioning by subsidizing small annuities and taxing large annuities (Direr, 2010). The government may also adopt the view that individuals do not save enough in long-term savings accounts or do not buy enough annuities at retirement. This may happen if they are shortsighted or underestimate their need for longevity insurance. Hence a government concerned about the adequacy of retirement income for future retirees may feel justified to subsidize retirement saving rate of return through tax exemptions.

The goal of this paper is to address the central issue of retirement savings sensitivity to tax incentives. We begin by studying an annuity model with a progressive personal income tax with two marginal tax rates (MTR). The model underlines the classic result of bunching with a kinked budget set. Looking for bunching evidence around kinks provides a preliminary test of the presence of behavioral responses to taxation along the intensive margin[1]. We first show that the French tax system entails significant incentives to save in retirement saving vehicles. We estimate in many cases a tax benefit equivalent to an annuity increase of 10% or more but also in some cases reverse incentives of similar magnitude.

We then use a large micro-file tax return data that contains detailed information about 500,000 tax units per year for four consecutive years and focus on contributions into saving vehicles in which annuitization is mandatory, contributions are tax deductible up to some limit and annuities are taxed at a normal rate. In accordance with our theoretical model, we look at whether individuals bunch at kink points of their budget set where the MTR jumps. The data does not reveal the presence of bunching, which is a result consistent with either no behavioral responsiveness to tax incentives or optimization frictions (Chetty, 2012). The second case occurs if savers respond to tax incentives but only imperfectly.

[1] See Saez (2010) for a similar test in the labor market.

For example, the contribution level could be set optimally when the saving plan is opened but not adjusted in subsequent years due to behavioral inertia. Or savers might not know exactly their taxable income when they contribute. In both cases, contributions would be scattered around the tax threshold up to a point where bunching may not be discernible in our data. We present a simple calibration exercise which supports this hypothesis.

To get around this difficulty, we carry out a second test based on the fact that similar individuals in terms of taxable income face different after-tax rate of return depending on their location on the tax schedule. We compare contributions levels of individuals whose taxable income is higher than but close to a given tax threshold (first group) with that of individuals whose taxable income is just below the same threshold (second group). Insofar as retirement income is lower than current income, savers in the first group will find themselves in a lower tax bracket when they retire and will benefit from a subsidized after-tax marginal rate of return. Savers in the second group although similar in terms of income have to experience a much stronger reduction of their income after retirement, generally out of reach, to lower their MTR. This creates a discontinuity at tax thresholds that we treat as an exogenous variation of the tax treatment. We find that the deduction scheme is effective in boosting the demand for annuity of the oldest savers (aged over 45) whose marginal tax rate is the highest. Results are more mixed for savers around the intermediate threshold and negative for those around the lower threshold. All those results hold for the intensive margins (the contributions level conditional upon contributing). The study of the extensive margin (the fraction of the population which saves in tax-qualified savings accounts) necessitates distinct theoretical and econometric frameworks and is left for further investigation.

An abundant literature deals with the empirical issue of the effectiveness of tax incentives to boost saving (Bernheim, 2002). Most studies investigate the US case in which wealth is generally withdrawn as a lump-sum instead of being converted into annuities. They find a relative effectiveness of tax incentives yet limited to the class of tax-favored saving products (Engen Gale and Scholz, 1994). Chernouzhoukov and Hansen (2004) document small wealth responses to 401(k)s in the top of the wealth distribution and some evidence of new savings at the bottom. Attanasio et al. (2004) consider retirement savings in the UK and US cases and conclude that tax incentives essentially redirect savings toward tax-favored accounts without a clear impact on aggregate savings. Chetty et al. (2012) draw a similar conclusion for retirement savings in Denmark. Engelhardt (1996) makes use of a natural experiment by examining the cancellation of a Canadian tax-subsidized saving program for annuitants and looks at differences between contributing and noncontributing households before and after its cancellation. Contrary to previous studies, he finds a substantial impact of tax subsidy on household savings. We depart from this literature by focusing on retirement savings with mandatory annuitization and by proposing new tests of saving sensitivity to tax incentives. Most studies do not take into account the possibility of optimization frictions. Chetty (2012) proposes a general model of demand with optimization frictions such as adjustment costs or inattention and derives bounds on structural price elasticities. He shows that frictionless models of labor supply are rejected by the data as they predict much more bunching at kinks than observed in practice. We show a similar result in a saving context. We are not able to investigate with our data whether the subsidy scheme has an impact on total savings rather than simply annuity savings. This issue is only relevant when a positive effect of tax subsidy is found, which is the case of the wealthiest savers.

Another strand of literature to which this paper is related deals with the demand for annuities and the annuity market participation puzzle. Annuities protect against longevity risk, yet empirical studies show that annuities are not voluntarily taken up by a large number of retirees (Poterba et al. (2003) for the US and James and Vittas (2004) for international evidence). This lack of insurance cannot be readily rationalized (Davidoff et al., 2004). Potential explanations involve the lack of flexibility of annuity contracts (Direr, 2010), a strong bequest motive, the presence of some annuitization through state social security and private defined benefit plans, and the presence of uncertain medical expenditures (Turra and Mitchell, 2004). Overall, those factors seem insufficient to fully explain the participation puzzle (Brown, 2007). Insofar as a lack of annuitization is a public concern, tax incentives could play a prominent role in encouraging individuals to buy annuities. This issue motivates our study which addresses the effectiveness of existing tax incentives in extending longevity insurance through the purchase of annuities. Annuity specificities should also be kept in mind when policy implications are drawn. Even in the case where tax incentives only reshuffle households' portfolios without increasing total savings, the shift towards annuities may still be socially beneficial to the extent that longevity risk is better insured.

The paper is divided into six sections. Section 2 analyzes the demand for annuity in presence of tax deduction. Section 3 presents the data set, the French tax system and assesses the quantitative impact of tax incentives on plans' return rate. Section 4 investigates the presence of bunching at kink points of the budget set, which is a major prediction of our model of annuity demand. Section 5 proposes an alternative test based on marginal rate of return discontinuity on both sides of the tax thresholds. Section 6 concludes.

2 A model of tax-advantaged retirement savings

The goal of this section is to present a standard model of retirement savings and to emphasize several testable implications. Let us consider a consumer who works one period at age $t = s$ during which she earns y_W and consumes c_s, and retires at age $t = L + 1$. To display possible interactions between plan's return rate and distance to retirement, s may take any value within the working period $\{1, ..., L\}$. The amount saved at age s, denoted x_s, is capitalized at a constant return rate r (with $R = 1 + r$) until age L and then converted into a constant flow of annuities denoted a that starts at age $L + 1$. The retiree receives a state pension y_R and consumes the amount c_t. Lifespan is uncertain from $L + 1$ onward. The probability of living until age $t = L + 2, ..., L + T$ conditional on age $L + 1$ is $q_t < 1$. Intertemporal utility is

$$u(c_s) + \sum_{t=L+1}^{T} q_t \beta^{t-s} u(c_t)$$

where u is period utility and β the subjective discount factor. A personal income tax applies to earnings, state pensions and annuities. There are two marginal tax rates (MTR): η_1 and η_2. All taxable income below S is taxed at rate η_1 and remaining income above S at rate η_2. Tax schedule is progressive: $\eta_1 < \eta_2$. Savings is taxed according to an EET scheme: contribution x_s is deducted from taxable income, rate of return is free of tax, and annuities are included in taxable income. The budget constraint at age s is

$$c_s + x_s + \eta_1 \min(y_W - x_s, S) + \eta_2 \max(0, y_W - x_s - S) = y_W \tag{1}$$

Taxable income $y_W - x_s$ below tax threshold S is taxed at rate η_1 and remaining income at η_2. $L - s$ periods later, capitalized contribution $R^{L-s} x_s$ is converted into a constant stream of annuities a. The conversion rate k indicates the level of annuity paid out in proportion to accumulated savings:

$$a = kR^{L-s} x_s \tag{2}$$

The conversion rate is such that insurers make zero profit (or that capital equals annuities' expected cost given individuals' survival rates):

$$R^{L-s}x_s = \sum_{t=L+1}^{T} \frac{q_t a}{R^{t-L}}$$

The conversion rate is therefore:

$$k = \frac{1}{\sum_{t=L+1}^{T} \frac{q_t}{R^{t-L}}} \tag{3}$$

It is further assumed that individuals simply consume their fixed state pension plus their annuity after retirement. Let us denote $d = c_t$, $t = L+1, ..., L+T$ the time invariant consumption level after retirement. The budget constraint in the retirement phase is:

$$d + \eta_1 \min(y_R + a, S) + \eta_2 \max(0, y_R + a - S) = y_R + a \tag{4}$$

Let η_W, $\eta_R \in \{\eta_1, \eta_2\}$ denote the tax rates at which marginal income is taxed before and after retirement respectively. Appendix A presents the piecewise intertemporal budget set whose local slope depends on which MTR prevails before and after retirement. The Euler condition of this problem is (see Appendix A):

$$\underbrace{\frac{u'(c_s)}{\sum_{t=L+1}^{T} q_t \beta^{t-s} u'(d)}}_{\text{marginal rate of substitution}} = \underbrace{R^{L-s}}_{\text{rate of return}} \underbrace{k}_{\text{conversion rate}} \underbrace{\left(1 + \frac{\eta_W - \eta_R}{1 - \eta_W}\right)}_{1+\text{subsidy rate}} \tag{5}$$

The marginal rate of substitution between present and future consumption is equal to after-tax marginal rate of return. The latter is the product of three terms. The first term is the capitalization rate of savings until retirement. The second term is the conversion rate that translates a capital into a periodic annuity. It embodies the mortality premium that individuals obtain in exchange of giving up their capital to insurers upon death. The last term indicates how the tax system alters the marginal rate of return. The subsidy rate is positive if $\eta_W > \eta_R$, that is, the MTR falls after retirement. The larger the gap between η_W and η_R the higher the subsidy rate. The subsidy rate vanishes if individuals keep the same MTR during their whole life ($\eta_W = \eta_R$) and becomes negative if the MTR increases after retirement. Given the progressivity of the tax scheme ($\eta_1 < \eta_2$), only individuals whose taxable income falls enough after retirement actually benefit from a tax advantage.

Eq. (5) shows no benefit attached to tax deferral *per se*. It is sometimes argued that a tax-deferral scheme is advantageous to taxpayers compared to a scheme in which taxes are paid upfront as postponement of taxes after retirement lowers the present value of taxes paid[2]. This reasoning does not take into account that the tax base is larger in a tax-deferral scheme: the actuarial stream of annuities taxed after retirement is greater than the sum of contributions due to compound interest. This effect cancels out the tax-postponement advantage, making subsidy rates independent of distance to retirement. Hence it is better to think of a tax deferral scheme as a mechanism that distorts the conversion rate of the annuity contract.

Consumers' budget set is piecewise linear with kinks at points where marginal tax rate jumps. Fig. 1 shows three examples of nonlinear budget sets in the consumption space.

Insert Fig. 1 around here

The vertical and horizontal dotted lines indicate the consumption value above which individual's taxable income is marginally taxed at the highest rate η_2 during the working and retirement periods respectively (See Appendix A). The two largest budget sets are delimited by three piecewise lines.

Insert Fig. 2 around here

Fig. 2 shows how the presence of a kink in the budget set affects savings. The increasing curve represents the wealth expansion path that connects consumers' optimums together for different wealth levels. As wealth is reduced, the budget set is nearing the origin. If individual preferences are convex, consumption at all ages is smoothly decreasing with wealth, except at the kink point of the budget set where present consumption is invariant for a non-empty interval of wealth. If wealth is smoothly distributed in the population, taxpayers will bunch at the tax threshold. To grasp the intuition, consider an individual who contributes little such that taxable income $y_W - x_s$ is above S and retirement income $y_R + a$ lies below S. In this case, her marginal rate of return is subsidized due to a lower MTR after retirement. If she is willing to contribute more so that her current taxable income is now lower than S, her marginal rate of return will fall. Hence, if her contributions are sensitive to after-tax marginal rate of

[2]When taxes are paid upfront and interest income is not taxed as in a TEE scheme, marginal rate of return is equal to $R^{L-s}k$.

return, she may limit the amount saved such that her taxable income is just equal to the tax threshold. A similar reasoning holds for a whole range of intertemporal wealths with the same consequence that taxable income is equal to the tax threshold. As the budget set is characterized by two kinks, another set of taxpayers may bunch in a second tax regime. Fig. 3 illustrates this possibility.

Insert Fig. 3 around here

The main difference with Fig. 2 is that retirement income $y_R + a$ is now larger than current taxable income $y_W - x_s$. Both types of bunching may coexist and share the same testable prediction that taxable income sticks to the threshold[3].

3 The French system

This section pursues two objectives: to present the French tax system and to assess the quantitative impact of tax subsidies on rate of return.

3.1 The French tax scheme

In France, the income tax is calculated on a family basis. The income for all family members, net of contributions in qualified retirement plans, is added up and then divided by the number of family units to determine the net income per family unit. The number of family units (*quotient familial*) depends on the family composition. Each spouse counts as one unit, the first two children count as half a unit each, the third and subsequent children count as one unit each. The net income per family unit is taxed according to Table 1 valid for incomes earned in 2008.[4]

Insert Table 1 around here

Let Q_w denote the number of family units of a given household. Taxable income $(y_w - x_s)/Q_w$ is household's income y_w net of all contributions x_s in tax deferred saving accounts divided by the number

[3] There is also the possibility not investigated here that retirees, not workers, bunch at the tax threshold. This configuration implies an unrealistic amount of information as consumers have to choose a contribution level during the accumulation phase so that their retirement income is just equal to the tax threshold many years later.

[4] The tax schedule has been stable over the period 2006 to 2011 except that tax thresholds have been adjusted for inflation and the maximum tax rate is 41% instead of 40% for incomes earned in 2010 and 2011. Developments of the theoretical model not reported show that our main theoretical claims would be preserved if savers anticipate a change in future MTR. This comes from the fact that return discontinuities are created by the present deduction scheme, regardless of future MTR.

of family units. The portion of income divided by family units is marginally taxed at rate η_i, $i = 1, ..., 4$ if $(y_w - x_s)/Q_w \in [S_i, S_{i+1}[$. After retirement, taxable income $(y_R + a)/Q_R$ is composed of the state pension and the annuity divided by the number of family units at the time of retirement. It is marginally taxed at rate η_i if $(y_R + a)/Q_R \in [S_i, S_{i+1}[$. To determine gross tax actually paid by households, the unit income tax is remultiplied by the number of family units[5].

Households may deduct contributions from their income up to 10% of their total earnings. The contribution limit, computed on an individual basis, has an absolute annual ceiling, which was $28,280$ euros in 2012. In the case individuals subscribe to several saving accounts, the deduction limit applies to the sum of contributions. We focus in the rest of the paper on taxpayers whose MTR is greater or equal to S_1. Households fully exempted of income tax benefit from other tax advantages that alter their saving marginal rate of return in a way that is not modeled here. Table 2 computes subsidy/tax rates based on the formula (5) for various combinations of MTR.

Insert Table 2 around here

The effect of the tax scheme amounts to a 9.5% decrease of the conversion rate when the MTR increases from 5% to 14%. The subsidy rate is maximum if the MTR switches from 30% to 14% with a 22.9% increase. A 10% increase of conversion rate means a permanent annuity supplement of 10% or that buying one euro of annuity costs 9% less. Overall, the tax system has a large impact, either positive or negative, on financial attractiveness of annuities.

The subsidy being applied to savings, it may be more telling to express it as a return rate premium, that is the return rate increase caused by the tax scheme. To do so, let us express the conversion rate $k(R)$ as a function of the interest rate R that enters the annuity formula (3):

$$k(R) = \left(\sum_{t=L+1}^{T} \frac{q_t}{R^{t-L}} \right)^{-1}$$

A higher interest rate on annuity wealth translates into a higher conversion rate. We can then compute a counterfactual savings return rate ρ as the return rate that individuals should benefit on their life-cycle

[5] As an example, let us consider a couple without dependent children whose total income is $21,000$ euros and total contribution 1000 euros. Their taxable income is $(21000 - 1000)/2 = 10,000$ euros. Their unit and gross income tax are respectively $(10,000 - 5,853) \times 0,055 = 228$ and $228 \times 2 = 456$ euros.

savings (including retirement savings) to be compensated from the removal of tax advantages:

$$R^{L-s}k(R)(1+\frac{\eta_W-\eta_R}{1-\eta_W})=\rho^{L-s}k(\rho)$$

The subsidy rate is then translated into a return rate premium $\rho - R$. Table 3 shows return rate premiums for different configurations of investment horizons ($L-s$) and MTR. Computations are based on $R = 1.03$ (the same rate applies to the accumulation and payout phases). Conversion rate ($k = 0.0543$) and counterfactual conversion rates $k(\rho)$ use French mandatory mortality tables for a French male saver born in 1960 who will convert his plan at age 62[6].

Insert Table 3 around here

The deduction system entails large variations of the implied plan's return rate. For example, lowering the MTR from 40% to 30% after retirement yields a tax break equivalent to a return rate increase of 1.14 percentage point. The longer the investment horizon, the smaller the premium as the subsidy/tax rate is diluted over a longer period. We conclude that the French tax scheme should affect savings behaviors if individuals are responsive to tax incentives, at least for those close enough to retirement.

3.2 The database

We use a large micro-file tax return data that contains detailed information about 500,000 taxpayers per year representative of the French population. We only consider saving accounts in which annuitization is mandatory at retirement, contributions are tax deductible up to some limit and annuities are taxed at a normal rate (EET scheme). Several saving accounts qualify for tax exemptions[7]. They all encompass an accumulation phase during the working life. Annuity payouts begin at retirement. Our database includes four years of tax filing for incomes earned between 2006 and 2009. We focus on contributions during the accumulation phase. Table 4 presents the number of taxpayers and savers who deduct a positive amount of contribution from their taxable income, broken down by years.

[6] Results do not vary much when the return rate and the conversion rate used to compute premiums are modified.

[7] Those are PERP (Produit d'épargne retraite populaire), the optional part of PERE (Plan d'épargne retraite entreprise), PREFON (dedicated to civil servants), COREM and C.G.O.S. Our dataset does not cover Madelin contracts, dedicated to self-employed and Perco, an employer-provided pension plan. In Madelin contracts contributions are deducted from benefits, not income. PERCO does not mandate annuitization

Insert Table 4 around here

Statistics in the upper panel of Table 4 are computed for taxpayers aged between 30 and 70. A subsample of savers between 45 and 65 who are most concerned by retirement saving is presented in the lower panel of Table 4. Only a minor proportion of taxpayers (around 5%) have subscribed a savings account in accordance with international evidence of a lack of annuitization. This proportion rises to 7% for the population between 45 and 65. Contributions are highly skewed with a mean contribution about twice as large as median contribution.

Among descriptive statistics, the family composition is of main relevance in the French case where the presence of children at the time of contribution reduces parents' MTR through the *quotient familial* mechanism (presented *supra*). Those children are likely to have gained their independence when their parents retire, suppressing the tax advantage. Therefore, the marginal rate of return of contribution in annuity products should be lower - *ceteris paribus* - for households with children than for childless households.

Insert Fig. 4 around here

Fig. 4 shows that savers with dependent children are less likely than childless savers to subscribe a retirement plan. Conditionally on subscribing a contract, they also contribute less. We should however be cautious when interpreting these results. A number of other characteristics correlated with parenthood and savings may explain this relationship. For instance, savers with children may save more in non-annuitized savings with the intention of transmitting a capital. Also, the presence of children complicates the forecast of future MTR. Consequently, the empirical part of the present paper considers only households without children[8].

[8]Around one saver over two has dependent children in our data set.

4 Do savers bunch at kink points?

4.1 Graphical analysis

In accordance with the model analyzed in Section 2, we look at whether individuals bunch at kink points of their budget set. We restrict our data set to savers aged between 30 and 70, without dependent children and whose contributions do not exceed the deduction limit. To detect bunching at kink points, we begin by plotting the histogram of the taxable income distribution with small bins of 500 euros. We control for noises by superimposing a kernel density estimate which smooths the raw distribution.

Insert Fig. 5 around here

Fig. 5 does not reveal visible bunching around the last three tax thresholds considered in our analysis. A small amount of bunching is detected around the first threshold which is seemingly due to other types of tax optimization[9]. Our first impression is confirmed by a closer look at densities around each thresholds broken down by age groups. We construct a measure d_i of relative distance to tax threshold S_i:

$$d_i = \frac{(y_w - x_s)/Q_w - S_i}{S_i} \qquad i = 2, 3, 4 \tag{6}$$

where $(y_w - x_s)/Q_w$ is taxable income, that is household's income net of all contributions in tax deferred savings accounts divided by the number of family units and which compares to thresholds S_i presented in Table 1. Three age groups are considered: 30 to 44, 45 to 54 and 55 to 70. We then group together households whose distance to the threshold defined in Eq. (6) is between 0 and 1%, 1% and 2% and so on. We adopt the same step of 1% for negative distances and report the size of each group in Fig. 6.

Insert Fig. 6 around here

Savers' densities around tax thresholds do not exhibit any jump at or around the three thresholds S_2, S_3 and S_4. Identical conclusions (not reported) are reached if a step of 2%, 5% or 10% is selected and when alternative measures of distance are taken. Hence the data does not reveal the presence of bunching, which may be consistent with the absence of sensitivity to tax incentives but also with the presence of optimization frictions. The latter possibility is examined in the next sub-section.

[9] In a non-reported graph, the cluster persists when the distribution of taxable income before deduction of contributions is plotted.

4.2 Interpretation

Although instructive, the previous test relies on a theoretical model in which individuals have full control over their income and savings. It is plausible that savers choose an amount of savings close but not equal to the best amount. For example, the contribution level could be set optimally at the time of subscription but not adjusted the subsequent years due to behavioral inertia. Or they may not know exactly their taxable income when they contribute. For those reasons, contributions may be scattered around the threshold up to a point where bunching may not be discernible in our data[10].

To this regards, it is worth comparing the distribution of savers around the tax thresholds and the one around the deduction limit. We recall that households may deduct contributions from their taxable income up to 10% of their total earnings with an absolute ceiling of around $28,000$ euros in 2012 (slightly less in previous years). Rational taxpayers should bunch at the deduction ceiling as net-of-tax marginal rate of return falls at the right-hand side of the ceiling (see Appendix B for a formal analysis). This result is very similar to the one found in Section 2 for taxable income around tax thresholds. In both cases marginal return falls if contribution exceeds a limit.

Insert Fig. 7 around here

Fig. 7 plots savers' distribution by steps of 1% of contributions relative to their own ceiling for the whole distribution and for a narrow interval centered around one. A peak of savers around the ceiling is observed, indicating a behavioral response to the deduction system. The presence of a peak contrasts with the absence of bunching around tax thresholds. This may reflect the fact that the net-of-tax marginal rate of return falls by a larger magnitude beyond the ceiling (deduction falls to zero) than beyond a tax threshold (deduction falls to next MTR). The deduction limit is also more salient than tax thresholds and savers may have a better command over the amount saved than over taxable income, which also involves earnings. At the same time, a significant proportion of savers miss the limit by saving too little or too much, indicating an imperfect control over the amount saved. This last observation suggests that the imperfect control hypothesis has some practical relevance.

Insert Fig. 8 around here

[10]Chetty (2012) stresses the importance of small optimization errors to account for the responsiveness of labor supply to tax incentives.

Returning to the saving model with tax thresholds, the smoothing mechanism may be visualized thanks to Fig. 8 which plots theoretical contribution against taxable income in the frictionless model. A mass of savers share the same level of taxable income (net of contribution) at the threshold. At this point, gross income and contribution vary in opposite direction so that net-of-contribution income remains constant for a whole range of gross income. If savers do not exactly target the tax threshold, net income is spread around the threshold as in Fig. 9.

Insert Fig. 9 around here

A mass of savers is not necessarily visible in this case. Yet, contributions remain larger at the right-hand side of the threshold indicating an influence of the tax system on savings. We may wonder whether the imperfect control hypothesis is consistent with a quantitatively reasonable error term. We investigate this issue by simulating a gross income distribution with a Pareto law. We then compute taxable income by deducting from gross income the frictionless contribution plus an error term of mean zero and various standard deviations (expressed in term of the threshold)[11].

Insert Fig. 10 around here

The resulting taxable income distribution is plotted in Fig. 10 in grey bars. The higher the standard deviation of the error term, the more spread mean contributions around the threshold as shown by the solid lines. For a standard deviation of 2.5% or more of the threshold, we can visually check that bunching at the threshold is not visible anymore, as in our data. Yet, mean savings at the right hand side is still higher that at the left-hand side within a 10% interval at both sides of the threshold. This last property is exploited in the next section to design a second test of price sensitivity.

5 The impact of tax thresholds on contributions

The theoretical model developed in Section 2 shows that similar individuals in terms of taxable income face different after-tax return rate depending on their location on the tax schedule. Last-euro after-tax

[11]More formally, let C denote the optimal contribution level derived from the theoretical model analyzed in Section 2. Actual contribution $\hat{C}$ is the sum of the frictionless contribution plus a random variable ϵ: $\hat{C} = C + \epsilon$. ϵ is an error term due to imperfect control of taxable income. Its standard deviation σ is expressed in terms of the threshold value. More detailed information about the simulations are given in Appendix C.

rate of return is higher at the right-hand side of a tax threshold than at the left-hand side as the MTR jumps at threshold.

This mechanism provides the basis for an alternative test of savers' sensitivity to tax breaks. We compare contribution levels of individuals whose taxable income is located at the right-hand side of, but not too far from a given tax threshold with that of individuals whose taxable income is at the left-hand side - yet remain near - of the same threshold. For brevity, the first group is called the "right-hand group"and the second the "left-hand group". Insofar as retirement income is lower than working life income, savers in the right-hand group will find themselves in a lower tax bracket when they retire and will benefit from a higher after-tax marginal rate of return. Individuals in the left-hand group although close to the first one in terms of income have to experience a much stronger reduction of their income after retirement, typically out of reach, to lower their MTR. They are consequently unlikely to benefit from any tax advantage.

In the spirit of Fig. 9, Fig. 11 presents mean contributions of savers located around each thresholds, by distance to one of the three thresholds.

Insert Fig. 11 around here

We do not observe larger mean contributions for the right-hand group for savers around thresholds S_2 and S_3. A differential in contributions seems to appear for savers around the highest threshold S_4 and especially for the oldest ones. The rest of the article explores this issue further. We first evaluate the empirical scope of the tax differential at either side of the three tax thresholds. We then carry out a multivariate analysis of a possible mean contribution differential.

5.1 The distribution of simulated subsidy/tax rates

To better assess our identification strategy, we begin by simulating the tax/subsidy rates $\frac{\eta_W - \eta_R}{1-\eta_W}$ taken from Eq. (5) in our data set for incomes earned in 2008. The sample is restricted to individuals aged between 50 and 68 with no dependent children and who do not exhaust their contribution limits. MTR η_W are retrieved by observing in which tax bracket $[S_i, S_{i+1}[$, $i = 2, 3, 4$, fall households' taxable incomes $(y_w - x_s)/Q_w$. Computing MTR η_R at retirement are less straightforward as it involves future retirement income. We first distinguish capital income and earned income in household's income: $y_w = y_e + y_c$ and assume that earned income as well as contributions increase by 5% every five years until age 60 and 3% every three year afterward. Capital income is stable over remaining life cycle. Household's public pension is assumed to be 70% of last earned income before retirement. We estimate the amount of annuitized wealth at retirement by assuming that all savers open an account at age 40 and accumulate contributions capitalized at rate 3%. Capital at retirement is transformed into a flow of annuity a by use of the legal conversion rate k which varies with annuitants' year of birth. We assume that all individuals aged between 50 and 62 retire at age 62, individuals between 63 and 65 at age 65 and individuals between 66 and 68 at age 68. Having excluded from the sample individuals with dependent children, we retain the case of a stable family composition and number of family unit: $Q_R = Q_w$. We are then able to estimate households' retirement taxable income $(y_R + a)/Q_R$ and future MTR η_R by assuming an unchanged tax schedule at the time of retirement[12]. Table 5 reproduces Table 2 and adds simulated savers frequencies in various tax configurations and their average subsidy/tax rate. We retain all savers whose taxable income is $+/-10\%$ of tax thresholds (upper panel) and $+/-15\%$ (lower panel).

Insert Table 5 around here

Subsidy or tax rates reported in Table 5 are weighted averages in three configurations: when the MTR falls after retirement, when it remains unchanged and when it increases. Frequencies come from our microsimulation exercise. The table exemplifies the mechanism upon which our identification strategy is based. Savers whose taxable income is just below a tax threshold may either stay below the same threshold after retirement and do not benefit from any tax advantage, or face a higher MTR after retirement and a negative subsidy rate. The last case happens if income grows enough to compensate for the income fall at retirement (recall that replacement rate is 70% in our simulation). Table 5 suggests that a non-trivial fraction of savers are concerned by a negative subsidy rate (from 5% of savers below S_4 to 47% of savers below S_2). At the same time, savers whose taxable income is higher than (but not too far from) the threshold may either experience a stable MTR or a decreasing MTR after retirement and hence benefit from a positive subsidy rate on average. Hence savers just above and just below the same threshold experience very different after-tax rate of return.

[12]Other assumptions about parameter values would lead to different MTR estimations. However this exercise is only meant to illustrate the general mechanism upon which our empirical strategy will be based.

Arguably, savers just below a threshold S_i could face a lower MTR after retirement if their taxable income falls below S_{i-1}. However, our simulations show that this is unlikely. First, tax thresholds are distant from each other. Table 1 shows that S_3 is 37.3% smaller than S_4, S_2 45% smaller than S_3 and S_1 50% smaller than S_2. This means that savers below but close to a tax threshold must experience a large drop of income to benefit from a smaller MTR at retirement. Second, earnings and capital income of individuals far from retirement grow over their remaining working life so that even though earnings are replaced by a smaller public pension at retirement, taxable income may still be large. Third, capital income is not reduced at retirement. Overall, individuals present in our data set belong to the limited fraction of the population who subscribed a retirement plan to smooth their income over their life-cycle. It is no wonder that most of them meet their target and do not face a lower MTR at retirement.

Insert Fig. 12 around here

Figure 12 shows the relation between 2008 taxable income on the horizontal axis and simulated subsidy/tax rates. Observations are concentrated on a number of horizontal lines. Each one represents a possible tax premium computed from a given configuration of present and future MTR (see Table 2 for their exact values). As in Table 5, individuals benefit on average from a higher subsidy rate (and as a result a higher after-tax rate of return) when their taxable income is just above a tax threshold compared to individuals whose income is just below the same threshold. The former need a small decrease in their income to lower their MTR after retirement whereas the latter must experience a large decline, generally out of reach, of their income to lower their MTR.

5.2 Empirical strategy

Table 5 shows that the location of taxable income relative to a threshold is correlated with the policy instrument: subsidy rates are significantly higher for individuals whose income is just above a threshold than for individuals just below. Insofar as the interval within which taxable incomes are compared is not too broad, the location relative to tax thresholds is also likely to be exogenous to other observed or unobserved factors. All individuals whose taxable income belongs to the same narrow interval should have similar characteristics. Moreover, there are many factors which make income locally random. For instances, saver (or her/his spouse) may have the opportunity of overwork or the benefit of a year-end bonus, so that income may fall either at the left or the right side of the threshold in a random fashion and independently of the propensity to save in tax-qualified savings accounts. Of course, this random component may be fully offset if savers choose a contribution level so that their income net of contributions is exactly at the threshold as in the frictionless model presented in Section 2. However we have seen that this model implies some amount bunching at the threshold, a characteristic not observed in the data. The exogeneity issue is investigated further in section 5.4.

Those observations justify our empirical strategy which consists in comparing contribution levels on both sides of the tax thresholds. For the three thresholds S_i, $i = 2, 3, 4$, documented in Table 1, we more formally define the right-hand group as all individuals whose taxable income is greater than S_i but smaller than $(1 + \delta)S_i$. The left-hand group is made up of all individuals whose taxable income is below S_i but larger than $(1 - \delta)S_i$. The total interval $[(1 - \delta)S_i, (1 + \delta)S_i]$ must not be too broad for the two populations to remain comparable. Conversely, narrow intervals may select too few observations. The main analysis considers an interval width $\delta = 10\%$. In the robustness section, we study the case with other interval: $\delta = 1\%$, 5% and 15%.

If the location of taxable income relative to a threshold is exogenous, we can treat it as an instrumental variable in our econometric analysis, which is based on a two-stage least square model:

$$\begin{cases} y_j = \alpha_i + \gamma_i p_j + X_j \beta_i + \varepsilon_j & i = 2, 3, 4 \\ p_j = a_i + c_i T_{ij} + X_j b_i + u_j & i = 2, 3, 4 \end{cases} \tag{7}$$

where y_j is the logarithm of the contribution by individual j whose taxable income belongs to the interval $[(1 - \delta)S_i, (1 + \delta)S_i]$, p_j the tax premium of individual j, T_{ij} a dummy variable which equals 1 if saver j is tax-advantaged (her taxable income belongs to the interval $[S_i, (1 + \delta)S_i]$) and 0 otherwise and X_j a set of control variables which includes age, sex, marital status (single or in couple), household's income, individual's earnings and the share of household's earnings in household's income[13]. Estimate γ_i is the average treatment effect associated with the threshold S_i. The tax premium p_j (or tax subsidy), the policy instrument, is taken from Eq. (5) and is equal to $(\eta_W - \eta_R)/(1 - \eta_W)$. It is computed for each individual by taking their current MTR and simulating their future MTR at retirement (see Table 2 for the range

[13] We do not use a regression discontinuity design. The absence of bunching found in the data is indeed compatible with Fig. 9 in which there is no discontinuity of contributions at the threshold.

of values).

The instrumental variable method is applied using different specifications: without control, with controls at the second stage only, and with controls at each stage. The dummy T_i in Eq. (7) is our instrumental variable. It is strongly correlated to tax benefits. In addition, it should affect contribution levels only through the induced variation of the rate of return and not through unobserved variables correlated with contributions. We discuss and test the validity of this instrument in the following section about robustness.

All regressions are run using a data set that merges four years of tax filing for incomes earned from 2006 to 2009. The sample is restricted to individuals without dependent children and whose contributions are smaller than the deduction limit. The absence of children simplifies the incidence of the number of family units on tax incentives. Age is presumably a major determinant of the degree of responsiveness to rate of return differential. The previous section has shown that the tax scheme has a greater incidence on return rates for individuals close to retirement. Moreover, older individuals are more prone to plan their retirement income and more able to forecast their future MTR. This is why we distinguish three age groups in the econometric analysis: individuals aged between 30 and 44, between 45 and 54 and between 55 and 70.

5.3 Results

Results of the 2SLS regressions are summarized in Table 6. For each threshold and each specification (no controls, controls in second stage and controls in both stages), we indicate the estimation of γ_i in model (7) which is the semi-elasticity of saving to the tax premium. The latter is the percentage increase in savings following a one point percentage increase of the tax subsidy. The same estimation is made with three different samples broken down by age: between 30 and 44, between 45 and 54 and above 55.

Insert Table 6 around here

Table 6 shows that the exposition to a favorable tax treatment exerts a large and significant increase in contribution for the richest individuals whose taxable income is close to the highest threshold S_4. If we focus on the last column where controls are introduced at the two stages of the 2SLS, the elasticity for the 45-55 and 55+ groups is around 4 and significant at the 5% level. For this value, an increase of 10 percentage points of tax premium - a realistic amplitude given the current values of tax subsidies - means a 10% permanent increase of annuity and yields a 40% increase in contribution. This is a large impact. The younger savers around the highest threshold have even a larger elasticity around 9 but the coefficient is less significant. Fig. 11 already suggested large differences in contribution around threshold S_4. For the 45 to 55 age category, mean contribution of savers located at the right of threshold S_4 is $6,028$ euros per year versus $3,595$ euros for those located at the left of the same threshold. For the above 55 category, it is $5,823$ euros for those at the right versus $3,238$ euros for those at the left.

Around threshold S_3, a significant elasticity of about one appears for households aged between 45 and 55. It is also close to one for those aged above 55 but not significant. Around threshold S_2, elasticity is negative and significant for those aged between 45 and 55 and not significant for those aged above 55. A negative elasticity may be explained by the fact that the threshold S_1 is close to the threshold S_2. Hence savers at the left-hand side of S_2 could be also at the right-hand side of S_1, with contradictory incentives.

5.4 Robustness tests

The identification strategy consists in comparing individuals whose taxable income is within a narrow interval and controlling for a full set of covariates, in order to compare similar households at both sides of the thresholds. Robustness tests are performed to check the validity of our instrument. The latter is valid if it is correlated to the tax premium and does not directly impact saving. The strong correlation has already been explained in the theoretical part and documented in Table 5.

The main issue is about the exogeneity of being at the left or the right of a threshold. The exact location should affect contribution levels only through the induced variation of the rate of return and not through unobserved variables correlated with contributions. There are several possible objections to our claim. First, the instrument may be questioned if assignment to the left or to the right is not random, that is if savers self-select below or above the threshold. To test this exogeneity issue, we run the following OLS regression:

$$X_j^l = \alpha_i + \gamma_i T_{ij} + X_j^{-l}\beta_i + \varepsilon_j \quad i = 2,3,4 \tag{8}$$

in which the dependent variable X^l is one of the covariates present in equation 7 (age, sex, marital status, household's income, individual's earnings and the share of household's earnings in household's income). The explanatory variables are X^{-l}, all other available covariates), T_{ij} a dummy variable which equals 1 if taxable income belongs to the interval $[S_i, (1+\delta)S_i])$ and 0 otherwise. The parameter γ indicates differences in covariate values for savers just left or right of threshold S_i. We test whether γ is equal to zero for all possible dependent variables X^l. If all γ are non-significant, savers of the two groups do not significantly differ with regard to observed characteristics. We may then presume that they do not differ along unobserved dimensions as well, which makes the possibility of self-selection less likely. Results are presented in Table 7.

Insert Table 7 around here

Table 7 shows very few differences between the two groups, especially around the highest threshold S_4 where large differences in contributions are observed. Savers aged 45-55 have less income above S_2 and S_3. We also observe a smaller proportion of savers aged 35-40 among 30-45 above S_3 and fewer married women aged 45-55 above S_2. The two groups' wages are not statistically different for any of the age or threshold category. If the exogeneity of the instrument is not certain for thresholds S_2 and S_3, the test concludes to the validity of the instrument for threshold S_4, around which no significant difference between the two groups are found.

A second test of the validity of our instrument may be carried out. If a differential tax treatment is the sole determinant of a difference in contributions observed in table 6, we should not observe systematic differences between the two groups if the treatment is dropped. This requirement is checked by performing a placebo test, which consists in repeating baseline regressions with all thresholds and their 10% band widths shifted by 10% to the left or to the right, so that the two compared groups face now similar tax incentives. Results are presented in table 8 with covariates at both stages in the 2SLS regression[14].

Insert Table 8 around here

The impacts on individuals' contributions presented in Table 6 disappear in Table 8, apart from the negative coefficient around threshold S_2 shifted 10% right (lower part of the Table). This last phenomenon

[14]Adding covariates increases the efficiency of our estimator. Suppressing covariates at the first stage does not modify our conclusions.

is presumably due to the proximity of threshold S_1 as already explained. Mainly, there is no significantly positive coefficient for threshold S_4 shifted right. We also note that the results are reversed around threshold S_4 shifted 10% left. It means that the effects of treatment presented in table 6 are not only due to individuals just above the true threshold contributing more, but also to individuals just below the true threshold - and therefore just above the threshold shifted 10% left - contributing less.

Last, we can test the robustness of our estimates by changing the interval width around the thresholds. Lowering the interval width reduces the sample and makes estimates less precise but improve the consistency of the estimates. We compute the 2SLS estimates of savings responses with respect to tax premium by instrumenting by T_i, presented in equation 7, with $\delta = 1\%, 5\%$ and 15% (instead of 10%). The results are presented in Table 9 with covariates at both stages.

Insert Table 9 around here

Treatment effects decrease when a larger interval $\delta = 15\%$ is selected, leading to less significant results. However, semi-elasticities for oldest savers around threshold S_4 remain large (between 2.96 and 3.54) and significant over 55. This is consistent with older individuals facing less uncertainty about their future MTR, and stronger incentives (cf. table 3). As expected, estimates are less significantly different from zero for $\delta = 1\%$ and 5% due to reduced sample size.

6 Conclusion

This article exploits a large micro-file tax return data to test whether savers respond to the presence of tax incentives by contributing more in retirement saving accounts. We begin by setting a model of demand for annuity in presence of tax deduction. We analyze how the tax scheme interferes with plans' marginal rate of return and outlines the possibility of bunching around the tax thresholds. We test this implication with our data and do not find the presence of bunching around tax thresholds. This result is consistent either with the absence of sensitivity to tax incentives or optimization frictions. We then analyze the latter possibility and show that the position of taxable income relative to tax threshold is still an important determinant of tax premium due to a discontinuity in marginal rate of return that we exploit as an exogenous variation of rate of return. We find that the deduction scheme is effective in promoting the demand for annuity of the richest savers and especially those whose marginal tax rate is the highest. Not only younger individuals face more uncertainty about their future MTR, but also a longer distance to retirement reduces tax advantages (cf. table 3). Results are more mixed for savers located at the intermediate tax threshold and negative for those around the lower threshold.

References

Attanasio O., Banks J. and M. Wakefield (2004) "Effectiveness of tax incentives to boost (retirement) saving: theoretical motivation and empirical evidence", IFS Working Papers (W04/33), Institute for Fiscal Studies, London, UK.

Bernheim B. D. (2002) "Taxation and Saving", Handbook of Public Economics, in: A. J. Auerbach & M. Feldstein (ed.), Handbook of Public Economics, edition 1, volume 3, chapter 18, pages 1173-1249 Elsevier.

Brown J. (2007) "Rational and behavioural perspectives on the role of annuities in retirement planning", NBER working paper 13537.

Carbonnier C., Direr A. et I. Slimani-Houti (2013) "Do Savers respond to Tax Incentives ? The case of Retirement Saving", Document de travail.

Card D., Lee D. S., Pei Z. and A. Weber (2012) "Nonlinear Policy Rules and the Identification and Estimation of Causal Effects in A Generalized Regression Kink Design", NBER Working Paper 18564.

Chernozhukov V. and P. Hansen (2004) "The effect of 401k participation on the wealth distribution: An Instrumental Quantile Regression Analysis", *Review of Economics and Statistics*, 86, 735-751.

Chetty R. (2012) "Bounds on Elasticities with Optimization Frictions: A Synthesis of Micro and Macro Evidence on Labor Supply", *Econometrica* 80(3), 969-1018.

Chetty R., J. N. Friedman, S. Leth-Petersen, T. H. Nielsen, T. Olsen, (2012) "Active vs Passive Decisions and Crowd-out in Retirement Savings Accounts: Evidence from Denmark", mimeo.

Davidoff, Thomas, Jeffrey R. Brown and Peter Diamond (2005) "Annuities and Individual Welfare", *American Economic Review*, 95(5), 1573-1590.

Direr A. (2010) "The Taxation of Life Annuities Under Adverse Selection", *Journal of Public Economics* 94 (1-2), p. 50-58.

Direr, Alexis (2010) "Flexible Life Annuities", *Journal of Public Economic Theory* 21 (1), p. 43-55.

Engen E. M., Gale W. G. and J. K. Scholz (1994) "Do Saving Incentives Work?", Brookings Papers on Economic Activity, Vol. 1994, No. 1 (1994), pp. 85-180.

Engelhardt G. V. (1996) "Tax Subsidies and Household Saving: Evidence from Canada", *Quarterly Journal of Economics* 111 1237-68.

James E. and D. Vittas (2004) "Annuity Markets in Comparative Perspective: Do Consumers Get Their Money's Worth?" World Bank.

Yoo K. and A. de Serres (2004) "Tax Treatment of Private Pension Savings in OCDE Countries", OECD Economic Studies No. 39.

Piketty T. Les Hauts revenus en France au XXe siècle, Grasset 2001.

Poterba J., Rauh J., Venti S. and D. Wise (2003) “Utility Evaluation of Risk in Retirement Saving Accounts” NBER Working Paper 9892.

Saez E. (2010) “Do Taxpayers Bunch at Kink Points?”, *American Economic Journal: Economic Policy* 2 180-212.

Turra C. M. and O. Mitchell (2004) “The Impact of Health Status and Out-of-Pocket Medical Expenditures an Annuity Valuation” Working Paper, Pension Research Council 2004-2.

Appendix A: The Euler equation

Since marginal tax rates (MTR) may take two values during the working period and after retirement, four cases must be studied. Assume first that taxable income is always greater than the tax threshold S ($y_W - x_s > S$ and $y_R + a > S$). MTR are $\eta_W = \eta_R = \eta_2$. This case corresponds to the tax regime (3) in Fig 1. The working period and retirement budget constraints are:

$$\begin{cases} c_s + x_s + \eta_1 S + \eta_2(y_W - x_s - S) = y_W \\ d + \eta_1 S + \eta_2(y_R + a - S) = y_R + a \end{cases}$$

or after some simplifications:

$$\begin{cases} c_s + (1-\eta_2)x_s = (1-\eta_2)y_W + (\eta_2 - \eta_1)S \\ d = (1-\eta_2)(y_R + a) + (\eta_2 - \eta_1)S \end{cases}$$

Combined with the two budget constraints, the two conditions $y_W - x_s > S$ and $y_R + a > S$ are equivalent to $c_s > (1-\eta_1)S$ and $d > (1-\eta_1)S$ in the consumption space respectively, as indicated in Fig 1. Substituting for $a = kR^{L-s}x_s$ and rearranging terms, the retirement budget constraint becomes:

$$\frac{d}{kR^{L-s}} = \frac{(1-\eta_2)y_R + (\eta_2 - \eta_1)S}{kR^{L-s}} + (1-\eta_2)x_s$$

Combined with the working period budget constraint, the intertemporal budget constraint obtains:

$$c_s + \frac{d}{R^{L-s}k} = (1-\eta_2)y_W + \frac{(1-\eta_2)y_R}{R^{L-s}k} + (\eta_2 - \eta_1)(1 + \frac{1}{R^{L-s}k})S \equiv Y_1 \tag{9}$$

We now suppose that $y_W - x_s > S$ and $y_R + a < S$, and corresponding MTR are $\eta_W = \eta_2$ and $\eta_R = \eta_1$. Proceeding the same way, the intertemporal budget constraint is:

$$c_s + \frac{d}{R^{L-s}k\frac{1-\eta_1}{1-\eta_2}} = (1-\eta_2)y_W + \frac{(1-\eta_2)y_R}{R^{L-s}k} + (\eta_2 - \eta_1)S \equiv Y_2 \tag{10}$$

When $y_W - x_s < S$, $y_R + a < S$, and $\eta_W = \eta_R = \eta_1$, the intertemporal budget constraint is:

$$c_s + \frac{d}{R^{L-s}k} = (1-\eta_1)y_W + \frac{(1-\eta_1)y_R}{R^{L-s}k} \equiv Y_3 \tag{11}$$

Lastly, when $y_W - x_s < S$, $y_R + a > S$, $\eta_W = \eta_1$ and $\eta_R = \eta_2$, it is:

$$c_s + \frac{d}{R^{L-s}k\frac{1-\eta_2}{1-\eta_1}} = (1-\eta_1)y_W + \frac{(1-\eta_1)y_R}{R^{L-s}k} + \frac{(1-\eta_1)(\eta_2 - \eta_1)S}{(1-\eta_2)R^{L-s}k} \equiv Y_4 \tag{12}$$

Fig. 1 shows how the four local budget sets combine to give the global budget set with two possible kinks at $c_s = (1-\eta_1)S$ and $d = (1-\eta_1)S$. Assuming that the optimal consumption bundle is not located at a kink, the (local) Lagrangian function to be solved is:

$$L(c_s, d) = u(c_s) + \sum_{t=L+1}^{T} q_t \beta^{t-s} u(d) + \lambda \left\{ Y_j - c_s - \frac{d}{R^{L-s}k\frac{1-\eta_R}{1-\eta_W}} \right\}$$

with λ the Lagrange multiplier and Y_j, $j = 1, ..., 4$ is intertemporal wealth. MTR η_R and η_W are either η_1 or η_2 depending on the tax regime. The first order conditions are:

$$\begin{aligned} u'(c_s) &= \lambda \\ \sum_{t=L+1}^{T} q_t \beta^{t-s} u'(d) &= \frac{\lambda}{R^{L-s} k \frac{1-\eta_R}{1-\eta_W}} \end{aligned}$$

whose combination gives the Euler equation:

$$\frac{u'(c_s)}{\sum_{t=L+1}^{T} q_t \beta^{t-s} u'(d)} = R^{L-s} k \frac{1-\eta_R}{1-\eta_W}.$$

Appendix B: Savings with a deduction limit

Savers have the possibility to reduce their tax bill by saving in tax-deducted products up to 10 % of their total earnings or an absolute annual ceiling, which was 28,280 euros in 2011. This ceiling is relatively high and very few savers are affected by this absolute limit. This Appendix presents how savings is theoretically affected by a deduction limit. The mechanism which leads to bunching in the saving model with one threshold and two MTR studied in Section 2 is still present with two formal differences. First the absence of deduction for the saving portion above 10% of earnings is formally equivalent to setting a MTR equal to 0% below the threshold. This entails a sharp drop of incentives which strengthens the bunching mechanism. Second the deduction limit is not an absolute euro-denominated threshold but a relative one expressed as a percentage of earnings. Hence potential bunching is only visible on a relative scale which plots the amount saved as a percentage of income.

We keep the same framework and notation as in Section 2 with D denoting the deduction limit. We adopt the simplifying assumption that only one tax rate η exists. The age s budget constraint is

$$c_s + x_s + \eta y_W - \eta \min(x_s, D) = y_W \tag{13}$$

Taxable income $y_W - x_s$ below the limit D is taxed at rate η. Only the portion D is deducted above the limit. Time-invariant retirement consumption is:

$$d + \eta(y_R + a) = y_R + a \tag{14}$$

The intertemporal budget constraint is piecewise linear. Its slope is $-R^{L-s}k$ for contribution below the deduction limit (for high level of present consumption) and $(1-\eta)R^{L-s}k$ for contribution above the limit (for low level of present consumption). The two lines form a convex budget set with a kink where saving is equal to the deduction limit. The same graphical argument as in Section 2 can be used to demonstrate the presence of bunching at the deduction limit.

Note that the presence of bunching cannot be explained by savers adjusting their labor income instead of their contribution level. Let us assume that y_W is endogenous. The first period budget constraint (13) can be slightly rewritten:

$$c_s + x_s = (1-\eta) y_W + \eta \min(x_s, D) \tag{15}$$

Hence the marginal rate of substitution between first period consumption and income (the slope of the budget set in the space (c_s, y_W)) is $(1-\eta)$ whatever the tax regime and whether contribution is below or above the tax limit. This is because the deduction limit depends on contribution and not taxable income. The ceiling D is independent of income as well since it is defined as 10 % of previous year earnings.

Appendix C: Simulation of savers' densities and mean savings around a tax thresholds

The simulation aims at determining savers' distribution according to their optimal taxable income (net of saving) Y^p and their mean savings, given the distribution f of the gross income Y^a. By definition, $Y^a = Y^p + S(Y^p)$, with the function $S(.)$ piecewise linear:

$$S(Y^p) = \begin{cases} \underline{S} & if\ Y^p < T - \eta \\ \frac{\overline{S}+\underline{S}}{2} + \frac{\overline{S}-\underline{S}}{2\eta}(Y^p - T) & if\ T - \eta \leq Y^p \leq Y^p + \eta \\ \overline{S} & if\ Y^p > T + \eta \end{cases}$$

The function $\Phi(.)$ is defined as $Y^a = \Phi(Y^p) = Y^p + S(Y^p)$, and the function ϕ is its inverse: $Y^p = \phi(Y^a)$. The function $S(Y^p)$ is derived from the actual behavior of savers given by the contribution function $C(Y^a)$ by $S(Y^p) = Co\Phi(Y^p)$. Hence the derivative of function Φ is:

$$\Phi'(Y^p) = \begin{cases} 1 & if\ Y^p < T - \eta \\ 1 + \frac{\overline{S}-\underline{S}}{2\eta} & if\ T - \eta \leq Y^p \leq Y^p + \eta \\ 1 & if\ Y^p > T + \eta \end{cases}$$

Consequently, the distribution of (frictionless) taxable income $Y^p = \phi(Y^a)$ follows the density $\psi(Y^p) = |\Phi'(Y^p)|\,.f\left[\Phi(Y^p)\right] = |\Phi'\left[\phi(Y^a)\right]|\,.f(Y^a)$. Afterwards, we consider that the actual contribution $\hat{C}$ is the frictionless contribution C plus an error term ϵ following a probability density function g assumed to be uniform, centered, and of standard deviation σ[15]. Similarly, actual taxable income $\hat{Y}^p$ is composed of the frictionless taxable income minus this error term: $\hat{Y}^p = Y^p - \epsilon$, where the density of Y^p is ψ. Hence, the density h of $\hat{Y}^p$ is $h(\hat{Y}^p) = \int_{-\infty}^{+\infty} \psi(\hat{Y}^p + u)g(-u)du$ and therefore:

$$h(\hat{Y}^p) = \int_{-\sqrt{3}\sigma}^{+\sqrt{3}\sigma} \frac{\left|\Phi'(\hat{Y}^p + u)\right|.fo\Phi(\hat{Y}^p + u)}{2\sqrt{3}\sigma} du \tag{16}$$

Figure 10 shows the simulated distributions of $h(\hat{Y}^p)$ for different values of the standard deviation of the error term ϵ, using the same step for the graphical representation as in Fig. 6, that is 5% percent of the income threshold (obtained by integrating $h(\hat{Y}^p)$). Mean contribution for different classes of taxable income $MS(\hat{Y}^p)$ is computed following equation 17:

$$MS(\hat{Y}^p) = \frac{\int_{-\sqrt{3}\sigma}^{+\sqrt{3}\sigma} \frac{\left|\Phi'(\hat{Y}^p+u)\right|.fo\Phi(\hat{Y}^p+u)}{2\sqrt{3}\sigma}\left[\Phi(\hat{Y}^p + u) - (\hat{Y}^p + u) + u\right] du}{\int_{-\sqrt{3}\sigma}^{+\sqrt{3}\sigma} \frac{\left|\Phi'(\hat{Y}^p+u)\right|.fo\Phi(\hat{Y}^p+u)}{2\sqrt{3}\sigma} du} \tag{17}$$

To run these calculations, some additional hypotheses were assumed. The initial distribution of income Y^a follows a Pareto distribution with a coefficient of 2.35[16]. The lower savings $\underline{S}$ and upper savings $\overline{S}$ are

[15] We choose an uniform distribution as the support of the probability density function should be a segment. Otherwise, negative contributions and taxable income would arise.

[16] This distribution fits the upper tail of the French income distribution following the results of Piketty (12001). This applies particularly for the high income and therefore for the analysis around the highest threshold of the income tax schedule.

respectively 2.5% and 5% of the threshold income. The parameter η is set at 1% of the threshold income, such that all the concentration at threshold in the theoretical case is contained in the the central interval.

As shown in Fig. 7, the optimal saving profile with respect to taxable income is vertical at the threshold in the frictionless case. We have reproduced a similar profile in Panel a of Fig. 10 where the error term ϵ and its standard deviation σ are zero. For graphical convenience, the dirac (the mass at the threshold) has been distributed over the interval $[T - \eta; T + \eta]$ where η is sufficiently small not to change the graphical presentation of savers' distribution[17].

[17]Programs have been coded with SCILAB. They are available upon request.

Tables

Table 1: The French tax schedule in 2008

Upper threshold (euros)	Tax bracket	Marginal tax rate (MTR)
$S_1 = 5,853$	up to S_1	$\eta_0 = 0\%$
$S_2 = 11,673$	$[S_1, S_2[$	$\eta_1 = 5.5\%$
$S_3 = 25,926$	$[S_2, S_3[$	$\eta_2 = 14\%$
$S_4 = 69,505$	$[S_3, S_4[$	$\eta_3 = 30\%$
$S_5 = \infty$	$[S_3, S_4[$	$\eta_4 = 40\%$

Note: The Table presents marginal tax rates for each tax brackets.

Table 2: Subsidy/tax rate and tax configuration

Working age MTR (η_W)	Retirement MTR (η_R)	Subsidy/tax rate $\frac{\eta_W - \eta_R}{1-\eta_W}$
same MTR		0%
5%	14%	$-9,5\%$
14%	5%	$10,5\%$
14%	30%	$-18,6\%$
30%	14%	$22,9\%$
30%	40%	$-14,3\%$
40%	30%	$16,7\%$

Note: The Table presents various configurations of marginal tax rates (MTR) during the working period and the retirement period. For each configuration, the subsidy rate (if positive) or the tax rate (if negative) is computed using the formula in Eq. 5.

Table 3: Return rate premiums and distance to retirement

Working age	Retirement	Distance to retirement $(L - s)$				
MTR (η_W)	MTR (η_R)	1	2	5	10	20
5%	14%	-0.70	-0.66	0.55	-0,43	-0.30
14%	5%	0.72	0.68	0.56	0.44	0.31
14%	30%	-1.39	-1.31	-1.11	-0.90	-0.63
30%	14%	1.54	1.43	1.19	0.92	0.64
30%	40%	-1.05	-0.99	-0.83	-0.66	-0.47
40%	30%	1.14	1.06	0.88	0.69	0.48

Note: The Table presents return rate premiums for possible configurations of marginal tax rates (MTR) during the working period and the retirement period and for various distances to retirement. It is a counterfactual savings return rate from which individuals should benefit on their life-cycle savings (including retirement savings) to be compensated from the removal of any tax advantages.

Table 4: Summary statistics

	Individuals aged 30-70			
	2006	2007	2008	2009
Number of taxpayers	16,848,594	17,045,740	17,124,668	17,241,702
Number of savers	942,165	972,878	879,861	880,088
Share of savers	5.59%	5.71%	5.14%	5.10%
Mean contribution (euros)	1,532	1,609	1,638	1,706
P25 contribution	387	410	438	445
Median contribution	720	721	730	790
P75 contribution	1,405	1,500	1,468	1,603
	Individuals aged 45-65			
	2006	2007	2008	2009
Number of taxpayers	8,206,099	8,401,024	8,447,159	8,643,563
Number of savers	572,660	607,729	550,045	581,793
Share of savers	6.98%	7.23%	6.51%	6.73%
Mean contribution (euros)	1,873	1,964	1,999	2,043
P25 contribution	502	509	570	542
Median contribution	866	940	936	992
P75 contribution	1,831	1,931	1,983	2,052

Note: savers are taxpayers who contribute in tax-qualified saving accounts.
Source: Sample of tax returns, DGFIP.

Table 5: Average subsidy/tax rate and frequencies

			Tax thresholds					
			S_2		S_3		S_4	
			below	above	below	above	below	above
$\delta = 10\%$	Stable MTR	Subsidy/tax rate	0%	0%	0%	0%	0%	0%
		Frequency	52.6%	41.9%	90.0%	24.8%	94.9%	32.6%
	Increasing MTR	Subsidy/tax rate	-9.5%	-	-18.6%	-	-14.3%	-
		Frequency	47.4%	-	10.0%	-	5.1%	-
	Decreasing MTR	Subsidy/tax rate	-	10.5%	-	22.9%	-	16.7%
		Frequency	-	58.1%	-	75.2%	-	67.4%
	Average subsidy/tax rate		-4.5%	6.1%	-1.9%	17.2%	-0.7%	11.3%
	Difference			10.6%		19.2%		12.0%
$\delta = 15\%$	Stable MTR	Subsidy/tax rate	0%	0%	0%	0%	0%	0%
		Frequency	55.6%	47.8%	92.5%	28.6%	96.5%	41.0%
	Increasing MTR	Subsidy/tax rate	-9.5%	-	-18.6%	-	-14.3%	-
		Frequency	44.4%	-	7.5%	-	3.5%	-
	Decreasing MTR	Subsidy/tax rate	-	10.5%	-	22.9%	-	16.7%
		Frequency	-	52.2%	-	71.4%	-	59.0%
	Average subsidy/tax rate		-4.2%	5.5%	-1.4%	16.4%	-0.5%	9.9%
	Difference			9.7%		17.8%		10.4%

Sample: Savers in 2008 aged between 50 and 68, no dependent children and contribution below the tax limit.

Note: Savers may belong to three tax regimes : a stable MTR after retirement, an increasing MTR after retirement or a decreasing MTR after retirement. For each tax regime, six regions are distinguished for taxable income: below or above tax thresholds S_2, S_3 and S_4 with a band width equal to + or $-\delta\%$. For every tax configuration, the table indicates subsidy rates (if positive) or tax rates (if negative) whose formula is taken from Table 2, and simulated frequencies of savers. For instance, 52.6% of savers whose working-life taxable income is below tax threshold S_2 remain below the same threshold after retirement and remaining savers (47.4%) have a retirement taxable income above the threshold and consequently an increasing MTR. The tax rate for this group is 4.5% which is the average rate of the two sub-groups weighted by their frequencies. The average subsidy rate of savers whose working-life taxable income is above S_2 is 6.1%. The difference of tax treatment between the two groups is therefore 10.6%. This differential tax treatment holds for savers whose taxable income is between $(1-\delta)S_2$ and $(1+\delta)S_2$ with $\delta = 10\%$ (upper panel). It is 9.7% for a broader bracket of taxable incomes ($\delta = 15\%$).

Source: Sample of tax returns, DGFIP.

Table 6: Estimation of responses to tax incentives

Dependent variable : annual contribution in tax-qualified saving accounts	obs.	Semi-elasticity of savings to the tax premium Controls: None	In second stage	In both stages
Taxable income around threshold S_2				
Savers aged between 30 and 45	319	0.396 (1.251)	0.130 (2.078)	0.141 (2.260)
Savers aged between 45 and 55	264	-2.871*** (0.861)	-5.566*** (1.358)	-6.051*** (1.424)
Savers aged over 55	226	-1.508 (1.403)	-2.804 (2.114)	-2.635 (1.977)
Taxable income around threshold S_3				
Savers aged between 30 and 45	382	0.807* (0.452)	0.531 (0.694)	0.499 (0.651)
Savers aged between 45 and 55	538	0.381 (0.354)	1.319** (0.595)	1.282** (0.578)
Savers aged over 55	547	-0.467 (0.366)	0.898 (0.608)	0.962 (0.652)
Taxable income around threshold S_4				
Savers aged between 30 and 45	90	2.747 (2.059)	7.680* (4.016)	9.430* (5.124)
Savers aged between 45 and 55	138	1.146 (1.355)	4.409** (2.205)	4.581** (2.290)
Savers aged over 55	200	1.032 (1.228)	4.264** (2.098)	4.078** (1.998)

Sample: savers aged between 30 and 70, without dependent children and contributions in tax qualified saving accounts below the deduction limit. Only savers whose taxable income is between $(1-\delta)S_i$ and $(1+\delta)S_i$ with $\delta = 10\%$ are included.
Note: The table indicates 2SLS estimators of tax premium P_i in Eq. (7). The regression is run with three distinct age samples and around the three tax thresholds considered. Covariates are age, sex, marital status, household's income, individual's earnings and the share of household's earnings in household's income. Heteroscedasticity-consistent standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.
Source: Sample of tax returns for income earned in 2006 to 2009, DGFIP.

Table 7: Comparability tests of right-hand and left-hand groups

	Variations of the controls around the threshold (δ =10%, robust)		
	Threshold S_2	Threshold S_3	Threshold S_4
Dependent variable: household's income			
Savers aged 30-45	-0.0366 (0.0226)	-0.0157 (0.0116)	0.0210 (0.0334)
Savers aged 45-55	-0.0895*** (0.0319)	-0.0322** (0.0145)	0.0416 (0.0408)
Savers over 55	0.0466 (0.0353)	-0.0008 (0.0163)	0.0475 (0.0268)
Dependent variable: individual's wages			
Savers aged 30-45	0.0395 (0.0269)	-0.0100 (0.0171)	-0.0416 (0.0576)
Savers aged 45-55	0.1884 (0.1184)	0.0055 (0.0282)	-0.3318 (0.2441)
Savers over 55	-0.1050 (0.1496)	-0.0187 (0.0564)	-0.1957 (0.1419)
Dependent variable: ratio of wages over household's income			
Savers aged 30-45	-0.0066 (0.0138)	-0.0056 (0.0094)	0.0047 (0.0248)
Savers aged 45-55	-0.0192 (0.0252)	-0.0076 (0.0146)	-0.0175 (0.0410)
Savers over 55	0.0537 (0.0414)	0.0404 (0.0242)	0.0710 (0.0401)
Dependent variable: age 35-40			
Savers aged 30-45	-0.0810 (0.0932)	-0.2351*** (0.0862)	0.1872 (0.2082)
Dependent variable: age 40-45			
Savers aged 30-45	0.0811 (0.0926)	0.1454 (0.0887)	-0.0473 (0.2475)
Dependent variable: age 50-55			
Savers aged 45-55	-0.0585 (0.0916)	-0.0852 (0.0703)	0.0572 (0.1776)
Dependent variable: age 60-65			
Savers over 55	-0.0823 (0.0751)	0.0588 (0.0542)	0.0227 (0.1534)
Dependent variable: married man			
Savers aged 30-45	0.0076 (0.0412)	0.0114 (0.0384)	0.0243 (0.0665)
Savers aged 45-55	-0.1140 (0.0647)	0.0754 (0.0431)	-0.0755 (0.1028)
Savers over 55	-0.0704 (0.0843)	0.0157 (0.0574)	-0.0117 (0.1129)
Dependent variable: married woman			
Savers aged 30-45	0.0364 (0.0439)	0.0045 (0.0335)	-0.0605 (0.0744)
Savers aged 45-55	0.1879*** (0.0569)	-0.0283 (0.0411)	-0.0656 (0.0994)
Savers over 55	0.0415 (0.0766)	-0.0090 (0.0569)	-0.0297 (0.1055)

Sample: savers aged between 30 and 70, without dependent children and contributions in tax qualified saving accounts below the deduction limit.
Notes: The Table presents the coefficients of the dummy T_i in the equation $y_j = \alpha_i + \gamma_i T_i + X_j \beta_i + \varepsilon_j$ for thresholds $i = 2, 3, 4$, where T_i is equal to one if taxpayers' taxable income is at the right-hand side of the threshold and 0 at the left. X_j includes many control variables. Samples are broken down by age groups, except when the dependent variable is an age dummy.
Standard errors in parentheses are computed with the White method to correct for heteroskedasticity, ** significant at 5%; *** significant at 1%.
Source: Sample of tax returns, DGFIP.

Table 8: Estimation of treatment effect with shifted threshold

Dependent variable : annual contribution in tax-qualified saving accounts	Semi-elasticity of savings to the tax premium Interval ($\delta = 10\%$) of taxable income	
	shifted 10% left	shifted 10% right
Taxable income around threshold S_2		
Savers aged between 30 and 45	-1.239 (1.929)	0.513 (1.779)
Savers aged between 45 and 55	0.640 (2.638)	-2.650** (1.308)
Savers aged over 55	-0.301 (3.073)	-1.908 (2.715)
Taxable income around threshold S_3		
Savers aged between 30 and 45	0.173 (0.532)	-0.072 (0.963)
Savers aged between 45 and 55	0.320 (0.488)	-0.691 (0.954)
Savers aged over 55	1.044* (0.607)	
Taxable income around threshold S_4		
Savers aged between 30 and 45	3.195 (2.052)	8.500 (7.317)
Savers aged between 45 and 55	-3.510*** (1.288)	1.716 (3.546)
Savers aged over 55	-2.702** (1.240)	4.160 (2.673)

Sample: savers aged between 30 and 70, without dependent children and contributions in tax qualified saving accounts below the deduction limit. Only savers whose taxable income is between $(1-\delta)S_i^s$ and $(1+\delta)S_i^s$ with $\delta = 10\%$ are included, with S_i^s shifted 10% left or right from the actual threshold S_i.
Note: The table indicates 2SLS estimators of variable P_i in Eq. (7). The regression is run with covariates at the two stages (age, sex, marital status, household's income, individual's earnings and the share of household's earnings in household's income), three distinct age samples and around the three tax thresholds. Heteroscedasticity-consistent standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.
Source: Sample of tax returns for income earned in 2006 to 2009, DGFIP.

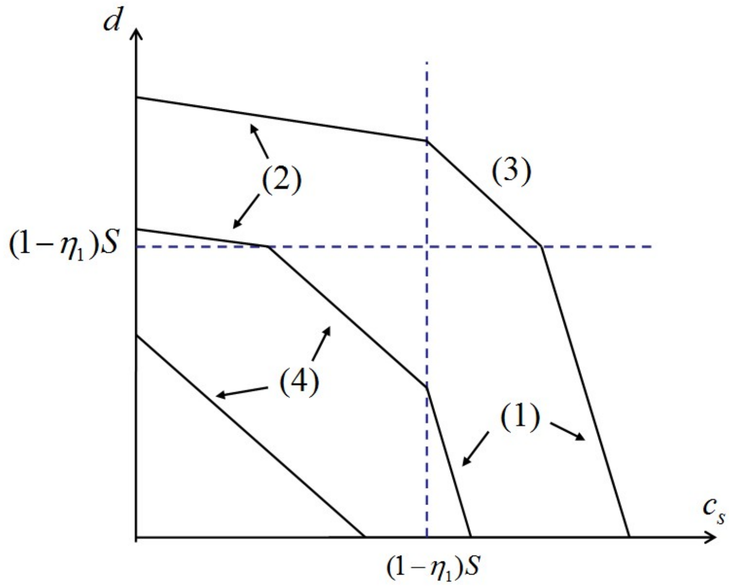
Table 9: Estimation of responses to tax incentives, alternative $\delta = 1\%,\ 5\%,\ 15\%$

Dependent variable : annual contribution in tax-qualified saving accounts	Semi-elasticity of savings to the tax premium Window of estimation					
	$\delta = 1\%$		$\delta = 5\%$		$\delta = 15\%$	
	obs.	Estimates	obs.	Estimates	obs.	Estimates
Taxable income around threshold S_2						
Savers aged between 30 and 45	26	4.280 (8.571)	170	1.087 (3.118)	459	-0.561 (1.684)
Savers aged between 45 and 55	28	-6.741** (2.819)	151	-5.576*** (1.685)	395	-4.522*** (1.319)
Savers aged over 55	32	-2.183 (4.233)	123	-1.067 (2.607)	337	-3.239* (1.812)
Taxable income around threshold S_3						
Savers aged between 30 and 45	37	1.634 (1.096)	197	0.396 (0.648)	602	0.179 (0.558)
Savers aged between 45 and 55	45	1.048 (0.719)	258	1.589** (0.711)	804	0.851* (0.510)
Savers aged over 55	51	1.936 (1.164)	266	0.582 (0.661)	825	-0.351 (0.550)
Taxable income around threshold S_4						
Savers aged between 30 and 45	6	NFR	42	5.317 (5.152)	137	3.938 (2.959)
Savers aged between 45 and 55	14	6.052 (18.879)	73	4.553* (2.482)	215	2.371 (1.855)
Savers aged over 55	24	1.701 (3.646)	101	2.037 (2.089)	322	2.959** (1.484)

Sample: savers aged between 30 and 70, without dependent children and contributions in tax qualified saving accounts below the deduction limit. Only savers whose taxable income is between $(1-\delta)S_i$ and $(1+\delta)S_i$ with $\delta = 1\%$ are included.
Note: The table indicates 2SLS estimators of tax premium P_i in Eq. (7). The regression is run with covariates at the two stages (age, sex, marital status, household's income, individual's earnings and the share of household's earnings in household's income), three distinct age samples and around the three tax thresholds considered. Heteroscedasticity-consistent standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. NFR: model not full ranked because of lack of observations.
Source: Sample of tax returns for income earned in 2006 to 2009, DGFIP.

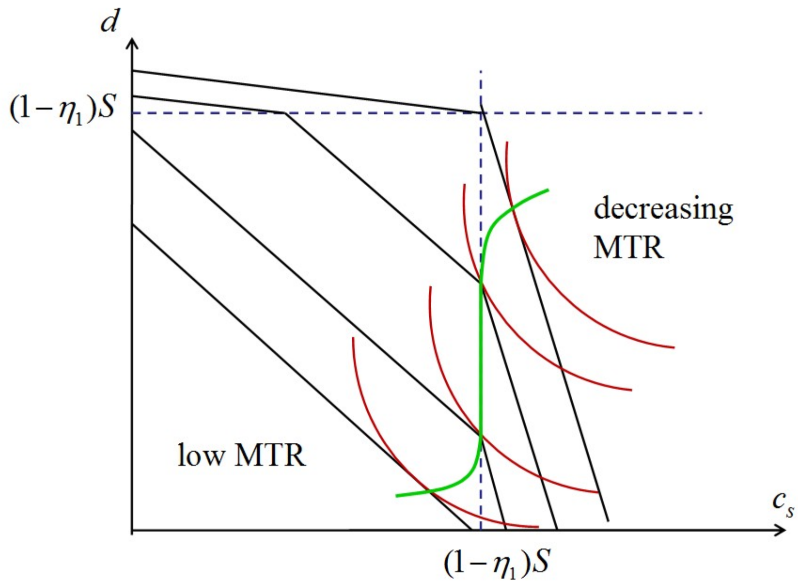
Figures

Figure 1: Three examples of budget sets



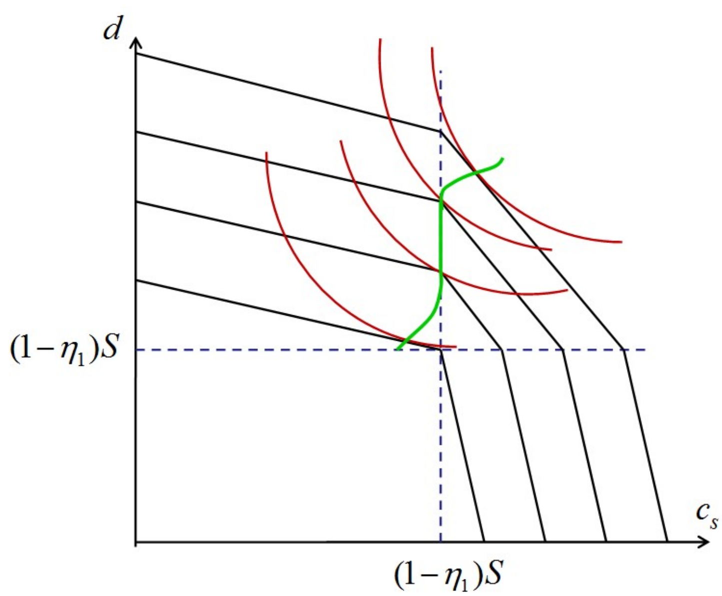
Notes: c_s is working-life consumption, d consumption at retirement, η_1 the lowest MTR, S the tax threshold and $(1-\eta_1)S$ is tax threshold expressed in consumption units. The figure displays three possible budget sets which differ in intertemporal wealths (the higher intertemporal wealth, the farther from origin). Lines (1) hold for small contributions, large present consumption and low retirement consumption. Working period taxable income is large ($y_W - x_s > S$) and retirement income is small ($y_R + a < S$) so that $\eta_W > \eta_R$. Plan's return rate is subsidized, as reflected by a steep slope of the budget line equal to minus the marginal rate of return $-R^{L-s}k\frac{1-\eta_1}{1-\eta_2}$. Lines (2) prevail when contributions are large and present consumption are small. In this tax regime, taxable income is below the tax threshold ($y_W - x_s < S$) and retirement income is above ($y_R + a > S$). The MTR is greater after retirement implying a tax-diminished return rate $R^{L-s}k\frac{1-\eta_2}{1-\eta_1}$. Line (3) is valid for intermediate contributions and high intertemporal wealth. Taxable income is above the tax threshold at all ages ($y_W - x_s > S$ and $y_R + a > S$) and the return rate is tax-neutral (marginal rate of return is equal to $R^{L-s}k$). Line (4) holds for intermediate contributions and low intertemporal wealth. Taxable income is below the threshold over the whole life cycle ($y_W - x_s < S$ and $y_R + a < S$) and the return rate is also tax-neutral.

Figure 2: Wealth expansion path



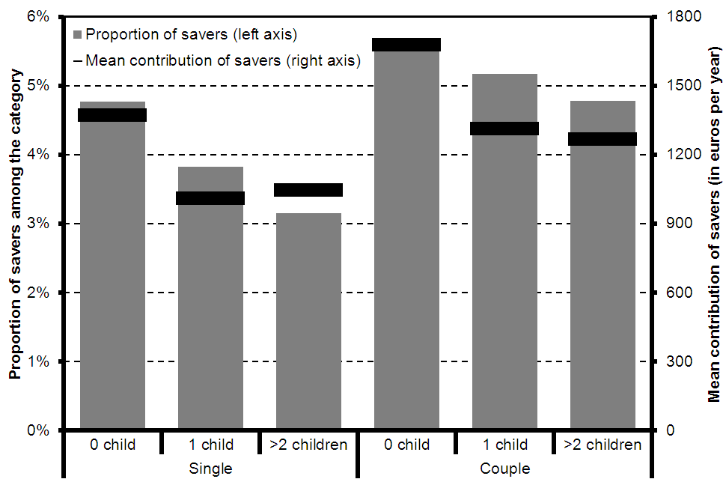
Notes: The wealth expansion path shows how intertemporal wealth affects consumption before and after retirement. It connects consumer's optimums together when the budget set is gradually relaxed. Savers with different wealth levels bunch at the tax threshold.

Figure 3: An alternative wealth expansion path



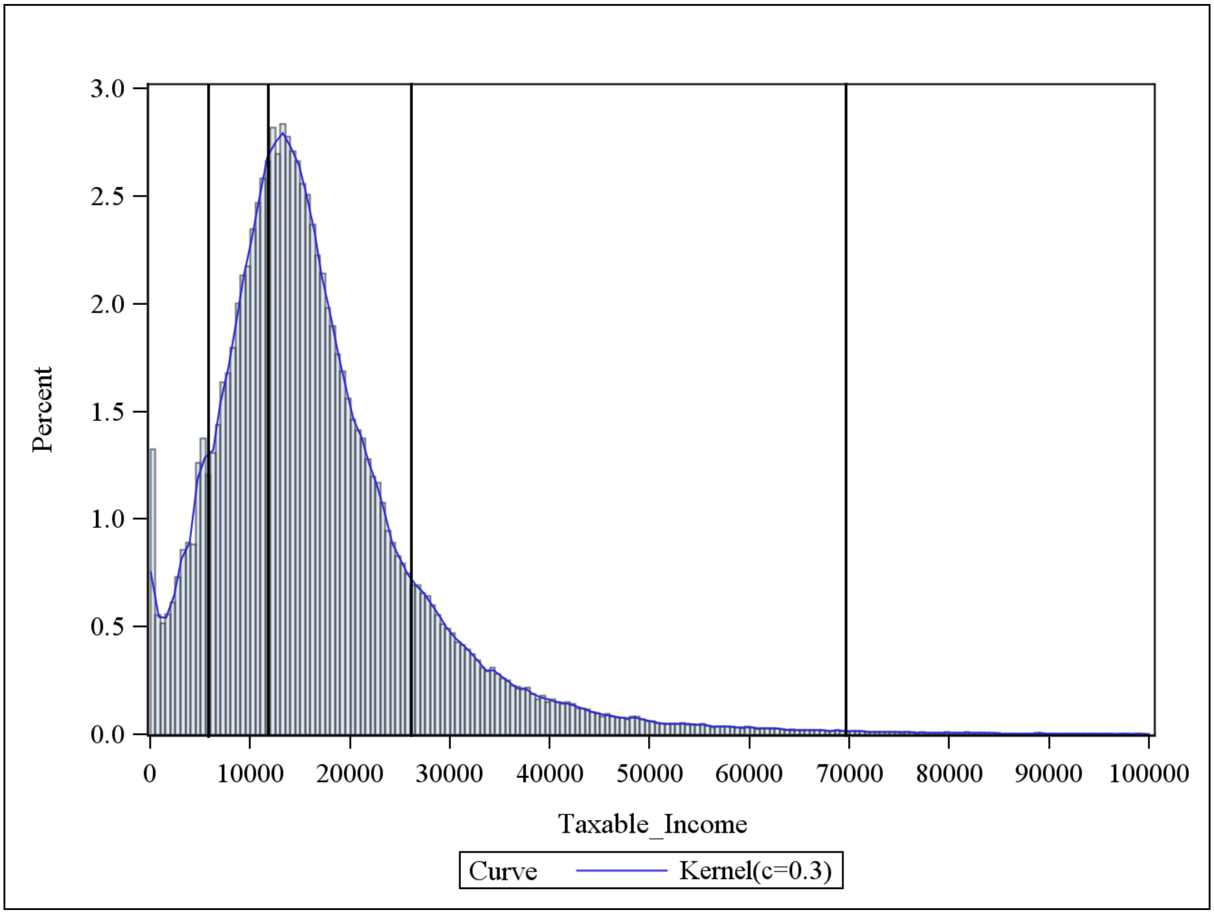
Notes: This wealth expansion path holds for consumers whose retirement income is larger than working-life income.

Figure 4: Family composition and retirement savings in PERP products



Source: Sample of tax returns, DGFIP.

Figure 5: Observed and simulated income distribution

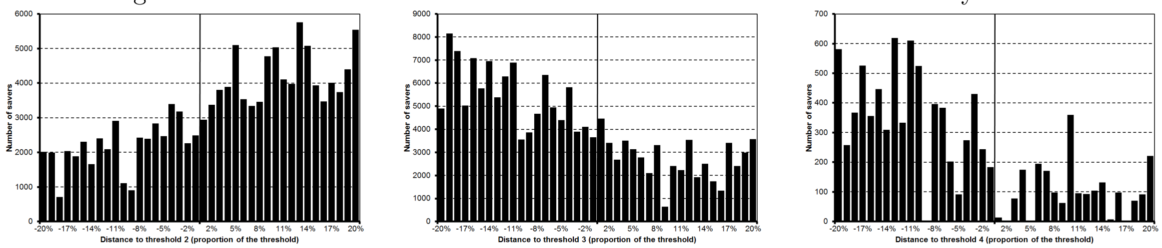


Source: Sample of tax returns, DGFIP.

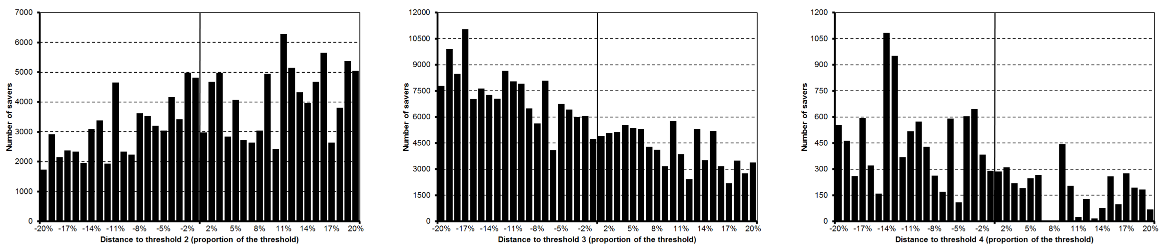
Note: We restrict our data set to savers aged between 30 and 70, without dependent children and whose contributions do not exceed the deduction limit. We plot the distribution of taxable income (net of contributions) with bins of 500 euros. The curve plots a kernel density of the simulated distribution with a bandwidth of 150 euros which fits the histogram. The four vertical lines indicate the tax thresholds S_1 to S_4.

Source: Sample of tax returns, DGFIP.

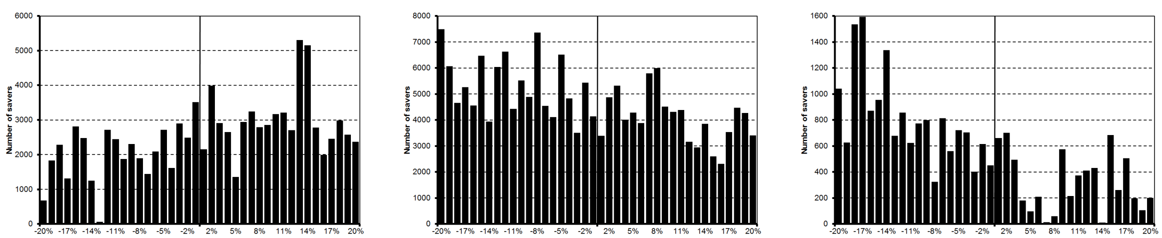
Figure 6: Relative distance of taxable income to tax threshold and density of savers



Savers aged between 30 and 44



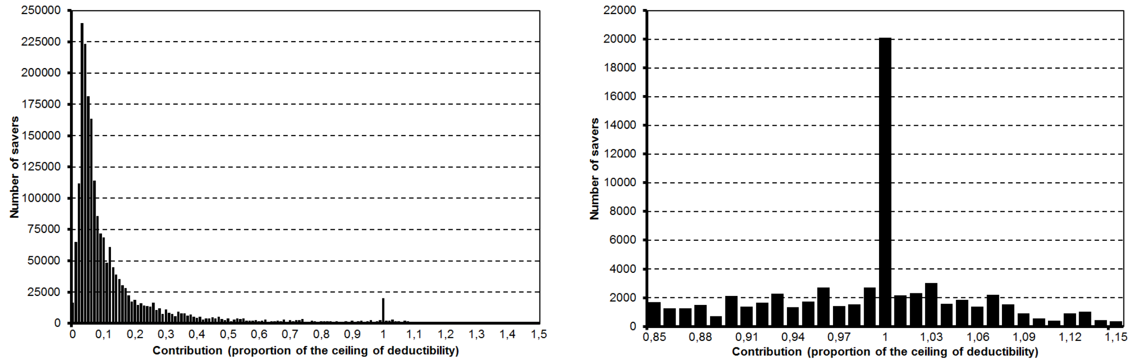
Savers aged between 45 and 54



Savers aged between 55 and 70

Note: We restrict our data set to savers aged between 30 and 70, without dependent children and whose contributions do not exceed the deduction limit. We group savers' taxable income whose distance to the threshold is between 0 and 1%, 1 and 2% and so on. We adopt the same step of 1% for negative distances. The number of savers in each group is reported on the vertical axis.
Source: Sample of tax returns, DGFIP.

Figure 7: Relative distance of contribution to deduction ceiling and density of savers



Note: We restrict our data set to savers aged between 30 and 70, without dependent children. In the left panel the distribution of the ratio contribution to ceiling with bins of 1% is plotted. In the right panel we do the same with a narrowed interval around one. We observe bunching for contributions between 1 and 1.01 times the deduction limit. Note that contributions exceeding the deduction limit do not benefit from tax deduction.
Source: Sample of tax returns, DGFIP.

Figure 8: Contribution and taxable income (net of contribution) in a frictionless environment

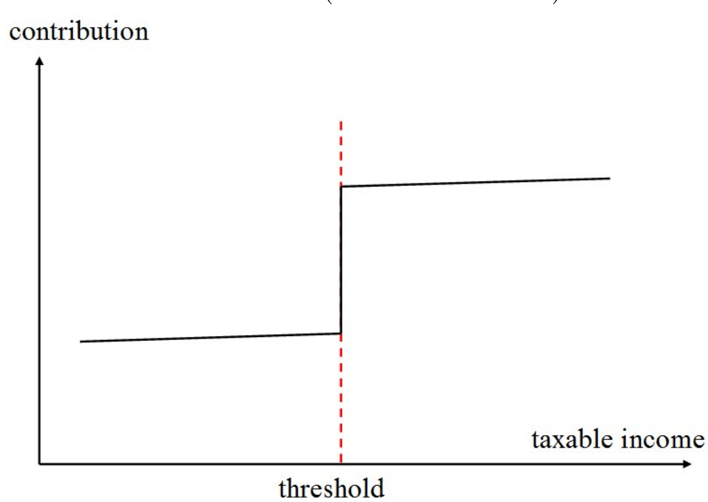


Figure 9: Contribution and taxable income (net of contribution) when savers do not set their taxable income exactly at threshold

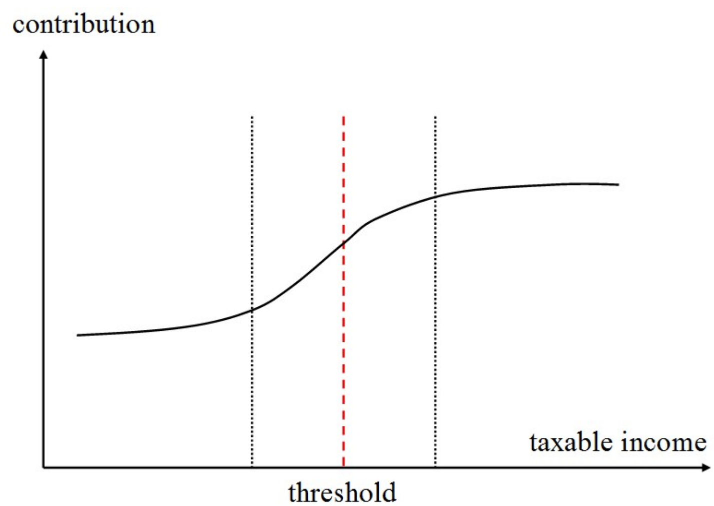
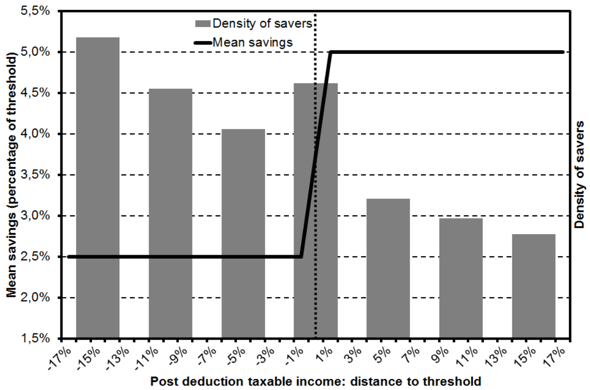
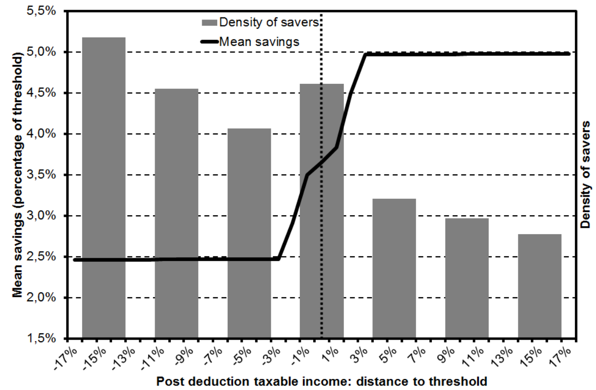


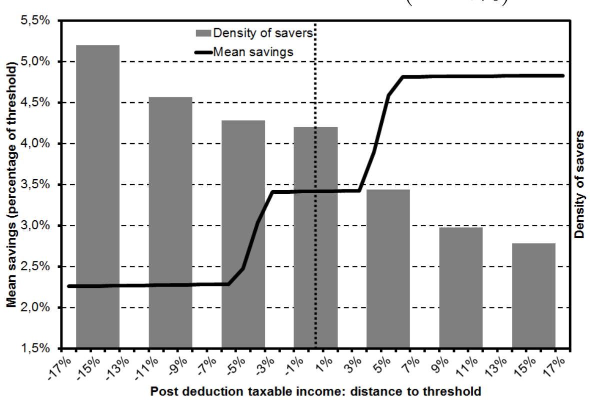
Figure 10: Simulation of savers' densities and mean savings around a tax threshold



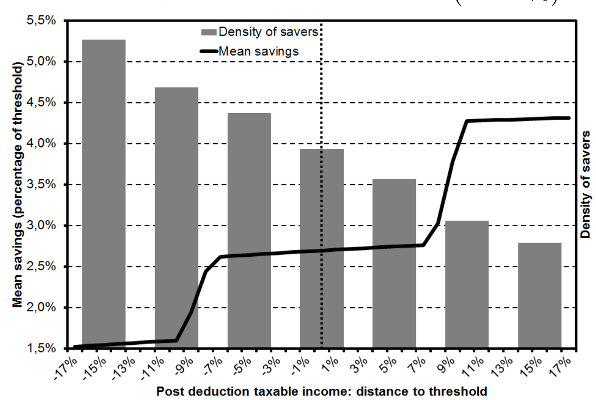
Panel a: Frictionless model ($\sigma = 0\%$)



Panel b: With a 'small' error term ($\sigma = 1\%$)



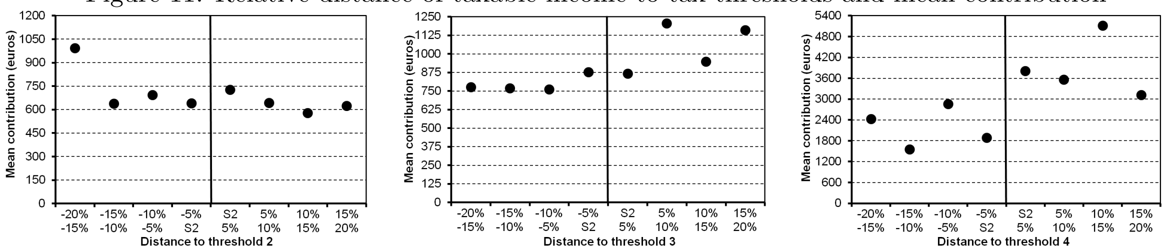
Panel c: With a 'medium' error term ($\sigma = 2.5\%$)



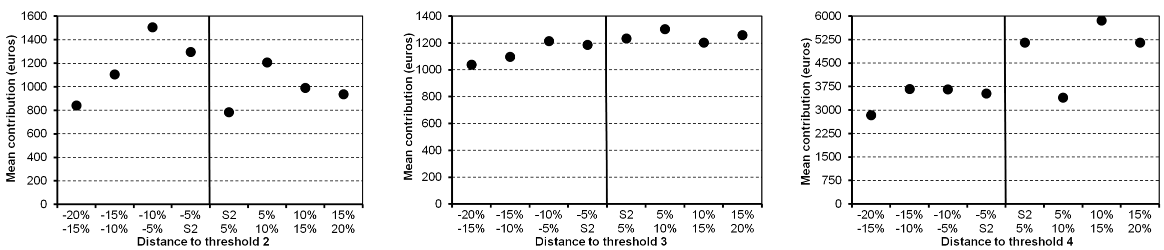
Panel d: With a 'large' error term ($\sigma = 5\%$)

Note: We simulate a gross income distribution with a Pareto law and compute taxable income by deducting from gross income the frictionless contribution plus an error term of mean zero and various standard deviations (expressed in term of the threshold). The resulting taxable income distribution is plotted in grey bars. The higher the error term standard deviation, the more spread contributions around the threshold as shown by the solid lines. For a standard deviation of 2.5% or more of the threshold, we can visually check that bunching at the threshold is not visible anymore as in our data.

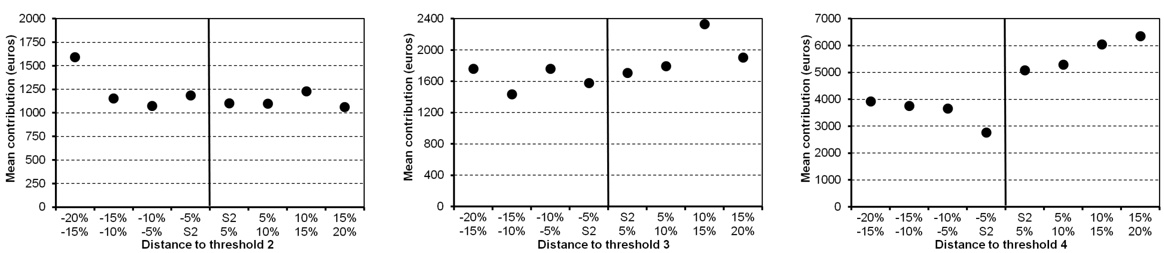
Figure 11: Relative distance of taxable income to tax thresholds and mean contribution



Savers aged between 30 and 44



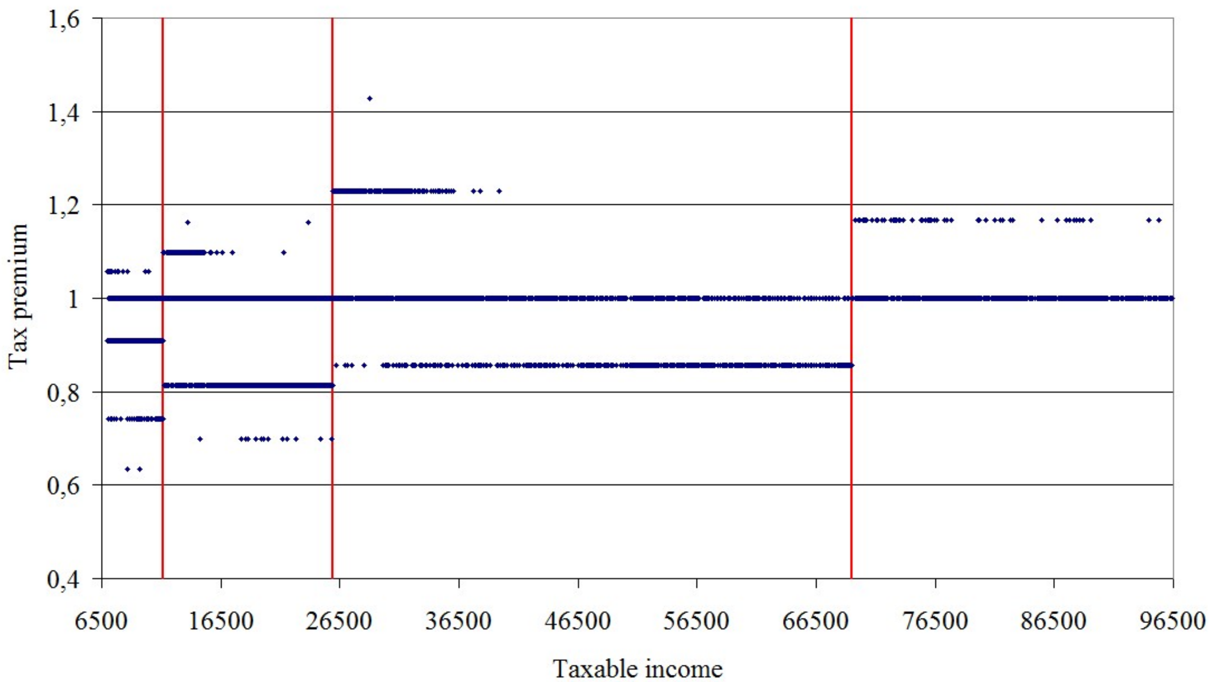
Savers aged between 45 and 54



Savers aged between 55 and 70

Note: We restrict our data set to savers aged between 30 and 70, without dependent children and whose contributions do not exceed the deduction limit. We group savers' taxable income whose distance to the threshold is between 0 and 1%, 1 and 2% and so on. We adopt the same step of 1% for negative distances. Mean contribution of each group is reported on the vertical axis.
Source: Sample of tax returns, DGFIP.

Figure 12: The relationship between taxable income and subsidy/tax rates



Note: This figure plots the location of tax units according to their 2008 taxable income and their simulated tax premium $\frac{\eta_W - \eta_R}{1-\eta_W}$ taken from Eq. (5). A point represents one observation. Vertical lines indicate tax thresholds S_2 to S_4. Observations are concentrated on a number of horizontal lines. Each one represents a possible tax premium computed from a given configuration of present and future MTR (see Table 2 for their exact values). We can see that taxpayers just above a threshold benefit from higher tax premium compared to taxpayers below the same threshold.
Sample: savers aged between 30 and 68, no dependent children and contributions below the tax limit.
Source: Sample of tax returns, DGFIP.