

How Price Elastic is the Demand for Retirement Saving? *

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Abstract

We exploit an administrative dataset of a big insurance company to assess the effects on annuity demand of a French regulatory reform which impacted actuarial return to deferred life annuity products. Unlike previous studies, annuity demand is measured by contributions in saving products which capital is converted into annuities at retirement. Our identification methodology is based on the fact that while female savers' annuity rate (conversion rate of capital into annuities) fell by 10%, male savers who did not expect to take the survivor option at retirement, were not affected by the reform. Assuming that single men fall in this category, and using this population as a control group, we find a decrease in demand by women of -16% which corresponds to a price elasticity of subscriptions of -1.5. The reform did not significantly alter contributions in saving accounts. We also document a very large anticipation effect created by the opportunity offered to early subscribers to benefit from older pricing.

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1 Introduction

The rise in life expectancy in developed countries puts pressure on public pension systems and their financial equilibrium but also affects private retirement plans that guarantee a regular income until the death of the insured. Since longer lifespan at old age raises the cost of guaranteed income payments, insurers are concerned by preserving their solvency. They do so by updating the mortality tables they use to convert wealth into annuities, with the effect of lowering annuity payouts in proportion to capital at the date of conversion. To what extent this may discourage savers from purchasing annuities is an open issue.

In France, insurers use regulatory mortality tables whose survival probabilities have been revised upwards several times since the 1980s. The resulting decrease in annuity rates (the rates at which saving is converted into an annuity at retirement) may be illustrated by the experience of a hypothetical male saver born in 1952. His rate was reduced from 7% before 1985 to 5% in 2007 and further by 4.5% in 2013, representing an overall 35% decrease. The drop affects a given generation and is entirely driven by successive upward revisions of longevity.

Longer life expectancy being an international phenomenon, the upward trend of annuity prices has been observed in other countries as well. Cannon and Tonks (2004) document in United Kingdom a significant drop in conversion rates since the 80s. Cannon and Tonks (2009) show that lower conversion rates recorded over the 1994-2007 period are largely explained by strong revision of annuitants' life expectancy. This trend is confirmed by Lowe (2014) who notes that, to obtain a nominal income of £10,000, £65,000 were needed in 1990 but over £175,000 by 2013. In Switzerland, insurance companies have significantly reduced for the same reasons the conversion rate in the unregulated segment of the annuity market (Bütler, Staubli and Zito, 2013).

The long-term annuity price increase raises interesting questions about savers' reaction and the future of longevity insurance. Does it mean a fall in demand for annuity with worrying long-term consequences for retirees' living adequacy in a context of reduced state-provided public pensions (OECD, 2011)? Or are savers willing to compensate rising prices by saving more so as to preserve their standard of living at retirement? Savers might also decide to stay away altogether from annuity products meaning less insurance against longevity risk.

Answering these questions requires an estimate of the price elasticity of demand for annuity contracts. To do so, we investigate the effects of a French major revision of mortality tables in 2007 which affected saving contracts in which the payment of life annuities is deferred until the retirement age. Our data cover the accumulation phase, not the distribution phase. However, since withdrawals are forbidden during the saving phase and full annuitization of saving is

compulsory at retirement, the decisions to subscribe a contract and how much to save into it are direct measures of demand for annuities. We exploit the fact that the reform produced asymmetric effects on men and women. Annuity rates for women who subscribed a contract after 2007 were reduced by about 10% compared to those who already owned a contract before this date. The reform was approximately neutral to men insofar as they did not expect to opt for a joint and survivor annuity. We assume that single men did not expect to opt for reversion at retirement and use this population as a control group.

We apply our identification strategy to a unique dataset from a leading insurer that contains a rich set of administrative information on saving contracts targeted to self-employed workers over the 2003-2009 period. In addition to information on the number of monthly subscriptions and individual contributions, the data set records subscribers' sex, birth date, family status, district of residence, proportion invested in risky financial assets and the distribution channel. It is supplemented by data from the marketing department about income and wealth profiles.

We first study reform's anticipation effects on sales. Attracted by the benefits of previous mortality tables, women subscribed six times more contracts the last six months prior to the reform compared to normal time. We also find a similar rush for men, and discuss why they subscribed more contracts despite being much less impacted than women. We then turn to the impact of the reform on subscriptions. Compared to sales to single men, contracts sold to women decreased by 16%, representing a price elasticity of -1.5. By contrast, the reform did not significantly alter contributions in saving accounts, after controlling for demand by single men.

Our results may be analysed through the lens of economic theory. In a standard consumption-saving model with uncertain longevity, competitive markets and time-separable intertemporal utility functions, the longevity risk is fully insured by the purchase of annuities, in the sense that consumption evolves smoothly over the life-cycle (Yaari, 1965). If longevity is revised upward during the saving phase, life-cycle sustainable consumption is reduced, leading to more savings. This result is empirically found by articles which study the relation between life expectancy and aggregate savings (Kinugasa and Mason 2007, Miles 1999, Deaton and Paxson 1997 and Lee, Mason and Miller 2001). Yet, there are several reasons why this relationship may not hold in real world annuity markets. First, annuity prices being adjusted stepwise on an irregular basis, they do not continuously track changes in savers' average life expectations. Second, savers may misinterpret the increase in annuity prices. If they underweight the longevity gains at the origin of the increase, they may wrongly conclude that annuities are not worth investing in. Lowe (2014) remarks that annuities have become unpopular in United Kingdom after a large fall in conversion rates and that this disaffection is best explained by people not factoring in the improved benefit provided by annuities when longevity is extending. To this regard, marked

preferences by investors for cash-out rather than annuities documented in the literature (Brown (2009), James and Song (2001), and James and Vitas (2004) for international evidence) may well be amplified by the fall in conversion rates. Such response may however be detrimental to investors as cash is a poor protection against longevity risk. Davidoff, Brown and Diamond (2005) and many others find that annuity products are adequate to insure against the risk of outliving one's resources at old age.

While theoretical and simulation studies on annuity demand are abundant, the empirical literature is comparatively still small. Several articles have analysed survey data in which hypothetical questions are asked to a sample of the population about their willingness to annuitise their wealth (Hurd and Panis, 2006, Cappelletti et al., 2013). Other articles study real choices between annuities and lump-sum payments by retiring employees (Warner and Pleeter, 2001, Benartzi et al., 2011, Büttler and Teppa, 2007). Only two articles investigate the relationship between demand and price in the annuity market. Chalmers and Reuter (2012) study the choice between life annuities and lump sums made by a large sample of retiring public employees. They find little evidence that retirees respond to variation in life annuity pricing, which suggests that cross-sectional variation in annuity pricing is not salient enough to be noticed by unsophisticated investors.

In contrast, Büttler, Staubli and Zito (2013) analyse the effects of a salient and sizeable decrease of conversion rates which apply to the unregulated segment of the annuity market. They find a 14 percentage points decrease in the proportion of individuals choosing to convert their savings into annuities at retirement. They observe a large anticipation effect in the form of a sharp increase of the number of annuitants in the months preceding the conversion rate reduction. We also study the consequences of a large and salient regulatory reform but focus on the demand for retirement saving during the accumulation phase rather than the choice at retirement between cash-out and annuities. This is particularly relevant, given that many countries like the US, Germany or the UK, have deferred annuity products. We confirm a significant price elasticity of annuity demand. We also find an anticipation effect whose size is even stronger than the one found in Büttler, Staubli and Zito, presumably because opening a saving contract is easier than postponing one's retirement date. Our results are also linked the expanding literature on the behavioural factors that discourage savers from purchasing annuities. Some articles have shown that the demand is sensitive to how the choices are framed (e.g. Beshears et al., 2014), to the default choice (Büttler and Teppa, 2007), or to the complexity of the annuity choice (Brown et al. 2017). We contribute to this literature by investigating a real case study in which many savers were wrong about the true effects of a reform impacting annuity rates and subscribed a contract despite having no special interest to do so.

The article is structured as follows. Section 2 describes the French pension system, examines the effects of the 2007 reform for savers and presents the database. Section 3 investigates pre-reform anticipation effects on demand. Section 4 assesses the effects of lower conversion rates on new subscriptions. Section 5 looks at the impact on contributions in saving accounts. Section 6 concludes.

2 French background and the 2007 reform

2.1 French background

The French pension system is a three-pillar system with a first pay-as-you-go pillar covering most pension expenditures and two funded pillars, one occupational, the other personal. Contributions in the second and third pillars represented in 2013 4.3% of first pillar contributions, and 2.2% of total pension benefits during retirement (Laborde, 2015). Annuities paid in proportion to last earned income remain low due to insufficient contributions (Direr and Roger, 2011).

The main financial products sold in the last pillar are deferred annuities which bundle a saving product and an annuity contract together. Contrary to immediate annuities which are exchanged against a lump sum of capital, saving is first accumulated during working life before being converted into an annuity at retirement. Contributions are tax-favoured during the accumulation phase, then annuity income is subject to the regular personal income tax during the distribution phase. In 2014, 7 million individuals held those products. Some products are specifically designed to civil servants (Préfon Retraite), wage-earners (Plan d'Épargne Retraite Populaire) or self-employed (Madelin contracts). Self employed population invests more in retirement savings than wage-earners due to lower public pensions. Contributions by this occupational category added up to 2.6 billion euros in 2014, with 1 million contracts in the accumulation phase and an average yearly contribution of 2600 euros per contract.

The present study focuses on Madelin contracts. Created in 1994, they are tax-deductible personal pension savings vehicle with a guaranteed deferred annuity. They start by an accumulation phase during which withdrawals are forbidden, except in exceptional cases (long-term unemployment, personal bankruptcy or permanent disability). Contributions are deductible from taxable benefit and saving is allocated among a menu of mutual funds proposed by the insurer. Accumulated wealth is then fully converted into a lifelong nominal annuity at retirement age, with a requirement to annuitise by age 75. French self-employed workers are on average richer than the general population. They are however more representative of the subpopulation of annuity holders as 50% of them hold a retirement saving contract against only 8% of wage

earners.

Conversion rates of capital into annuities are regulated. The annuity is calculated so as saver's capital at retirement is equal to the expected actuarial sum of annuities weighted by survival probabilities at each age. The formula which relates the annuity rate to a mortality table and a discounting rate is presented in Appendix 1. At the time of subscription, insurers guarantee a mortality table and a minimum interest rate to savers. Mortality tables are enforced by government law. They are periodically updated with the latest revisions dating back to 1985, 1993, 2007 and 2013. Since the 2000s, the interest rate assumed by insurers to discount future flows (see Appendix 1) varies between 0 and 2.5%, depending on the contracts. It is equal to 1.5% for the contracts in our dataset.

In 2006, the government, led by a European directive, issued a decree forcing insurers to price annuities separately for men and women. In March 2011, the European Court of Justice unexpectedly ruled that it would, in future, be unlawful for European Union member states to use gender as a factor in the calculation of insurance premiums and benefits with effect two years later. This led to a new regulatory reform implemented in 2013. This article focuses on the consequences of the 2007 reform. The 2011 regulatory reversal is unlikely to bias our estimates since it came as a complete surprise for savers and even professionals in the market. The assumed interest rate may vary across contracts and periods but cannot be changed after subscription. It was the same for all contracts in our data, whatever the subscription year, so that the only exogenous change affecting the annuity rate around the 2007 period is the update of mortality tables.

2.2 The 2007 reform

In summer 2006, the government published new prospective mortality tables called TH05 differentiated by birth year and sex (TGH05 for men and TGF05 for women), to replace previous gender-neutral tables TPRV93 from 2007 onward. The new tables only apply to contracts signed after this date. Plans subscribed before 2007 retained the benefit of previous tables. Fig. 1 shows annuity rates before and after the 2007 reform for female subscribers with respect to birth year.

<Insert Fig. 1>

Rates are decreasing with birth year for both tables as younger generations are expected to live longer than older ones.¹ Annuity contracts are much less attractive for women with new tables TGF05 than with older ones TPRV93. For example, cohorts born in 1950 benefited from

¹As the distribution period is extended, insurers lower annuity payout so as to maintain the actuarial equality between capital and the expected discounted sum of annuities, see Appendix 1.

a conversion rate of 5% before the reform and 4.5% with new tables, representing a 10% fall of annuity for a given amount of capital. The price rise has two causes: increasing longevity and the fact that annuity prices become solely based on female survivorship rates. Fig. 2 shows the same graphic for men.

<Insert Fig. 2>

Contrary to women, the reform is approximately neutral to men. This comes from the coexistence of two opposite effects of similar magnitude. On the one hand, previous tables TPRV93 were unisex, whereas new tables TGH05 are gender-specific and as a result more favourable to men since their statistical life expectancy is shorter. On the other hand, the new tables factor in improved longevity since the last time mortality was estimated, which reduces annuity rates.

The rates are valid for savers who will not opt for a joint and survivor annuity at retirement. The impact of the reform to joint-life annuities is less clear-cut. Compared to single life annuities, women benefit from a lesser reduction, whereas men are negatively affected by the reform. We have data, provided by the same insurer, about who chose a joint the survivor option at retirement (Table 1).

Table 1: joint-life annuity frequency by sex

%	no reversion	60% reversion	100% reversion
Men	46.6	16.2	37.2
Women	92.5	5.3	2.2

Source: insurer’s internal data. Sample: Madelin contracts. Example: 16.2% of male subscribers chose to convert their retirement plan with a 60% reversion to a secondary beneficiary.

More than one in two men chose to opt for a survivor annuity either at 60% or 100% while the vast majority of women did not. Since the option is taken at retirement and we have data on the accumulation phase, we cannot sort out savers who expect to take the option from those who do not. This is only a real issue for men as few women take the option in Table 1. It is handled by assuming that men who declared to be single in our data (unmarried, divorced or widowed) at the time of subscription did not expect to choose a joint survivor option. Regarding our identification strategy of reform’s effects, the saving choices of women will be investigated and the group of single men will be our control group.

2.3 Data

We use data recording nationwide sales of Madelin contracts from a large insurance company between March 2002 and April 2009. It contains 7,853 subscriptions with information about savers and contracts: sex, birth date, marital status, number of children, occupational category, district of living², subscription date, contributions and contribution dates.

Contributions in Madelin contracts are allocated among several mutual funds preselected by the company and a money-market fund. Mutual funds, mostly composed of equities, are risky. The money-market fund is composed of short-term debt and offers a risk-free rate of return. Our data indicates the share of wealth invested in risky mutual funds by policy owners at the end of each year.

We obtained an income index and a wealth index for customers in our dataset from the marketing department. The higher the index, the higher the estimated customer's income or wealth. We build from those indices two dummy variables, called high income profile and high wealth profile, which are equal to 1 if policy owner's index exceeds a conventional threshold so that approximately 10% of customers are classified as high income or high wealth respectively. The type of seller who distributed the contract is also recorded. It is either a general agent who sells all company's insurance products (home insurance, car insurance, ...) or a specialized agent who focuses on financial planning (retirement, financial advice and insurance planning) targeted to high income customers. Both types of seller are independent contractors with an exclusive mandate with the insurer.

The implementation date to the new tables was set by government decree to January 1st 2007. Some insurers delayed however their application to new contracts by a few months for sales promotion. The insurer which provides us with the data switched to the new tables on March 1st 2007. Even for savers who subscribed before this date, previous tables are only guaranteed to plans converted into annuities before December 31st 2030. As most subscribers convert their plan before age 65, all savers born after 1965 are discarded from the data.

We observe all contributions made between January 2002 and February 2009 in plans still in the accumulation phase in 2009. Contribution frequency varies from one subscriber to another. Some contributed every month, others quarterly or annually. Contributions are annualized by aggregating infra-annual contributions starting from the first month of subscription.³

Table 2 shows summary statistics by subscription years.

²The French territory is divided into 101 administrative units called départements.

³The first contribution may start one or two months after the subscription. The relevant date for the mortality tables is the subscription date, not the date of the first contribution. Thus, a saver opening a plan in February 2007 and making a first contribution in April 2007 still benefits from old tables. Her first annual contribution aggregates all contributions recorded between April 2007 and March 2008.

<Insert Table 2>

The Table shows interesting raw results. Annual subscriptions reached a peak in 2006, just before the policy change. It represented 2.5 times the average number of sales recorded between 2003 and 2005 and 2.4 times that observed in 2007. The share of women was stable around 35% before the policy change then dropped to 28% two years after the reform, which may be attributable to reform's negative effects to new female subscribers. Contributions were steadily increasing between 2003 and 2007. We will show in Section 5 that the trend was smooth around the reform date both for impacted and non-impacted populations.

The next two sections examine the extent to which the policy change affected subscriptions. Section 3 investigates the anticipation effects before the reform and Section 4 studies the post-reform price effect.

3 Reform's anticipation effects

Fig. 3 documents how strong was the anticipation effect created by the reform. Subscriptions are merged by six month periods and separates women from single men. Contract sales are normalized to 100 the first half of 2006, which is the last semester before the reform took effect. The vertical line indicates the date of the reform.

<Insert Fig. 3>

The last six months of 2006 are characterized by a six-fold increase in female subscriptions and a seven-fold increase in male subscriptions compared to the first six months of the same year.⁴ Over this period, the insurer sold the equivalent of three years of normal time subscriptions. This represents a net demand rather than a sales displacement. The periods just before and after the peak did not appear to suffer from a trough of sales. Rather, it seems that the imminent implementation of the reform convinced new customers to take out a savings plan.

We conclude that the reform's announcement opened a "sales period", during which a product is temporarily sold at a discount. The same phenomenon is observed in other retail industries, although its size is unusual. One explanation lies in the way insurance contracts are sold. Madelin contracts are distributed by insurance agents who sell multiple contracts to their customers (home insurance, car insurance, death insurance, ...) and are in a long-term contracting relation with them. As a result, they have a full list of readily contactable customers. They also efficiently prospect their customer base as they know who are self-employed, and therefore

⁴778 contracts were sold to women the last six months, against 131 the previous semester. 512 contracts were sold to single men against 73 the previous six months.

eligible to the sales promotion, and who did not already subscribe a contract. Their easy access to a well targeted list of potential purchasers with whom they already contracted in the past is a powerful marketing leverage that may explain a large part of the sales peak.

Outside the peak, sales remained approximately stable apart from a seasonal increase the second half of each year by about 50%. 2008 subscriptions seems not to have been affected by the concomitant financial crisis, presumably because saving can be invested in riskless assets with a minimal rate of return guaranteed by the insurer (see Appendix 1).⁵

The female peak can be simply explained by the reform. We saw indeed in Section 2 that women benefited from more favourable annuity rates by subscribing before march 2007. The male peak is more difficult to rationalize since the reform hardly affected them. Given that the increase in demand was mainly a net demand, it appears that a large number of male investors would have not subscribed absent a reform. It seems that men have been confused by the actual effects of the reform and that the differential treatment of the two sexes has been widely overlooked.

To further investigate the nature of the peak, we test two plausible scenarios, a demand side effect and a supply side effect. According to the first scenario, more informed women, but less informed men, should have disproportionately participated to the peak. We presume that the richest individuals, upper-class occupations, or those who live in the wealthiest residential areas are better informed. Consistent with an offer effect, more informed sellers should be associated with more women and less men participating to the peak. Insurance agents specialized in financial planning have a priori a better knowledge of regulatory constraints than general insurance agents. To test those scenarios, we estimate an OLS model over an 18 month period, from March 2006 to August 2007. The explained variable PEAK is a binary variable equal to 1 if a saver subscribed during the six month peak and 0 if the subscription took place six months before or after that period. We separately regress for men and women on a series of explanatory variables listed in Table 3.

<Insert Table 3>

The demand side story is not validated by the results. The richest or wealthiest, business managers and executives, or inhabitants in the richest residential areas participated to the peak in the same proportion than other populations. One exception is female owners of mutual funds, presumably more knowledgeable about financial markets. Yet, contrary to the intuition, male mutual funds owners also disproportionately subscribed during the peak.

⁵Table 2 shows however a drop in the share of saving invested by policyholders in risky mutual funds.

Although not the one which was expected, an interpretation involving the supply side emerges from the results. Insurance agents specialized in financial planning did attract more female customers than general insurance agents during the peak but also more male savers. On the one hand, they probably were better aware than general insurance agents of the imminence of the reform and rightly alerted their female clientele in greater proportion. On the other hand, they seemed to disproportionately misreport the impact of the reform to men, either by ignorance about its gender specific details, or due to commercial incentives. The relative stability of the composition of savers by socio-demographic characteristics during the peak is consistent with the indiscriminate sales to the whole population.

4 Reform effects on new subscriptions

The analysis of the reform shows that the annuity rate of women who subscribed after the reform was reduced by about 10% compared to women who subscribed before it. We investigate whether the reform discouraged female savers from subscribing a plan by comparing pre and post reform subscription by women after controlling temporal effects by using single men subscriptions.

A methodological clarification is first necessary. The sales peak presented in the previous section raises questions about the quality of the control group. We observed that single men massively subscribed right before the reform as women did, which reveals a confusion about the reform's differential impact on men and women. However, one may argue that while savers may be easily mistaken by reforms' consequences before it took effect, errors are unlikely after its implementation. The misinformation problem is critical before the reform since savers cannot easily know in advance what would have been their rate if they had waited a few additional months. Because the effects of the reform are complex to understand, most of them relied on sellers' information, which proved to be imperfect. On the contrary, once the reform is implemented, their annuity rate is perfectly known. It is the rate guaranteed by the insurer at subscription and written in the contract's general terms and conditions.

One might also fear that the sales peak dried up the market for several years, leading to a persistent depressed demand after the reform. A trough of sales after the peak cannot however be detected in Fig. 3. Moreover, since the male peak was proportionately as important as the female one, this effect is also controlled by the evolution of the male demand. In other words, if a displacement effect biased down our estimate of the impact of the reform on sales to women, it also biased in a similar way sales to single men. From a methodological point of view, the fact that single men participated to the peak improves the ability of this group to control for confounding factors after the reform.

Fig. 4 shows the evolution of the ratio of new subscriptions by women to new subscriptions by single men.

<Insert Fig. 4>

The ratio remained approximately flat from 2003 to 2006, then declined after the implementation date indicated by a vertical bar, in accordance with a substantial effect of the reform on female demand. The impact is estimated by an OLS regression which controls for a large set of characteristics:

$$AFTER_i = f(\beta_0 + \beta_1 WOMEN_i + X_i\beta_2 + \epsilon_i)$$

where $AFTER_i$ equals 1 if subscription i took place after the reform, from March 2007 to February 2009, and 0 before the reform, from March 2004 to February 2009. X_i is a vector of covariates described in Sub-section 2.3 and presented in Table 2. Our sample is restricted to women and single men. The variable of interest β_1 measures to what extent female subscriptions deviated from single men subscriptions after the reform. Table 4 shows the results for three models. In model (1) the dummy $AFTER$ is regressed on $WOMEN$ without any control variables. Model (2) adds a full set of covariates. One might worry that a six-fold increase in demand during a short period of time may bias our estimates. This is why the robustness of our results are checked in model (3) in which the six-month period of the peak has been removed.

<Insert Table 4>

In all three models and in accordance with visual impression from Fig. 4, the $WOMEN$ estimator is significantly negative at the 1% threshold. The marginal effect of $WOMEN$ measures by how much the female share varies due to the reform. It is equal to -8.16% in model (1), -10.02% in model (2) and -13.15% in model (3). Taking the average share of women in the studied population after the reform as a reference, which was 62.3%, variation rates in female demand in models (2) and (3) are respectively $-0.1/0.623 = -16\%$ and $-0.13/0.623 = -20.9\%$. With a 10% increase in annuity price, price elasticities are $-16/10 = -1.6$ and $-20.9/10 = -2.1$. In both cases, the quantitative impact of the reform on annuity demand was quite significant.

5 Reform's effects on contributions

Did the policy change also impact how much savers contributed into their plan? We exploit the asymmetric effects of the reform for women and single men to estimate the impact on contributions. We use a difference-in-difference approach with a treated group (women) and a control group (single men). We however do not follow a cohort of subscribers before and after

the reform as women who subscribed before the reform retained the benefit of the old tables afterwards. Instead, we compare the contributions of subscribers who opened a plan before and after the reform. The method allows us to control for time effects (contributions are compared the same dates), but not for cohort effects. The latter are controlled by the inclusion in the regressions of demographic, geographic, socio-occupational variables, and by income and wealth indices.

We may wonder to what extent anticipation effects documented in Section 3 might bias the reform’s estimated impact on contributions. A bias could arise if unobserved variables are correlated with the propensity to contribute and the decision to subscribe before the reform. For example, if wealthier savers subscribed earlier due to better information, the reform’s impact on contributions could be biased down. To this regard, single men seem to adequately control for anticipation effects. This group experienced a subscription peak at the same time and of similar magnitude than women. This suggests that potential unobserved effects driving the anticipation effect affected women and single men the same way. This impression is reinforced by Section 4’s results which show that sales composition was not significantly altered during the peak both for women and men (see Table 3). Moreover, two major factors of the peak, subscribing with an agent specialized in financial planning and investing in mutual shares, affected in a similar way the two sexes.

The validity of the difference in difference methodology is based on the parallel trend assumption according to which contributions from the treated and control groups would have followed a common trend, had there been no reform. This assumption can be tested on years preceding the reform. If the 2007 reform is the unique event that differentially impacted the saving decisions of the two groups, a parallel trend in savings should be observed before 2007. Fig. 5 plots average contributions the first year of the contract by women and single men for every subscription year over the period 2002 to 2007.

<Insert Fig. 5>

The parallelism of contributions during years prior to the reform is graphically verified. Men’s contributions seem to control for women’s contributions in the absence of identified events differently affecting the two sexes. Statistical tests reported in Appendix 2 confirm the parallel trend assumption. Fig. 5 also shows that the difference remains approximately constant after the reform, suggesting that regulatory changes did not produce a significant impact on contributions. To test the absence of effect, we estimate contributions between March 2002 and February 2008 using the OLS model:

$$V_i = \beta_0 + \beta_1 AFTER_i + \beta_2 WOMEN_i + \beta_3 AFTER_i \times WOMEN_i + \beta_4 D_i + X_i \beta_5 + \epsilon_i \quad (1)$$

where V_i denotes subscriber i 's log of annual contribution, $AFTER_i$ equals 1 if subscription took place between March 2007 and February 2008, 0 before and $WOMEN_i$ is equal to 1 for female policyholders and 0 for male ones. The cross-dummy variable $AFTER_i \times WOMEN_i$ equals 1 if the contribution is made by a woman after the reform and 0 otherwise. Its coefficient measures the impact of the reform on contributions. The D_i are temporal dummies which cover annual periods from March to next year February over the period 2002 to 2006. X_i includes covariates described in Sub-section 2.3.

<Insert Table 5>

Table 5 presents two sets of regression, one with control variables limited to temporal dummies, and another one with all control variables. In both models women contribute significantly less than single men. The two groups contribute more after the reform than before but the difference is not statistically different across groups. Hence it is not possible to discern any controlled impact on female contributions.

Other explanatory variables have the expected sign. In the full model, contributions increase with age. Upper occupational categories (business managers, executives and independent professions) contribute more than other occupations, and so do high incomes and high wealths. Customers who live in Paris or its posh suburbs and those who subscribed a plan with an insurance agents specialized in financial planning contribute more as well. High proportions of wealth invested in risky mutual funds have no statistical impact on contributions.

6 Conclusion

Annuities are special saving products. They address the financial planning needs of people approaching retirement by protecting against the risk of outliving one's assets. It is therefore of prime interest to study to what extent higher prices deter savers from purchasing life annuities. This study exploits the asymmetric effects on annuity prices of a French regulatory reform to estimate the impact on the demand for retirement savings. Three margins of behavioural responses are distinguished: anticipation effects created by the brief opportunity of benefiting from old annuity rates, post-reform effects on subscriptions and contributions.

A powerful increase in demand just before the reform is evidenced. Subscriptions were six times higher over a six month period. A significant effect on subscriptions after the reform is also highlighted by comparing female subscriptions, affected by the reform and subscriptions by single men, not concerned by it insofar as they did not expect to take the joint survivor option. We find a large annuity price elasticity of -1.6.

While the reform was anticipated by a large number of investors, contributions in saving accounts remained stable the first year after the reform. Hence the drop in annuity rate has not been offset by more saving, at least in the short-run. Savers are therefore likely to benefit from lower annuity income at retirement.

Overall, the reform had lasting positive effects on the number of subscriptions. Due to strong anticipation effects, the post-reform reduction in demand was more than offset by the initial strong increase the six months preceding its implementation. Assuming that the demand is permanently 10% lower than what it would have been absent the reform, post-reform effects would cancel out the initial peak sales only after 20 years of depressed demand.

The overall positive effect of the reform is largely based on excess demand by men, which represents two thirds of total demand. Yet, a close inspection of the reform reveals that men had no clear interest in subscribing before the reform. This puzzle reinforces the idea that annuity contracts are complex products poorly understood by investors (Brown, 2009; Brown et al. 2012). Understanding the benefits of lifelong annuities involve knowledge about capital markets, mortality tables, and the regulatory framework that most savers lack. This study also highlights the ambiguous role of the supply side. Insurance agents specialized in financial planning were more likely than general insurance agents to persuade new customers before the regulatory reform but did not discriminate enough between men and women.

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APPENDICES

Appendix 1: The annuity pricing formula in the French market

The way insurers determine annuity rates is regulated in the French market. At the time of conversion, the annuity is computed such that, given a mortality table and an assumed interest rate, wealth is fully redistributed in expectation to annuitants over their remaining life:

$$W = \sum_{t=0}^T \frac{p_t A}{(1+r)^t}$$

with A the annuity payout amount, W capital at the time of conversion, p_t the probability of being still alive in t periods, and r the interest rate assumed by the insurer to discount future annuities. The resulting annuity rate is:

$$\frac{A}{W} = \left(\sum_{t=0}^T \frac{p_t}{(1+r)^t} \right)^{-1}$$

which is decreasing with survival rates p_t and increasing with assumed interest rate r .

An important feature of the French regulatory framework is that the annuity rate is a minimal rate guaranteed at the time of subscription. It cannot be reduced over the course of the contract in case of financial underperformance (a realized rate below the assumed rate r) or if annuitants' live longer than what mortality tables anticipated. Insurers protect themselves against those downside risks by assuming from the start a low assumed interest rate and by using regulatory tables which are to some extent optimistic about savers' longevity. Conversely, all financial gains coming from above expectation return or below expectation longevity must be redistributed to subscribers within a delay of eight years through higher annuities. Insurers make a profit by charging fees similar to fees in mutual funds (front-end loads and investment management fees). They also levy mortality and expense fees during the distribution phase.

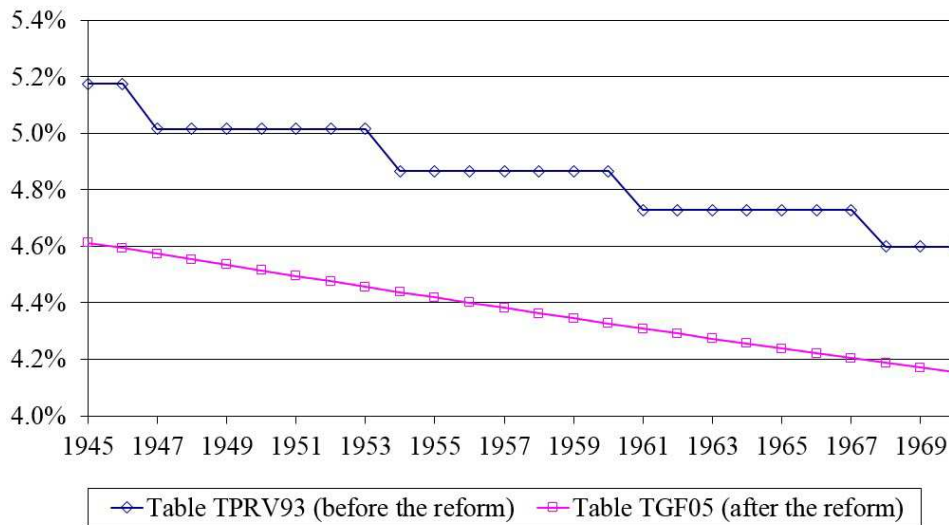
Appendix 2: Formal test of the parallel trend assumption

The parallel trend assumption is tested by a placebo strategy, which consists in replicating Section 5's difference in difference procedure, but shifted backward at a time when no known event has distinctly affected women's and single men's situation. Our data starting in 2002, the econometric test presented in Eq. 1 can be replicated four times back in the past. Table 6 shows the regression results.

<Insert Table 6>

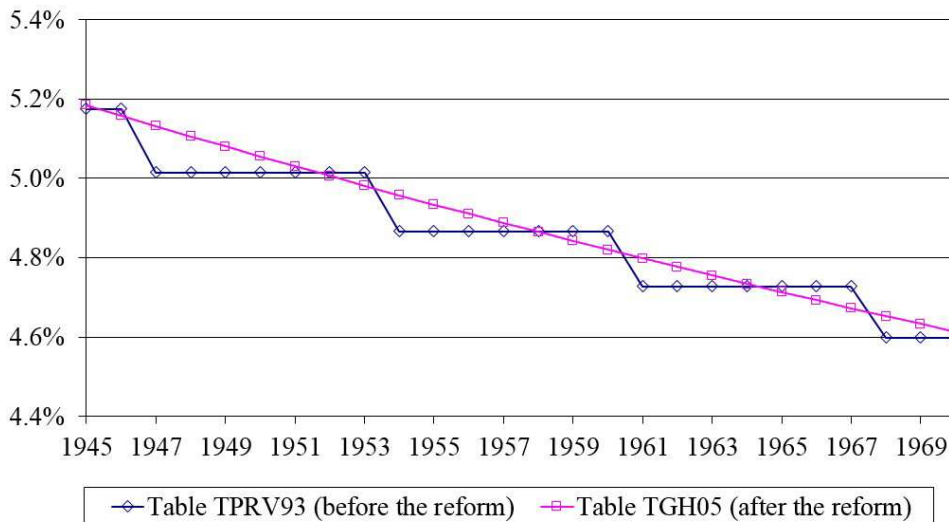
Estimates of the variable of interest $AFTER \times WOMEN$ are not significant even at the 10% threshold for all subperiods. The parallel trend assumption in absence of differential treatment is therefore supported by our data.

Fig. 1. Female annuity rates by birth year in mortality tables TPRV93 and TGF05



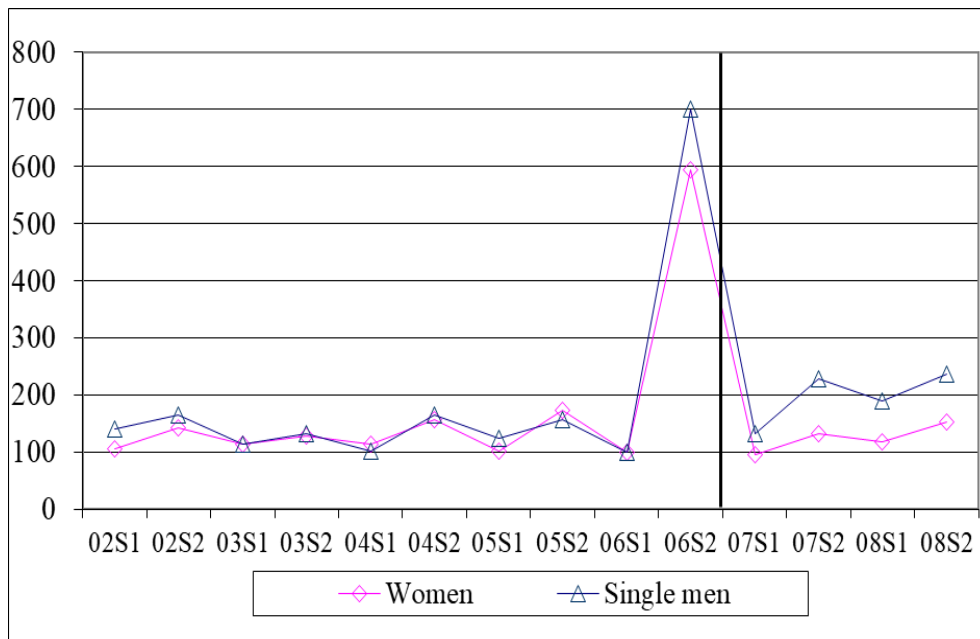
Note: the annuity rate is the annuity payout in proportion to accumulated wealth at the time of conversion. Table TPRV93 applied to female policy owners before 2007, and Tables TGF05 after 2007. Calculation hypotheses: saving plan's conversion at 65 y.o. ; assumed interest rate of 1.5% ; no reversion to the surviving spouse.

Fig. 2. Male annuity rates by birth year in mortality tables TPRV93 and TGH05



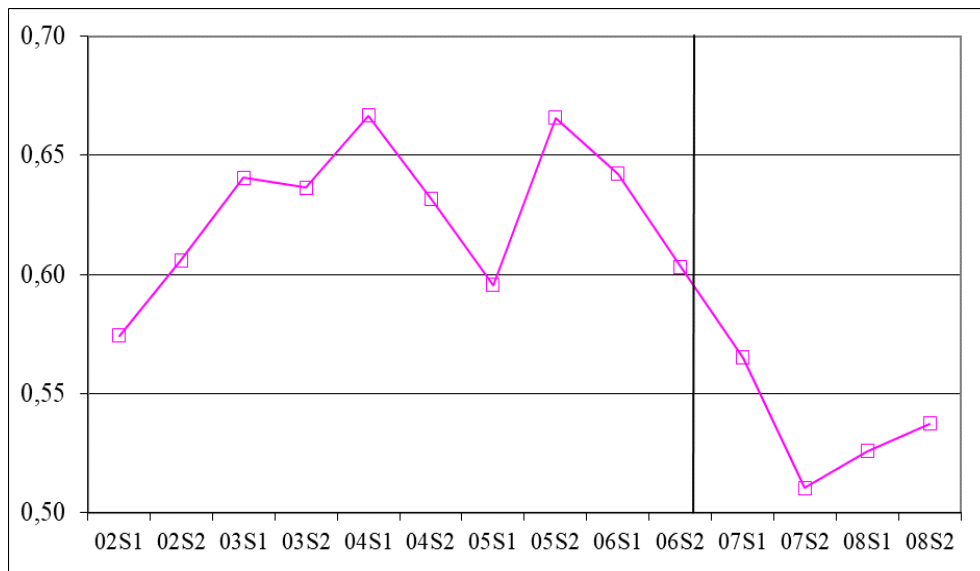
Note: Table TPRV93 applied to men before 2007, TGH05 after 2007. Calculation hypotheses: conversion at 65 y.o.; assumed interest rate of 1.5% ; no reversion to the surviving spouse.

Fig. 3. Six-month subscriptions, index base 100: first half of 2006 (06S1)



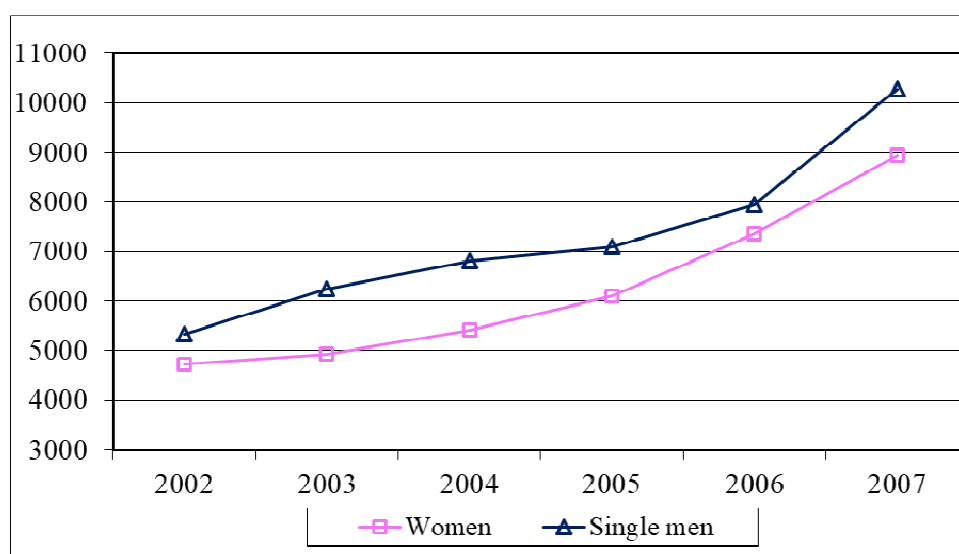
Note: The first half of the year starts in March, so that the first half of 2007 starts the first month of implementation of the new tables. Hence, the period 02S1 aggregates subscriptions from March 2002 to August 2002, 02S2 from September 2002 to February 2003, etc. The number of subscriptions is normalized to 100 the first half of 2006 (06S1). The vertical line indicates the implementation date of the new tables.

Fig. 4. Subscription ratio of women to single men, semi-annual frequency



Note: The graphic plots the ratio of female subscriptions to single men's subscriptions. Men in couple and subscribers whose family situation is not recorded are excluded (13% of male and female subscribers). Semester 02S1 aggregates subscriptions from March to August 2002, 02S2 from September 2002 to February 2003, etc. The vertical line indicates the implementation date of new tables.

Fig. 5. Average contributions every first year of subscription



Note: A year n goes from March n to February $n+1$. Contributions in saving accounts are annualized to eliminate infra-annual fluctuations and differences in timing of contributions.

Table 2. Summary statistics of the dataset

	2003-5	2006	2007	2008
Number of subscriptions	3023	2536	1054	1240
Women share	0.341	0.358	0.283	0.285
Average annual contribution (euros)	6067	7718	9213	-
Share of couples (married or in a relationship)	0.585	0.569	0.533	0.527
Mean age	48.3	49.5	50.4	51.0
Share of savers with children	0.344	0.320	0.328	0.325
Share of small businesses (craftsmen, shopkeepers, ...)	0.141	0.110	0.172	0.159
Share of independent professions (doctors, lawyers, ...)	0.713	0.733	0.581	0.561
Share of business managers and executives	0.075	0.068	0.114	0.125
Share of high incomes	0.086	0.100	0.092	0.068
Share of high wealths	0.090	0.134	0.093	0.113
Proportion invested in mutual funds (MF)	0.362	0.437	0.435	0.300
Share investing more than 50% in MF	0.334	0.420	0.391	0.203
Share who subscribed with specialized agents	0.601	0.788	0.626	0.640
Share living in Paris, Yvelines or Hauts de Seine	0.175	0.207	0.189	0.157

Note: A year goes from March n to February $n+1$. For compactness, the period 2003-5 aggregates three years of subscriptions and goes from March 2003 to February 2006. Contributions being aggregated on an annual basis, complete contributions are not available for subscribers between March 2008 and February 2009.

Covariates: High incomes and high wealths are binary variables constructed from segmentation indices used by the marketing department. Mutual funds are risky funds invested in financial markets available within savings accounts. Specialized agents are insurance general agents specialized in financial planning, as opposed to general agents who sell all company 's insurance products. Yvelines and Hauts de Seine are Paris's richest suburbs.

Table 3. Regression of subscribing during the peak vs. before or after the peak for men and women separately (OLS model)

Dependent variable : 1 if subscription took place during the six-month peak (from September 2006 to February 2007) and 0 before (from March 2006 to August 2006) or after the peak (from March 2007 to August 2007)		
	Women	Men
Age	-0.00432 (0.1133)	-0.00503** (0.0162)
In couple (married or in a relationship)	<i>ref</i>	<i>ref</i>
Single (never married, divorced or widow)	0.02620 (0.4042)	-0.02999 (0.2575)
Other marital situation or not recorded	-0.06783 (0.1346)	-0.08052** (0.0279)
With children	0.06809** (0.0317)	-0.00357 (0.8876)
Small businesses (craftsmen, shopkeepers, ...)	<i>ref</i>	<i>ref</i>
Independent professions (doctors, lawyers, ...)	0.08192 (0.1194)	0.06816** (0.0328)
Business managers and executives	-0.07648 (0.4085)	0.00141 (0.9734)
Other (employees, farmers, unemployed, inactive, retirees)	0.06944 (0.2806)	0.03474 (0.4238)
High income profile	-0.01263 (0.7983)	-0.01728 (0.6556)
High wealth profile	-0.02694 (0.5090)	-0.02732 (0.3860)
Share invested in mutual funds	0.14286** (0.0269)	0.17806*** (0.0002)
Contract sold by insurance agents	<i>ref</i>	<i>ref</i>
Sold by specialized insurance agents	0.187543*** (1.65e-06)	0.16142*** (2.69e-09)
Live in Paris, Yvelines or Hauts de Seine	0.005972 (0.8662)	0.01141 (0.7076)
Number of observations	1035	1894
R2	0.0538	0.0473

Standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1

Sample: subscriptions by sex from March 2006 to August 2007.

Note: the estimator of the constant is not reported.

Covariates: "High income" and "high wealth" profiles are binary variables constructed from segmentation indices used by the company's marketing department. Mutual funds are risky funds invested in financial markets available within savings accounts. Specialized agents are insurance general agents specialized in financial planning, as opposed to general agents who sell all company's insurance products. Yvelines and Hauts de Seine are Paris's richest suburbs.

Table 4. OLS regression of subscribing after vs. before the reform date

Dependent variable: AFTER equals 1 if subscription took place after the reform (from March 2007 to February 2009) and 0 before (from March 2004 to February 2007)			
	With subscriptions during the peak		Without the peak
	model (1)	model (2)	model (3)
WOMEN	-0.08164*** (9.75e-08)	-0.0915*** (2.75e-05)	-0.1202*** (2.65e-05)
Small businesses (craftsmen, shopkeepers, ...)		<i>ref</i>	<i>ref</i>
Independent professions (doctors, lawyers, ...)		-0.1119*** (1.38e-05)	-0.13553*** (3.39e-05)
Business managers and executives		0.0696* (0.08241)	0.04408 (0.37323)
Other (employees, farmers, unemployed, inactive, retirees)		0.0460 (0.17572)	0.11833*** (0.00682)
High income profile		-0.04106 (0.12882)	-0.04605 (0.21180)
High wealth profile		0.00629 (0.78537)	0.01009 (0.74548)
Share invested in mutual funds = 0 %		<i>ref</i>	<i>ref</i>
Share invested > 0 and < 50%		-0.26204*** (< 2e-16)	-0.19766*** (1.24e-12)
Share invested >= 50%		-0.32641*** (< 2e-16)	-0.25904*** (< 2e-16)
Contract sold by an insurance agent		<i>ref</i>	<i>ref</i>
Sold by a specialized insurance agent		-0.02343 (0.27535)	0.07131*** (0.00780)
Number of observations	3835	3835	2545
R2	0.00738	0.0963	0.0975

Standard errors in parentheses and % marginal effect (only reported for WOMEN) in brackets ;
 *** p<0.01, ** p<0.05, * p<0.1

Sample: subscriptions by women and single men between March 2004 and February 2009.

Note: constant's estimator is not reported. Model (1): univariate analysis of being a woman on subscribing after the reform; model (2): full multivariate model of subscribing after the reform; model (3): multivariate model where subscriptions during the peak (from September 2006 to February 2007) are removed. Covariates included in the analysis but not shown in the table are: in couple (married or in a relationship), single (never married, divorced or widow), other marital situation or not recorded, with children, live in Paris, or its richest suburbs, log of annualized contribution. "High income" and "high wealth" are binary variables constructed from segmentation indices used by the marketing department. Mutual funds are risky funds invested in financial markets available within savings accounts. Specialized agents are insurance general agents specialized in financial planning, as opposed to general agents who sell all company's insurance products.

Table 5. OLS regression of log of contribution over 2002-2008

Dependent variable: log of annualized contribution the first 12 months after subscribing		
	model (1)	model (2)
Constant	8.0570*** (0.0487)	7.694*** (0.0906)
AFTER (March 2007 to Feb. 2008)	0.3519*** (0.0802)	0.1846** (0.0799)
WOMEN	-0.1344*** (0.0352)	-0.1114** (0.0479)
AFTER×WOMEN	-0.0802 (0.0941)	-0.0567 (0.0913)
2002	<i>ref</i>	<i>ref</i>
2003	-0.0534 (0.0640)	-0.0983 (0.0621)
2004	0.1172* (0.0623)	0.0240 (0.0619)
2005	0.1477 (0.0619)	0.0000 (0.0632)
2006	0.0992 (0.0515)	-0.0496 (0.0538)
Age < 46		<i>ref</i>
Age 46-50		0.1235*** (0.0377)
Age 51-55		0.3625*** (0.0449)
Age 56-60		0.6685*** (0.1658)
Age > 60		0.5354*** (0.1658)
In couple (married or in a relationship)		<i>ref</i>
Single (never married, divorced or widow)		-0.0148 (0.0458)
Other marital situation or not recorded		0.1673*** (0.0643)
With children		-0.324 (0.0405)
Small businesses (craftsmen, shopkeepers, ...)		<i>ref</i>
Independent professions (doctors, lawyers, ...)		0.1751*** (0.0547)
Business managers and executives		0.3670*** (0.0896)
Other (employees, farmers, unemployed, inactive, retirees)		0.0713 (0.0755)
High income profile		0.2097*** (0.0581)
High wealth profile		0.2862*** (0.0522)
Share invested in mutual funds = 0 %		<i>ref</i>
Share invested > 0 and < 50%		-0.0749 (0.0522)
Share invested >= 50%		0.0278 (0.0561)
Contract sold by an insurance agents		<i>ref</i>
Sold by a specialized insurance agents		0.1050** (0.0433)
Live in Paris, Yvelines or Hauts de Seine		0.1183*** (0.0424)
Number of observations	4214	4214
R2	0.01486	0.08212

Standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1

Sample: subscriptions by women and single men between March 2002 and February 2008.

Note: AFTER is equal to 1 if subscription took place after the reform (between March 2007 and February 2008), and 0 otherwise.

Covariates: "High income" and "high wealth" are binary variables constructed from segmentation indices used by the marketing department. Mutual funds are risky funds invested in financial markets available within savings accounts. Specialized agents are insurance general agents specialized in financial planning, as opposed to general agents who sell all company's insurance products. Yvelines and Hauts de Seine are Paris's richest suburbs.

Table 6. Least ordinary square regressions of log of contribution for various sub-periods

Dependent variable: log of annualized contribution the first year of subscription					
	2003-2008	2004-2008	2005-2008	2006-2008	2007-2008
AFTER	0.1415* (0.0833)	0.1341* (0.0759)	0.0997 (0.0731)	-0.1136 (0.0721)	0.1846** (0.0799)
WOMEN	-0.1374 (0.0933)	-0.1447** (0.0719)	-0.1779*** (0.0614)	-0.1541*** (0.0556)	-0.1114** (0.0479)
AFTER×WOMEN	0.0212 (0.0932)	0.0343 (0.0733)	0.0955 (0.0654)	0.0723 (0.0633)	-0.0567 (0.0913)
# of observations	4214	4214	4214	4214	4214

Standard errors in parentheses ; *** p<0.01, ** p<0.05, * p<0.1

Sample: subscriptions by women and single men between March 2002 and February 2008.

Note : regressions duplicate model (2) in Table 5 except that the reform date is artificially shifted to the past. The first column covers the largest interval of time for the dummy variable AFTER covering the period from March 2003 to February 2008. The pre-reform period is as a result limited to March 2002 - February 2003. For the second column 2004-2008, the post-reform period goes from March 2004 to February 2008 and the pre-reform period from March 2002 to February 2004, and so on. AFTER×WOMAN is equal to 1 if the contract is signed by a woman after the reform. For strict comparison with the baseline case presented in Table 5, log annualized contributions are observed only the first year after subscription. Control variables, not reproduced, are identical to those used in Table 6: age and year dummies, marital status, presence of children, occupational category, income and wealth profiles, mutual funds holding, distribution channel, and residence.