How Price Elastic is the Demand

for Retirement Saving? *

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Abstract

An administrative dataset of a big insurance company is exploited to assess the effects on annuity demand from a French regulatory reform which impacted actuarial return to deferred life annuity products. Female savers whose conversion rate of capital into annuities fell by 10% are distinguished from men in couple whose conversion rate was reduced by 5% if they expected to opt for a joint and survivor annuity at retirement, and single men not affected by the reform insofar as they did not expect to take the survivor option. Once controlled by the evolution of single men, we find a decrease in demand by women and men in couple of -16% and -12% respectively with corresponding price elasticities of subscriptions of -1.5 and -2.5. The reform did not significantly alter payments in saving accounts conditional on subscribing. We also document a very large anticipation effect created by the opportunity given to early subscribers to benefit from older pricing.

J.E.L. codes : D8, E21

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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 an annuity until the death of the insured. Longer lifespan at old age makes the stream of guaranteed income payments more costly to insurers which raise annuity prices to preserve their solvency. Insurance companies adjust annuity prices by revising either the assumed interest rate (the rate they expect to obtain when they invest premiums in financial markets) or the mortality tables they use to convert wealth into a flow of annuities. In France, regulatory survival probabilities have been revised upwards several times since the 1980s which resulted in a significant decrease of conversion rates (annuity payouts in proportion to capital at the date of conversion). The resulting rise of the annuity price (the inverse of the conversion rate) may be illustrated in a telling manner by the experience of a French man born in 1952. His conversion rate was reduced from 7% before 1985 to 5% in 2007 and 4.5 % in 2013, representing an overall 35% decrease. This drop affects a given generation and is entirely driven by successive upward revisions of its longevity. It would be even larger if generations of different birthdates had been compared.

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 is 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 many questions about savers' reaction. Does it

mean a fall of the demand for annuity with worrying long-term consequences for living adequacy of retirees 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? Both reactions may be rational according to whether the price effect or the income effect dominates. Savers might also decide to stay away altogether from annuity products meaning a lack of insurance against longevity risk.

Answering these questions requires an estimate of the price elasticity of demand for annuity contracts. To do so, we investigate savers' response to a major reform of regulatory mortality tables which took place in France early 2007 and produced asymmetric effects on men and women. The reform was approximately neutral to men insofar as they did not expect to opt for a joint and survivor annuity, but reduced female conversion rate by about 10 %. As the decision of reversion is made at retirement and as a result not observed in our data, we identify men not expecting to opt for reversion with single men and use this population as a control group.

We exploit subscription data of a large insurer for retirement saving contracts targeted to self-employed workers over the 2003-2009 period. In addition to information on the number of monthly subscriptions and individual payments, 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 old mortality tables, women subscribed six times more contracts the last six months prior to the reform compared to normal time. More surprisingly, male subscriptions were multiplied by a similar factor in spite being much less impacted. We then isolate two populations affected by the reform: women whose conversion rate was down by 10% and men in couple (who are presumed to expect to opt for reversion at retirement) whose conversion rate was reduced by 5%. We find a 16% decrease of contracts sold to women and a 12% decrease to men in couple after controlling for

the evolution of sales to single men. Elasticities with respect to conversion rates are respectively -1.5 and -2.5. Last, we show that the reform did not significantly alter payments in saving accounts when controlling for demand by single men. Overall and paradoxically, the reform brought about a positive net effect on demand thanks to strong reform's anticipation effects.

Our results may be analyzed through the lens of economic theory. In standard consumption-saving models with uncertain longevity, competitive markets and time-separable intertemporal utility functions, the longevity risk is fully insured (i.e. consumption evolves smoothly over the life-cycle) if consumers fully annuitize their wealth. If longevity is revised upward during the saving phase, life-cycle consumption should be immediately reduced leading to more savings. This result is found empirically by articles which study the relation between life expectancy and aggregate savings (Kinugasa and Mason 2007, Miles 1999, Deaton and Paxson 2000 and Lee, Mason and Miller 2001). Yet, there are several reasons why this relationship may not hold in annuity markets. First, annuity prices do not continuously track changes in savers' average life expectations and are adjusted stepwise on an irregular basis.[1] Second, savers may misinterpret the increase in annuity prices. If they underweight (or ignore altogether) the longevity gains at the origin of the price increase, they may wrongly conclude that annuities yield insufficient return. Lowe (2014) remarks that annuities have become unpopular in United Kingdom due to a large fall of conversion rates and that this disaffection is explained by people not factoring in the improved benefit provided by annuities when longevity is extending. Hence marked preferences by investors for cash-out rather than annuities documented in the literature (Brown (2009), James and Song (2001), and James and Vittas (2004) for international evidence) may well be amplified by the fall of 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.

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[1]In France for instance regulatory mortality tables have been updated in 1985, 1993 and 2007

While theoretical and simulation studies on annuity demand is abundant, the empirical literature is comparatively still small, with some exceptions. Several articles have analyzed survey data in which questions are asked to a sample of the population about their willingness to annuitize their wealth (Brown, 2001, 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, Bütler and Teppa, 2007). Yet, 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 plausibly exogenous 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, Bütler, Staubli and Zito (2013) analyze the effects of a salient and sizable 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. 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. The latter decision is not an issue here as annuitization is mandatory at retirement. We confirm a significant price elasticity of annuity demand.

The article is structured as follows. Section 2 describes the French pension system and examines the effects of the reform for savers. Section 3 presents the insurer's database. Sections 4 and 5 assess the effects of lower conversion rates on new subscriptions. Section 6 looks at the impact on payments in saving accounts. Section 7 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. The last pillar is steadily growing since the 1990s. The main financial products that compose it are deferred annuities which bundle together an investment product and an annuity phase. They are tax-favored during the payout phase and mandate annuitization at retirement. Some products are specifically designed to civil servants (Préfon Retraite), wage-earners (Plan d'Épargne Retraite Populaire) or self-employed (Madelin contracts). In 2009, 3 million investors held those products.

Yet, individual and occupational retirement savings are not widespread in France. Contributions in the second and third pillars represented in 2009 only 5.7% of first pillar contributions, and 2.3% of total pension benefits during retirement (Andrieux et al., 2011). Annuities paid in proportion to last earned income remain low (Direr and Roger, 2011). Madelin contracts analyzed here were created in 1994. Those products, directed to self-employed, are deductible from taxable benefit and supplement public pensions. Savings may be converted into annuity between age 55 and 75. At retirement, annuity income is taxed at normal income tax rate. Self-employed invest more in retirement savings than wage-earners due to lower public pensions. Their maximum pension replacement rate is indeed 50% of labor income against 75% for wage-earners. Payments in Madelin contracts totaled two billion euros in 2009. 834,000 contracts are in the accumulation phase with an average payment of 2400 euros per contract. 57% of self-employed owned a policy in 2009 compared to only 8% for the employed population.

Rates of conversion 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 assumed interest rate which serves to discount annuities in the formula varies between 0 and 2.5%, depending on the contract (it is 1.5% in our data).

Mortality tables used by insurers are enforced by government law. They are periodically updated with the latest revisions in 1985, 1993, 2007 and 2013. 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 however, 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.

2.2 The 2007 reform

In summer 2006, the government published prospective mortality tables TH05 differentiated by birth year and sex, called TGH05 for men and TGF05 for women, to replace previous gender-neutral tables called TPRV93 from 2007 onward. However most contracts subscribed before this date retained the benefit of previous tables, which is the case of insurance policies analyzed in this study. Figure 1 shows conversion 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.[2] Annuity contracts are much less attractive for women under the new tables TGF05 than under older ones TPRV93. For example, cohorts born in 1950 enjoyed a conversion rate of 5% before the reform and only 4.5% with new tables representing a 10% fall of annuity for a given amount of converted wealth. The price rise is explained by increasing longevity and by the fact that annuities are now solely based on female survivorship rates. Fig. 2 shows the same graphic for men.

<Insert Fig. 2>

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[2]As 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.

The impact of the new tables is approximately neutral for men. This comes from the coexistence of two opposite effects of similar magnitude. On the one hand, previous tables were unisex and actually based on female mortality for both sexes. New gender-specific tables are favorable to men as their statistical life expectancy is shorter. On the other hand, the new tables factor in improved longevity recorded since the last update which reduces male rates of conversion.

We have implicitly assumed so far that savers will not opt for a joint and survivor annuity. In practice, the insurer may guarantee a benefit to a secondary beneficiary, usually the spouse, to whom insurer shall pay all or part of the annuity after policyholder's death. For the contracts analyzed in this study, 60% or 100% of the annuity may be payable to the second beneficiary till death. The higher the percentage, the lower the conversion rate so as to maintain actuarial equality between converted capital and the discounted sum of annuities.

The asymmetric effect of the reform on the two sexes persists in the event savers choose a survivor annuity but with qualifications. Insurers use as inputs for spouse's survival probabilities the new tables by sex (TGH05 in the case of a male spouse and TGF05 for a female spouse), regardless of the subscription date. In other words, subscribers before regulatory changes benefit from previous tables only for their own mortality rates, not for the secondary beneficiary's ones. Fig. 3 shows female conversion rates under various configurations with 60% reversion to spouse.

<Insert Fig. 3>

Mixed tables (TPRV93 for the policy owner and TGH05 for the secondary beneficiary) apply to subscribers before 2007 (early subscribers for short). TG05 tables apply to late subscribers (TGF05 for the main beneficiary and TGH05 for the secondary beneficiary). For reference, conversion rates from table TPRV93 would have applied to early subscribers had the reform not been implemented. Female early subscribers still benefit from better conversion rates than late subscribers if they expect to choose a survivor annuity but the gap is narrowed (7% on average instead of 10% without reversion). The reform did not significantly alter the situation of early

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subscribers as in both scenarios, male survivorship is described by similar tables (TGH05 with the reform and TPRV93 without). Fig. 4 shows male conversion rates under various combinations with a 60% survivor annuity to spouse.

<Insert Fig. 4>

The reform reduces early subscribers' rates by about 4% (TPRV93 tables vs mixed tables) as they insure their spouse on the basis of less favorable female table (TGF05 instead of TPRV93). But it lowers late subscribers' rates by an equivalent margin so that the gap between the two groups is still approximately zero.[3] Overall, the reform's final impact depends in some cases on the survivor annuity option at the time of conversion. This choice is not observed but we dispose of reversion decisions from past converted saving plans (Table 1).

Table 1: Reversion 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 converted into annuities. Reading the Table: 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 choose a survivor annuity. Providing a similar pattern is extrapolated forward, most women in our data will not opt for survivor annuity and will benefit from a conversion rate reduced by 10%. Table 2 summarizes changes in conversion rates caused by the reform.

<Insert Table 2>

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[3]The two groups insure the first beneficiary on the basis of equivalent tables (TPRV93 and TGH05) and the second beneficiary on the basis of the same female table TGF05.

Differences across sex are maximal in the absence of spouse reversion and become approximately zero for a 100% survivor annuity (5.5% vs 5.3%), as only couple's joint life expectancy matters. Not only the reform impacts differently the two sexes, but also with a distinct timing. Women should subscribe before changes take effect. For men expecting to opt for a survivor annuity, reform effects are unavoidable as new tables TGF05 are applied to the secondary beneficiary regardless the subscription date. Hence effects on demand, if any, should only be driven by a price effect which occurs as soon as men became aware of the reform to come. This happened in the middle of the year 2006.

2.3   Data

We dispose of data recording nationwide sales of retirement saving contracts called Madelin contracts from a large insurance company between March 2002 and April 2009. The dataset contains 7,853 subscriptions with information about savers and contracts: sex, birth date, marital status, number of children, occupational category, district of living[4], subscription date, amounts paid and payment dates.

Payments in Madelin contracts may be allocated among several mutual funds preselected by the company and a money-market fund. The former, mostly composed of equities, are risky, whereas the latter is composed of short-term debt and offers a close-to-riskless rate of return. Our data set indicates the share of wealth invested by policy owners in mutual funds at the end of each year.

We dispose of an income index and a wealth index for each customer produced by 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 either classified as high income or high wealth. The

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[4]The French territory is divided into 101 administrative units called départements.

type of seller who distributed the contract is also recorded. It is either a general agent who sells all insurance products of the company (home insurance, car insurance, ...) or a specialized agent who focuses on financial planning (retirement, financial advice and insurance planning) for high income customers. Both types of seller are independent contractors with an exclusive mandate with the insurer.

The transition date to the new tables was established by government decree on January 1st 2007. Yet some insurers delayed their application to new contracts by a few months, mostly 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.

We observe all payments made between January 2002 and February 2009 and still in the accumulation phase in 2009. Payment frequency varies from one subscriber to another. Some make a payment every month, others quarterly or annually. Payments are annualized by aggregating infra-annual payments starting from the first month of subscription.[5]

Table 3 shows summary statistics of the dataset by subscription years.

<Insert Table 3>

The Table shows interesting raw results, which will be more thoroughly investigated in next sections. Annual subscriptions reach a peak in 2006, just before the policy change. It represents 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 is stable around 35% before the policy change then drops to 28% two years after the reform, which is attributable to the negative effects of the reform to women. Payments are steadily increasing between 2003 and 2007. We will show that this trend

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[5]The first payment 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 payment. Thus, a saver opening a plan in February 2007 and making a first payment in April 2007 benefits from old tables. Her first annual payment aggregates all payments recorded between April 2007 and March 2008.

is smooth around the reform date both for impacted and non-impacted populations. Last, the share of subscribers in couple falls after 2007. We will see that this is mainly attributable to single men who are negatively impacted by the reform.

The next two sections examine the extent to which the policy change has affected subscriptions. We distinguish the impact before the reform, called the anticipation effects (Section 3), and after the reform, interpreted as a price effect (Section 4).

3 Reform's anticipation effects

3.1 A six-fold increase in semestrial subscriptions

Fig. 5 shows the monthly evolution of male and female new subscriptions. The vertical bar indicates the date from which the new tables take effects.

<Insert Fig. 5>

An annual seasonality is observed with a trough in August and a peak at the end of the year mainly for tax reasons.[6] An outstanding peak of sales extends the six months preceding the application dates of the new tables, from September 2006 to February 2007. It is observed for both men and women and demonstrates that the reform has not gone unnoticed. Annual sales jump from approximately 1,000 contracts in 2004 and 2005 to 2500 in 2006. This represents 1,500 sales in excess which concentrates the last six months before February 2007.

Fig. 6 helps to visualize the relative importance of the 2006 peak by distinguishing women from single men (unmarried, divorced or widowed) and men in a couple (married or in a relationship).

<Insert Fig. 6>

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[6]Subscribing in December of year n instead of January of year $n + 1$ allows savers to meet year n deduction limit.

New contracts are aggregated by periods of six months and normalized to 100 the first half of 2006. Years start in March, so that the first half of 2007 begins the first month of implementation of the new tables. The vertical line indicates the date of the reform. Outside of the peak, sales remain approximately stable apart from a seasonal increase the second half of each year by about 50%. The six months preceding the reform are characterized by a six-fold increase in female subscriptions, a five-fold increase for male in couple and a seven-fold increase for single men. Over this short period, the insurer sold the equivalent of three years of normal time subscriptions. This represents a net demand rather than a mere displacement of sales. The period just before and after the peak does not appear to suffer from a trough of sales. Rather, it seems that the imminent implementation of the reform has convinced a new population of customers to take out a savings plan.

The female peak can be simply explained by the appeal of old tables. We saw that late subscribers may expect to experience a 5 to 10 percent decrease of conversion rates (depending on the survivor option). The male peak is more difficult to rationalize. They will benefit from a lower conversion rate if they expect to take the survivor option but regardless of the subscription date. Given that the increase in demand is 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. The next section investigates more thoroughly this issue.

3.2 Who were the most sensitive to anticipation effects?

We may wonder if some groups of investors better understood the real benefits of an early subscription. As sales have increased six-fold over a short period of time it is likely that some composition effects may be observed. Graphics in Fig. 7 shed light to this issue.

<Insert Fig. 7>

For reference, Fig. 7.1 and 7.2 show in a stylized manner how the subscription share of a sufficiently informed population should evolve in response to the incentives created by the reform. Men should not subscribe more the six months before the reform (the shaded area) to benefit from elusive better returns. Yet we know from Fig. 6 that they actually did. Hence a peak of the relative share of a given male group within the male population means that an above-average fraction of this group got it wrong. After the reform, the group's share may remain stable, decrease or increase depending on the relative sensitivity to conversion rate changes, at least for men anticipating a survivor option. For women, a relative sale peak of a given group is only visible if it were better informed or more sensitive to the benefits of the reform compared to the rest of the female population.

Graphs 7.3 to 7.12 show the evolution of the share of subscribers sorted by socio-demographic categories and distribution channel.[7] Insurance agents specialized in financial planning appear to have attracted more customers than general insurance agents, as attested by a peak for women but also for men (Fig. 7.3). The benefit of dealing with specialized agents who presumably have a better knowledge of regulatory constraints than general insurance agents, is here ambiguous. On the one hand, they appeared to be better aware of the imminence of the reform and rightly alerted their female clientele in greater proportion. On the other hand, they seemed to dispro-portionately misreport the impact of the reform to men, either by ignorance about its gender specific details, or by commercial incentives.

Investors grouped by socio-professional category seemed to react differently to the reform. Male independent professions are over-represented at the peak. Male or female business leaders and executives and male owners of small businesses (craftsmen, shopkeepers, ...) appeared to under-react to the peak, although the pattern is not clear-cut. No peak is clearly discernible

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[7]Other factors than the reform may as well affect the evolution of the shares but they presumably are wiped out by the outstanding size of the anticipation effects, leading to a six-fold increase of subscriptions.

for other categories of investors: inhabitants of Paris and its posh suburbs[8], high income and wealth savers and subscribers with children. Age is also unrelated to subscribing more at the peak. So did the average proportions invested in mutual funds (the risky part of the saving account) which tracks the financial market cycle.[9]

The graphical interpretation is supplemented by an econometric analysis. We estimate a logistic model over an 18 month period, from March 2006 to August 2007. The explained variable PEAK is a binary variable equal to 1 if savers subscribe during the six month peak and 0 if they subscribe six months before or six months after that period. We regress separately for men and women on a series of explanatory variables listed in Tables 4 and 5.[10]

<Insert Tables 4 and 5>

For women (Table 4), the presence of children, ownership of mutual funds and subscription with a specialized agent significantly explain the presence of a peak. For men, independent professions, owners of mutual funds and subscribers with a specialized agent also contribute to the sales peak. Graphical analysis of Figures 7 suggests however that only subscriptions with a specialized agent for both sexes and independent professions for men seem to have experienced a genuine peak which cannot be confused with sample fluctuations. Conversely, the visual peak for male or female business leaders and executives and male owners of small businesses is not confirmed by the econometric analysis. Overall, the sales peak does not induce strong deformation of the sales mix, which is surprising given its magnitude.

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[8]Hauts de Seine and Yvelines. The inhabitants of these districts seemed to have overreacted to the reform but six month before the expected period.

[9]See Direr and Yayi (2014) for a full analysis of savers' portfolio choices with the same dataset.

[10]The econometric test is complementary to the graphical analysis. Significant coefficients may reveal other configurations such as a permanent decline in the probability of purchasing

4 Reform effects on new subscriptions

In this section we are interested in the effects of the regulatory reform on contract sales after the implementation date. We first present the impact on male savers in couple, then on women.

4.1 Impact on men in couple

Fig. 6 shows that men in couple subscribed proportionally less than single men after September 2006 which approximately corresponds to the moment when the imminence of a reform were released to the public. The gap is simply explained if men in couples are presumed to expect to take the survivor option, contrary to single men. Indeed, we noticed in Section II that annuities became more expensive for men who expect to opt for a survivor annuity. Fig. 8 shows semi-annual variations of the share of savers in couples in the male population. It also indicates as a reference the same statistic for women.

<Insert Fig. 8>

Both variations are consistent with reform's expected effects as regulatory changes penalize men in couples and relatively favor women in couple insofar as the two groups expected to opt for a survivor annuity. Indeed, as noted in Table 2 of Section 2, the first group benefited from lower conversion rates after the reform whereas the second group was less negatively impacted among women. Although it is not possible to precisely date when investors became aware of the reform and its effects, Figure 8 shows a relative drop in the demand of men in couple between the first and second half of 2006 as indicated by the dotted vertical line. The share of women in couple in total female subscriptions rose around the reform date, which is also consistent with the direction of the impact of the reform on this group.

The reform's impact on male demand may be estimated by using the counterfactual evolution of the weighted average share during the previous three years. Appendix 1 presents the calculations and indicates a decrease in demand attributable to the reform by around -12%. Ta-

ble 2 in Sub-section 2.2 shows that the conversion rate decrease is 3.5% for a survivor annuity of 60% and 5.5% for one of 100%. The average decrease in conversion rates is estimated at - 4.8% by assuming as in Table 1 that about one third of men in couple will choose the 60% survivor annuity and two thirds 100%. This leads to a demand elasticity with respect to conversion rate of about -2.5.

4.2 Impact on women

The analysis of the reform shows that the conversion rate of women who subscribed after the reform was reduced by about 10% compared to that of early female subscribers. The reduction is lower for those who planned to opt for a survivor annuity but very few of them were expected to do so (see Table 1). Did this detrimental effect on saving return discourage savers to subscribe a contract ? We answer this question by comparing changes in subscription after the reform of women and a control group composed of single men presumably not affected by the reform. Figure 9 shows the ratios of new subscriptions for women vs men and women vs single men.

<Insert Fig. 9>

The ratio women vs single men remains flat from 2003 to 2006, then starts declining after the reform implementation date indicated by a vertical bar. Assuming the female demand would have remained parallel to that of single men absent a reform, Appendix 2 shows a 14.6% decrease of female subscriptions in 2007 and 2008 attributable to the reform. If a 9.74% decrease in female conversion rates is retained, which represents an average estimate experienced by women (see table 2), we obtain an elasticity of demand with respect to conversion rate equal to -1.5.

The impact on female demand may be econometrically estimated by a logistic equation:

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

in which $AFTER_i$ equals 1 if subscription i takes 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 3. We restrict our sample to women and single men. The variable of interest β_1 measures to what extent female subscriptions deviate from subscriptions of single men after the reform. Table 6 shows the results for three models. In model (1) the dummy $AFTER$ is regressed on $WOMEN$ without control variables. Model (2) adds a full set of covariates. We saw in section 4 that sales jumped right before the reform yet without major changes in the composition of demand. Moreover, one quantitatively significant factor of the jump, sales by specialized agents was common to both sexes. Nevertheless one may worry that a six-fold increase in demand during a short period of time may bias our estimation (see also the next section on methodological issues). 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 6>

In all three models and in accordance with visual impression from Fig. 9, the WOMEN estimator is significantly negative at the 1% threshold.[11]

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% in model (2) and -13% in model (3). Taking the average share of women after the reform as a reference, changes in female demand are respectively $-0.1/0.623$ = -16% and $-0.13/0.623$ = -20.9% in models (2) and (3) respectively. Corresponding elasticities are $16/9.74$ = 1.64 and $20.9/9.74$ = 2.1. Hence the econometric analysis confirms a significant impact of the reform on female demand.

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[11]It can be checked that the univariate model (1) leads to the same estimates than the ones calculated in Appendix 2. Indeed, $\text{Prob}(AFTER|WOMEN) = (exp(\beta_0 + \beta_1))/(1 + exp(\beta_0 + \beta_1)) = (exp(-0.539 - 0.372))/(1 + exp(-0.539 - 0.372) = 0.287$ and $\text{Prob}(AFTER|MEN) = (exp(\beta_0))/(1 + exp(\beta_0)) = (exp(-0.539))/(1 + exp(-0.539)) = 0.368$. The female share before and after the reform may be deduced, which are 0.623 and 0.532 respectively. Those are the same estimates than the ones found in Appendix 2.

4.3 Are single men an appropriate control group ?

The drop of the female share is attributable to the reform as all other causes should impact the two sexes the same way. This reasoning raises the issue of the quality of the control group. Men subscribed *en masse* right before the reform as women did, which reveals a confusion about actual effects of the regulatory change. From a methodological point of view, however, anticipatory effects of the male population similar to those of women do improve its ability to control for confounding factors.

One might especially fear that the sales peak which precedes the implementation date dries up the market for several years and explains the weakness of the female demand after the reform. But since the male peak was proportionately as important as the female one, this potential effect is also controlled by the evolution of the male demand. Despite a six-fold increase in demand the last six months before the reform, the share of women did not seem to deviate from its trend in Fig. 9.

5 Reform's effects on payments

Which impact had the reform on payments made by savers ? We present econometric results, then discuss some methodological issues.

5.1 Model and results

We exploit the asymmetric effects of the reform for women and single men to estimate the impact on payments. 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 payments of subscribers who opened a plan before and after the reform. Hence he method allows us to control for time effects (payments 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.

The econometric model of payments between March 2002 and February 2008 is:

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

where V_i denotes subscriber i log of annual payment, $AFTER$ equals 1 if subscription takes place between March 2007 and February 2008, 0 before and $WOMEN$ is equal to 1 for female policyholders and 0 for male ones. The cross-dummy variable $AFTER \times WOMEN$ equals 1 if annualized payment is made after the reform by a woman and 0 otherwise. Its coefficient measures the impact of the reform on payments. D_i are temporal dummies which cover annual periods from March to next year February over the period 2002 to 2006 and X_i includes covariates described in Sub-section 2.3 and presented in Table 3.

<Insert Table 6>

Table 6 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. Men and women contribute more after the reform than before but the difference is statistically the same across groups. Hence it is not possible to discern any controlled impact on women payments.

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 wealth. 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.

20

5.2 Robustness

The identification strategy relies on single men's ability to control for other effects not related to the reform affecting female payments. This raises two issues. First, anticipation effects documented in previous section are likely to bias the reform's estimated impact on payments. Unobserved variables could be correlated with the propensity to contribute and the decision to subscribe before the reform. For example, if wealthier savers are also early subscribers due to better information, the reform's impact on payments could be biased down. Second one may wonder to what extent the parallel trend assumption on which the double-difference analysis is based, is valid.

Several arguments are in order. First single men seem to adequately control for anticipation effects as well. This group experienced a subscription peak at the same time and of similar magnitude than women. This strongly suggests that potential unobserved effects driving the anticipation effect affected women and single men the same way. This impression is reinforced by previous results in Section 4 showing that sales composition was not significantly altered during the peak for most observed variables. In particular, the main factor of the peak, subscribing with an agent specialized in financial planning, affected the same way both sexes. Only male independent professions seem to have moderately contributed more than proportionally to the peak without a similar effect for women.

Second, the validity of the methodology is based on the parallel trend assumption according to which payments from the two groups would have followed a common trend had there been no reform. This assumption can be tested on years preceding the reform. Figure 10 shows average payment the first twelve months after subscription for women, men and single men over the period 2002 to 2007.

<Insert Fig. 10>

Payments in saving accounts are annualized to eliminate infra-annual fluctuations and differ-

21

ences in timing of payments. We graphically check the result of parallelism for years prior to the reform. Men's payments seem to control for women's contributions in the absence of identified events differently affecting the two sexes. We also see that the difference remains approximately constant even after the reform, suggesting that regulatory changes did not produce a significant impact on contributions.

The parallel trend assumption can be more formally tested by replicating the difference in difference procedure shifted in the past at a time when no known event has distinctly affected single men and women. Our data starting in 2002, the econometric test can be replicated four times back in the past. Table 8 shows the regression results.

<Insert Table 8>

Estimates of the variable of interest $AFTER \times WOMEN$ are not significant at the 10 % threshold for all subperiods and for the two alternative control groups, men or single men. The parallel trend assumption in absence of differential treatment is therefore backed by our data.

6   Conclusion

Annuities are special saving products. They address the financial planning needs of people approaching retirement by protecting against the risk or 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 of a French reform of regulatory mortality tables to estimate the impact on the demand for retirement savings. Three margins of behavioral responses are distinguished: anticipation effects created by the opportunity to benefit from old conversion rates, post-reform effects on subscriptions and contributions.

We document a strong reaction to the announcement of the reform as subscriptions are multiplied by six over a six month period. We also highlight a significant effect on subscriptions by comparing post-reform subscriptions of women, affected by the reform and single men, not

concerned by the reform insofar as they do not expect to take the survivor option. We estimate a large annuity price elasticity of -1.5. We also compare post-reform subscriptions of men in couple affected by a more costly survivor annuity and single men with an estimated price elasticity of -2.5.

While the reform was anticipated by a large number of investors, payments in saving accounts remained stable the first year after the reform. Hence the drop in conversion rate has not been offset by more saving, at least in the short-run, which means that savers are likely to benefit from lower annuities at retirement, nearly 10% for women and 5% for men who choose the survivor option.

Overall, the reform had lasting positive effects on the number of subscriptions since the post-reform reduction in demand was more than offset by the initial strong increase the six months preceding its implementation due to powerful anticipation effects. 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.

This overall positive effect of the reform is largely based on male peak sales as men make up about two thirds of total demand. Closer inspection of the reform, however, 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). They involve knowledge about capital markets, mortality tables, and the regulatory framework. This study also highlights the ambiguous role of insurance agents specialized in financial planning who were more prompt than general insurance agents to attract new subscriptions before the regulatory reform but did not enough discriminate between men and women.

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APPENDICES

Appendix 1: Univariate analysis of the impact of the reform to subscriptions by men in couple relative to single men

The table shows annual evolution of contract sales from September 2003 to August 2008 for men in couple (either married or in a relationship) relative to the whole male population (men in couple and single men). Years start in September, which is the approximate month during which the government decision to update regulatory mortality tables has been known by the public. The share of men is relatively stable at around 64% the first two years and then goes down by about five percentage points from mid-2006. To assess the effects of the reform on subscriptions, we extend past trend by assuming a counterfactual share of men in couple equal to the average share observed the previous three years (2003-6). The variation of subscriptions by men in couple attributable to the reform is -12.6% the first year ((0.581-0.665)/0.665) and -11.4% the second year.

Number of subscriptions	2003-4	2004-5	2005-6	2006-7	2007-8
Men in couple	400	369	356	844	435
Men	570	580	543	1453	739
Share of men in couple	0.702	0.636	0.656	0.581	0.589
Counterfactual share					
(previous three year average)				0.665	0.665
Variation of male subscriptions				-12.6%	-11.4%

Note : a year goes from September n to August $n+1$. September 2006 is the approximate date from which the reform was known to the public. Men whose family situation is not recorded are excluded from the analysis.

Appendix 2: Univariate analysis of the impact of the reform to subscriptions by women relative to single men

The table presents annual evolution of contract sales between March 2004 and February 2009 for women relative to single men. Years start in March, which is the first month of implementation of the reform in 2007. We extrapolate the share of women in 2007-8 and 2008-9 by assuming a counterfactual share equal to the average share observed the previous three years. The variation of subscriptions by women attributable to the reform is -14.6% ((0,532-0,623)/0,623) the first two year after the reform.

Number of subscriptions	2004-5	2005-6	2006-7	2007-8	2008-9
Women	354	361	909	299	354
Single men	194	205	585	263	311
Total	548	566	1494	562	665
Share of women	0.646	0.638	0.608	0.532	0.532
Counterfactual share					
(previous three year average)				0.623	0.623
Variation of female demand				-14,6%	-14,6%

Note : a year goes from March n to February $n + 1$. March 2007 is the first month from which new subscribers have been impacted by the reform.