The cost of longevity in France : An assessment from the supplementary pension market

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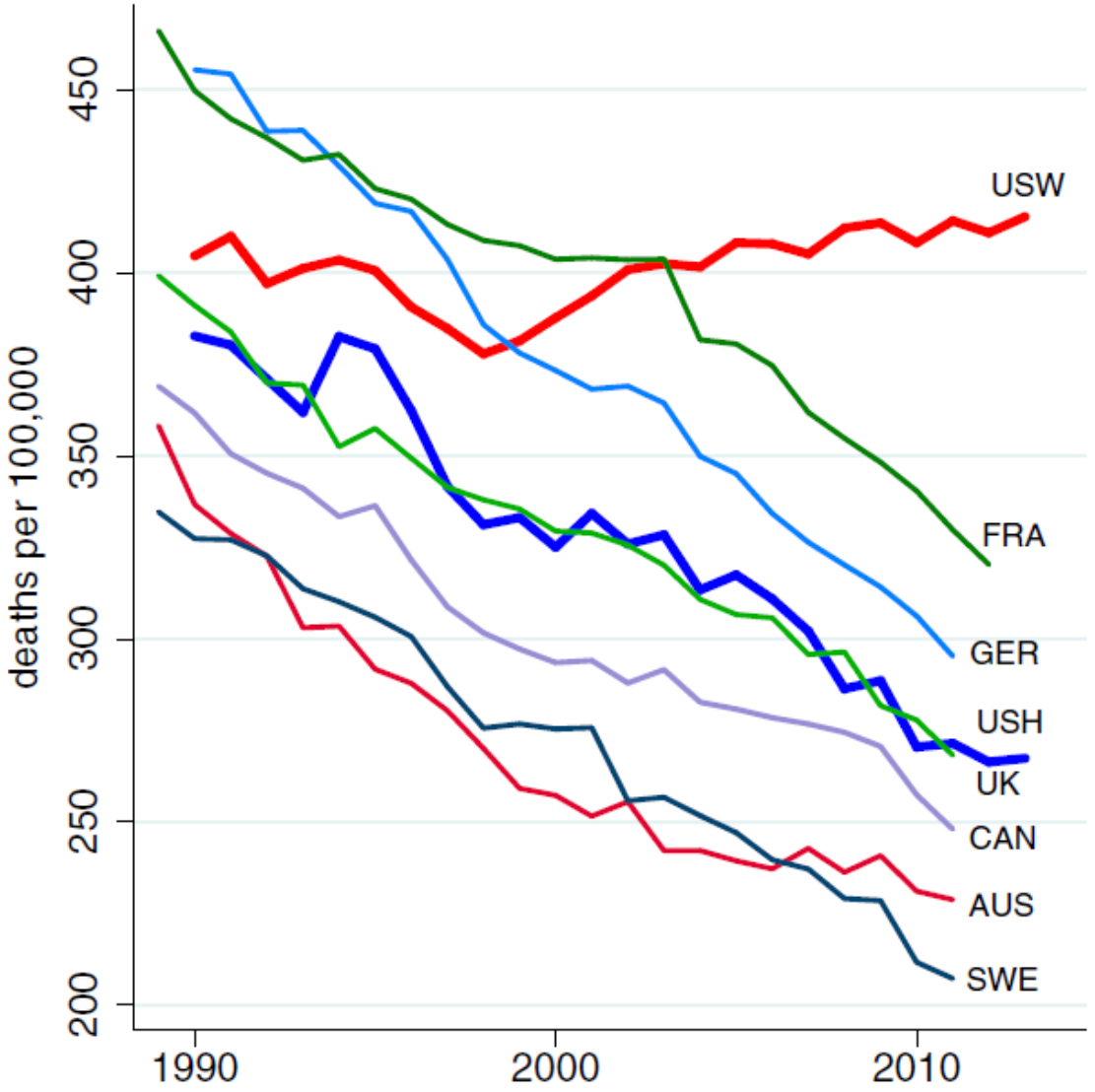
Introduction



Outline

1. Context, Motivations and Problematics
2. Longevity risk : definition and assessment
3. Database
4. Results
5. Conclusion

1. Context, Motivations and Problematics

a. Context (general)

- The (future) pension problem in France has been a hot issue for more than two decades beginning the white book about the future of pensions in France, released in 1991 and forwarded by the Prime Minister, Michel Rocard. In fact, the debate was launched among experts in the middle of the eighties.
- Since the very beginning of the awareness of this issue, painful decisions had been put off by politics
- The first reform was launched in 1993 (Balladur reform) and was concentrated on the private sector It three key points were:
  - the increase of the period of contribution for a full pension rate from 37.5 years to 40 years,
  - the shift from 10 to 25 years of the best earned years for the calculation of the pension,
  - the indexation of the pension on the consumer price index instead of general wage increase as before.
- The second reform occurred in 2003 (Fillon 1). It had two main aspects:
  - the progressive alignment of the contribution length of the private sector to the public sector (from 37.5 years to 40),
  - the progressive extension of the length of contribution from 40 to 41 years for both the private sector and the civil servants from 2009 on.
- The third reform extended in 2010 (Woerth or Fillon 2). Contrary to the two previous reforms, this one had none striking measure but various technical adjustments. Let's just mention:
  - the progressive lengthening of the legal retirement age to 62 years from 2018.

1. Context, Motivations and Problematics

a. Context (supplementary pension)

- The reforms we mentionned concern only one (although very important) aspect of the pension system in France. As most of you are awared, the pension system in France as in many other developped countries, is organised around three pillars :
  - The first pillar is the compulsory system. In France, as you know, although the unification was promised at the setting of the pension system after the WWII, it didn't happen and there are still today a variety of pension schemes (private sector, civil servants, Railway workers, Gas and electricity workers…);
  - The second pillar is what we call the complementary scheme. This complementary scheme has two compartments:
    - The first one is compulsory for workers of the private sector and is organized around AGIRC/ARRCO depending on the amount of your pay,
    - The second one is compulsory for civil servants from a certain level of wage and is called RAFP, and IRCANTEC for non civil servants workers of the public sector.
  - The third pillar is supplementary pension is meant to provide an opportunity for individuals to save towards increasing their retirement income. This system is organized inside some companies and which is the subject of this work.

- The supplementary scheme has many products, each one with it own specifications. Let mention four products:
  - A39 of the GCI
  - A82 of the GCI
  - A83 of the GCI
  - Madelin Law

1. Context, Motivations and Problematics

a. Context (supplementary pension)

- Definitions
  - A 39 of the GCI
    - The A39 of the General Code of Income is a product set up by some companies for a few number of their employees, general high level executives. This is a defined benefit product. This means that the employer knows the amount he/she will received (generally as a percentage of his/her last pay) when retired.
    - This scheme can be managed inside the company as a social liability or outsourced to an insurer,
    - This product is appropriate for executive near retirement age.
  - A82 of the GCI
    - The A82 of the General Code of Income is a product subscribed by a company for a selected number of employees. By this aspect, this product is close to the A39.
    - The A82 of the GCI is however a defined contribution product which make a big difference with the A39 product. This means that the employee won't know the amount of its pension until he/she retires.
  - A83 of the GCI
    - The A83 of the General Code of Income is a product subscribed by a company for its employees after an unilateral decision, a convention with unions or a referendum inside the company.
    - The A83 of the GCI is a defined contribution product.
  - Madelin Law
    - The Madelin Law product is equivalent to A83 of the GCI for independent workers.

1. Context, Motivations and Problematics

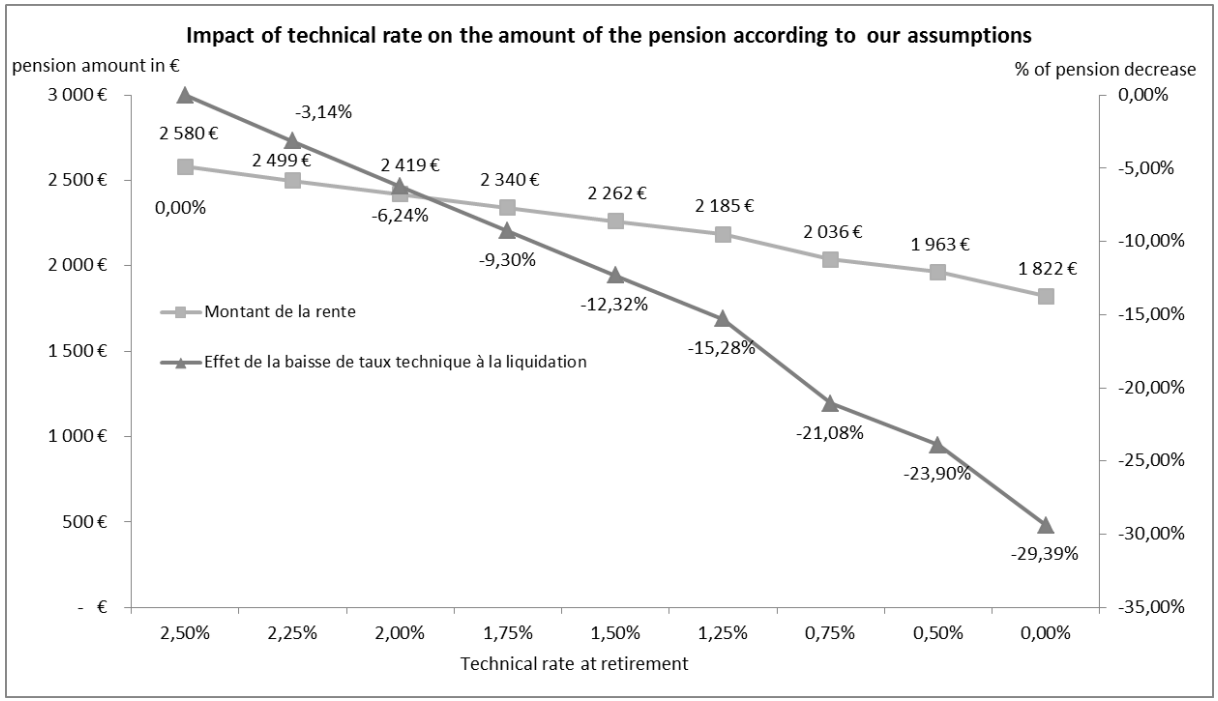
b. Motivations

- General problems of the compulsory pension scheme in France is well documented
  - Various reports beginning with the 1991 Charpin report are available;
  - Every year the COR (the Retirement Advisory Board) updated its forecast of future pension levels according to consensus assumptions
- It's now publicly known that for most employees, the compulsory scheme won't provide enough resources to keep the living standard while retired:
  - If civil servants will received about ¾ of their last pay when retired and if under the (current) law, minimum wage workers are guaranteed to received about 80% of the minimum wage, the situation of other employees are worrisome,
  - For instance, according to many projections, executives can expect about 40% of their last salary when retired.
- Following the previous points, the battle to keep the living standard when retired lies on the second and the third pillars of the pension scheme
  - The fate of this battle lies on the third pillar since it's strongly backed by the tax incentives.
  - If the third pillar fails, the battle of keeping enough resources when retired can not be win,
- Few research works to our knowledge have been done on this interesting topic,
  - Anyone knows that the year of retirement is not neutral on the amount of the pension, but how much?
  - In the current context of slow interest rates, we changed the technical rate with 25 basis point step to assess that impact
  - The drop can be more than 29% as the following figure shows

1. Context, Motivations and Problematics

b. Motivations

- Assumptions
  - Man aged 62 on December 31, 2015 ;
  - pension fees : 1.3% ;
  - capital: 50 000 €.



- We got access to an invaluable and original database from which we draw some interesting conclusions

1. Context, Motivations and Problematics

c. Problematics

- Compare observed deaths from our sample to those expected from the regulatory tables
  - This comparison shall help the insurer to assess the longevity risk of a portofolio of annuitants;
  - After assessing the longevity risk, it has to measure the financial costs linked to it
- Compare sinistrality of an individual scheme to one of a collective scheme
  - This comparison can help us answer questions of the type is there an asymmetry of information between the annuitants and the insurer?
  - Are there factors of longevity risks other than the traditional ones we use, namely age, gender and born generation?

2. Longevity risk

Definition and assessment

Definition

- A risk that mainly appears when the observed life expectancy is above expected life expected used to prize an annuity

Assessment

- To assess the longevity risk one needs indicators
- We refer to three approaches to build that indicators
  - Approach 1 – a comparison of observed deaths to expected deaths based on regulatory tables for the entire period
  - Approach 2 - a comparison year by year of observed deaths to expected deaths based on regulatory tables for the entire period on one hand and their consequences in terms of reserves on the other hand
  - Approach 3 - a comparison for sixteen generations of observed survival probabilities to expected survival probabilities from regulatory tables

2. Longevity risk

Definition and assessment

Assessment

- Approach 1 – a comparison of observed deaths to expected deaths based on regulatory tables for the entire period
  - Two indicators can be built : death ratio (RD) and Mortality gap (EM)

$$RD = \frac{DO}{DA},\ DA = \sum_{i=1}^{N}(1 - p_i)$$

where

DO is the number of observed deaths,

DA is the number of the expected deaths from the tables,

p_i is the survival probability of the annuitant i given by the table,

N is the number of pensioners at the beginning of the period.

$$EM = \frac{DO}{N} - \frac{DA}{N}$$

Note that EM>0 means that observed deaths are more than expected deaths from tables

2. Longevity risk

Definition and assessment

Assessment

- Approach 2 - a comparison year by year of observed deaths to expected deaths based on regulatory tables for the entire period on one hand and their consequences in terms of reserves on the other hand
  - Two more indicators can be built : mortality rate in amount (TM) and Mortality gap (EM) defined in the first approach.

$$TM_t = \frac{MM_t}{PMO_t}$$

  - Mortality loss or gain (MM)

where

TM_t is the mortality rate amount of the year t,

MM_t is the loss or the gain due to the mortality of the year t,
PMO_t is the opening reverve of the year t,
R is the annuity amount,
p_x is a probability of an annuitant aged x years to be alive in one year,

2. Longevity risk

Definition and assessment

Assessment

- Approach 2 - a comparison year by year of observed deaths to expected deaths based on regulatory tables for the entire period on one hand and their consequences in terms of reserves on the other hand
  - Two more indicators can be built : mortality rate in amount (TM) and Mortality loss or gain (MM)

$$MM_t = \underbrace{(p_x R \quad -1_{v \in V}.R)}_{(1)} + \underbrace{(p_x.\mathrm{PM}_t - \quad 1_{v \in V}.PM_t)}_{(2)}$$

with

$$1_{v \in V} = \begin{cases} 1 & \text{if the annuitant is alive} \\ 0 & \text{if the annuitant is dead} \end{cases}$$

2. Longevity risk

Definition and assessment

Assessment

- Approach 2 - a comparison year by year of observed deaths to expected deaths based on regulatory tables for the entire period on one hand and their consequences in terms of reserves on the other hand
  - Note that when the annuitant survive in the year t, there is a loss of mortality for the insurer. We therefore have:

$$MM_t = \underbrace{(p_x R - R)}_{(1)} + (p_x . \underbrace{PM_t - PM_t}_{(2)})$$

  - If the annuitant dies during the year t, there is a gain on mortality for the insurer. This leads to:

$$MM_t = \underbrace{(p_x R)}_{(1)} + (p_x . \underbrace{PM_t}_{(2)})$$

2. Longevity risk

Definition and assessment

Assessment

- Approach 3 - a comparison for sixteen generations of observed survival probabilities to expected survival probabilities from regulatory tables
  - For the purpose of this comparison, we estimate survival probabilities i.e.

$$S(t) = P(T \geq t)\,,\ \forall\, t \geq 0$$

based on two measures:

- Kaplan Meier

$$S_{KM}(a_x) = \prod_{i/a_i > a_t}^{a_m} \left(1 - \frac{d_i}{n_i}\right) \qquad q_x = 1 - \prod_{i/a_i > a_t}^{a_m} \left(1 - \frac{d_i}{n_i}\right) \qquad n_i = n_{i-1} + t_{i-1} - d_i - c_{i-1}$$

- Nelson-Aalen

$$H_{NA}(a_t) = \sum_{i, a_i < a_t} \frac{d_i}{n_i}$$

2. Longevity risk

Definition and assessment

Assessment

Where

- $S_{KM}(a_x)$ is the survival function calculated from the sample,
- $\{a_1,\dots,a_m\}$ are dates of distinct events (death or other exit) during $]x, x+1]$
- n_i number of living annuitants in a_i
- n_{i-1} number of living annuitants in a_{i-1}
- d_i number of dead annuitants in a_i
- c_{i-1} number of exit annuitants on the right of the interval $]a_{i-1}, a_i]$, i.e. Exited before the date a_i
- t_{i-1} number of anuitants troncated on the left, i.e. entered just after a_{i-1} and before a_i

- n_x number of annuitants alive at age x
- d_x number of annuitants dead in the interval $]x, x+1]$
- c_x number of annuintants troncated on the right of the interval $]x, x+1]$, i.e. exited before age $x+1$
- t_x number of annuitants troncated on the left, i.e. entered before the age $x+1$

3. Database

Source: a big insurance company of the country - first use for this purpose

- Features of the sample
  - Table 1 A – general features

	Individual scheme (%)	Collective scheme	Total
Number of insured	53 786 (78,35%)	14 859 (21,65%)	68 645
Number of deaths	5 885 (85,04%)	1 035 (14,96)	6 920
Direct rights	48 601 (90,36%)	14 230 (95,77%)	62 831
Indirect rights	5 185 (9,64%)	629 (4,23%)	5 814

  - Table 1B – Breakdown by type of pension scheme

Type of rights	Gender	Number of annuitants and percentage by gender	Average pension	Deaths, numbers and percentage	Average age at retirement
Individual Supplementary scheme					
Direct and Indirect Rights	**Total**	**53 786**		**5 885**	
Direct rights	**Global**	**48 601**	**3 382 €**	4 930	62 years and 3 months
	Male	75%	3 694 €	82%	
	Female	25%	3 070 €	18%	
Indirect rights	**Global**	**5 185**	**1 788 €**	**955**	73 years
	Male	3%	1 787 €	4%	
	Female	97%	1 832 €	96%	
Collective Supplementary scheme					
Direct and Indirect Rights	**Total**	**14 859**		**1035**	
Direct rights	**Global**	**14 230**	**5 073 €**	**967**	62 years and 6 months
	Male	70%	6 040 €	69%	
	Female	30%	2 848 €	31%	
Indirect rights	Global	629	4 276 €	68	69 years and 10 months
	Male	6%	4 383 €	18%	
	Female	94%	3 143 €	82%	

4. Results

- **First approach : observed and expected deaths for the entire period**

- Table 2 – Change in mortality for the period 2007-2013

Gender	Sample size	Observed number of deaths (DO)	Expected number of deaths (DA)	DO/DA	Observed deaths rate (DO/N)	Expected deaths rate (DA/N)	Mortality spread
Total	**68 645**	**6 920**	**5 989**	**115,55%**	**10,08%**	**8,72%**	**1,36%**
Men	46 563	4 766	4 061	117,36%	10,24%	8,72%	**1,51%**
Women	22 082	2 154	1 928	111,75%	9,75%	8,73%	**1,03%**
Analysis by pension scheme							
Scheme		Observed number of deaths (DO)	Expected number of deaths (DA)	DO/DA	Observed deaths rate (DO/N)	Expected deaths rate (DA/N)	Mortality spre
Collective scheme		1 035	876	118,12%	6,97%	5,90%	**1,07%**
Individual and professionnal scheme		5 885	5 112	115,11%	10,94%	9,51%	**1,44%**

- Findings
  - More deaths observed than expected by the tables TGH05 and TGF05,
  - Higher spread of mortality for men (+1.51%) than for women (+1.03%),
  - Spread of mortality is higher for individual and professionnal scheme than with collective scheme,
  - No anti-selection detected,
  - Heterogeneity of the population of annuitants.

4. Results

- **Second approach : spread of mortality in numbers and in reserves**

Figure 1 – Mortality change per year for the entire sample

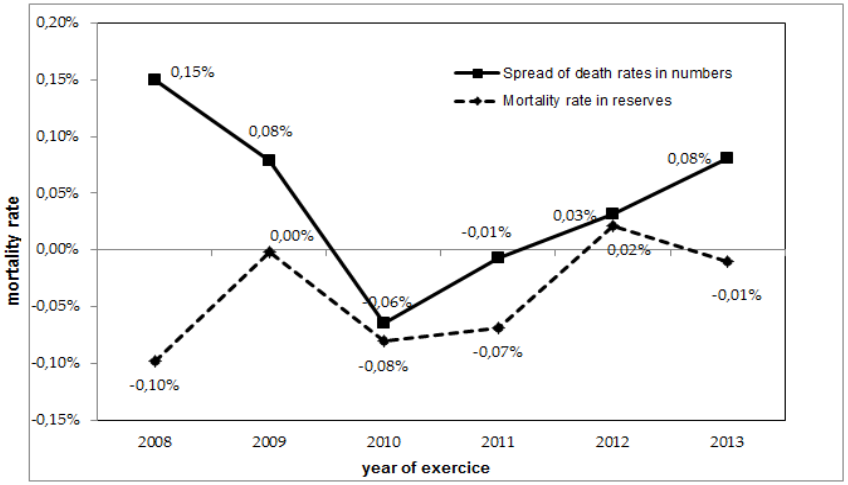
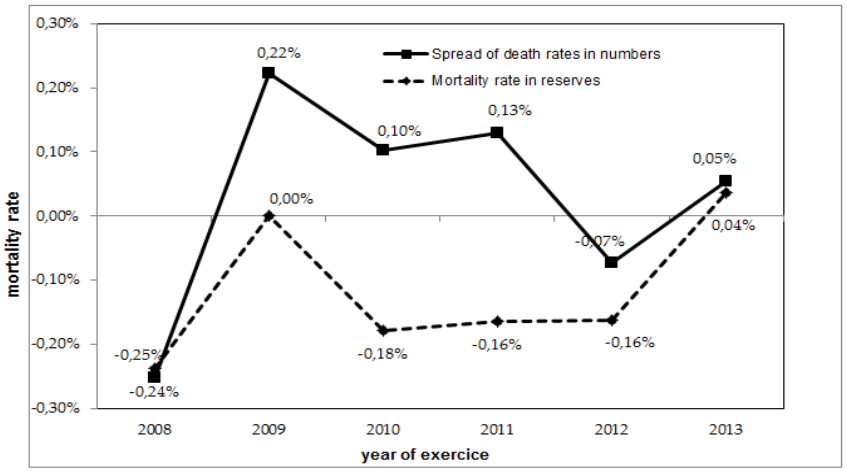


Figure 2 – Mortality change per year for collective scheme



- Main Findings
  - Results in terms of numbers and reverves don't follow the same direction,
  - In 2008, the portofolio shows a gain in numbers (+0.15%) but a loss in reserves (-0.10%),
  - On average for the seven years, there is a gain in numbers (+0.04%) but a loss in reserve (-0,04%),
  - The previous results are amplified if we focus on collective pension scheme where we know that amounts are higher,
  - Note that in 2010 and 2011, losses in reserves are huge (-0.18% and -0.16% respectively) although we observed gains in numbers (+0.10% and +0,13%). On average, losses in reserves reach -0.12%, average gain in numbers (+0,03%),

4. Results

- **Second approach : spread of mortality in numbers and in reserves**

Figure 3 – Mortality change according to annuity amount for the entire sample

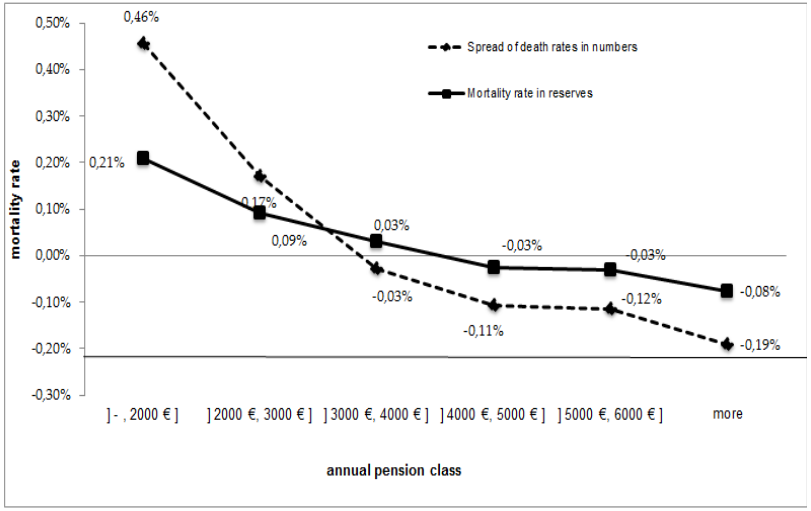
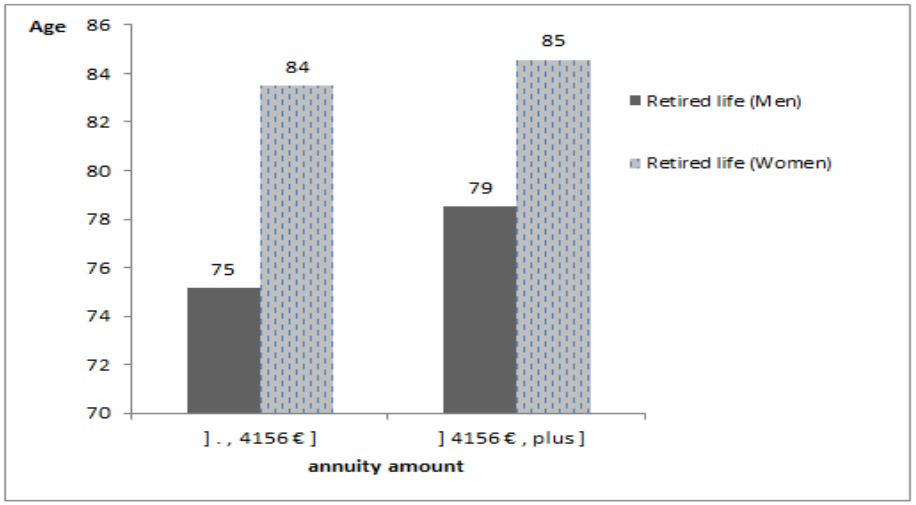


Figure 4 – Average lifetime of collective scheme annuitants according to annual pension amount

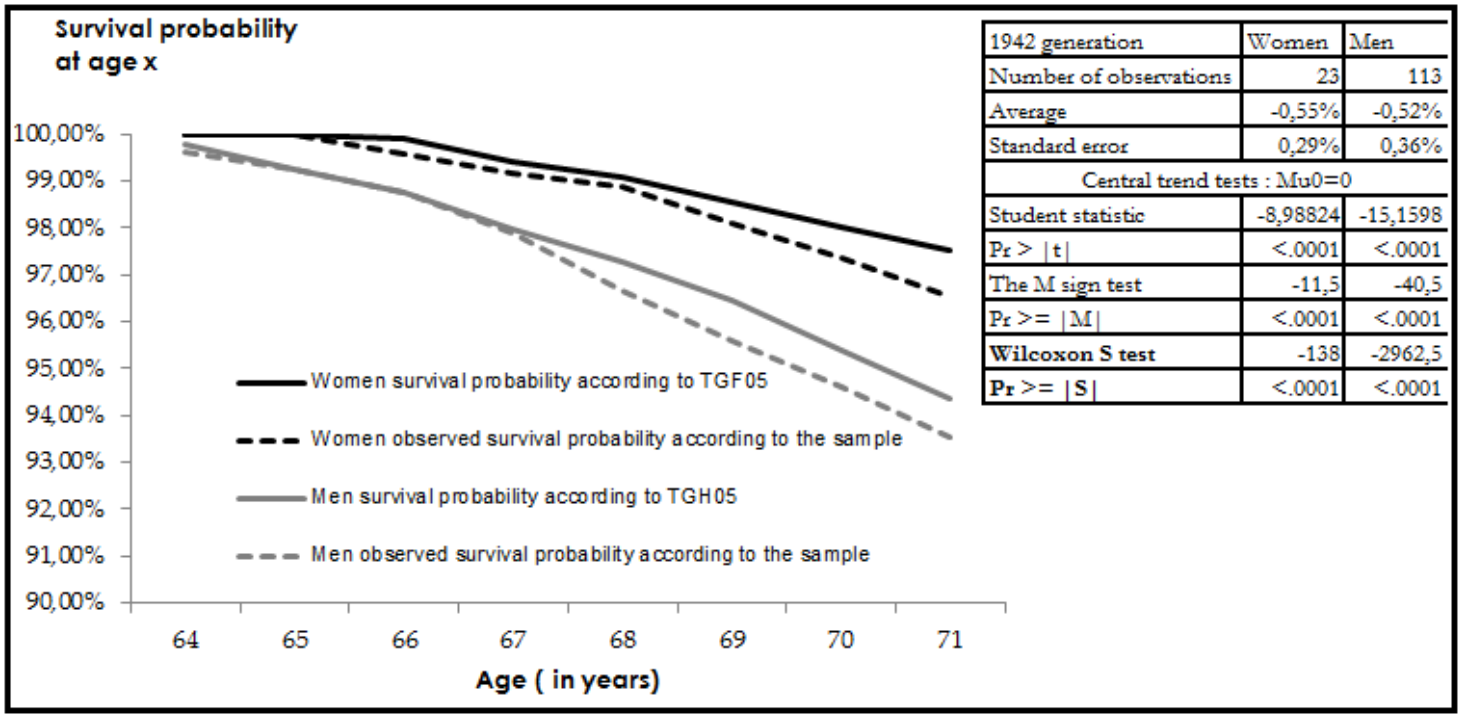


- More deaths are observed among renters with annual pension less or egal to €2 000 (+0,46%),
- In terms of reserves, this provides a gain to insurer of about 0.21% (thoses annual pension less then 2 000€),
- For annuity higher than €6 000, there are less observed deaths than expected from the tables leading to loss for insurer (-0,08%),
- More strikingly, losses in reserves increase with the amount of the annuity. The loss for the insurer for annuitants with a annual pension higher than €6000 is -0.19% of the opening reserves,
- For collective scheme, analysis of dead pensioners, men with annual pension higher than €4 156 live 4 years longer than other men (1 year for women).

4. Results

- **Third approach : Comparison of survival probability by generation**

- Figure 5 – Generation 1942 case



1942 generation	Women	Men
Number of observations	23	113
Average	-0,55%	-0,52%
Standard error	0,29%	0,36%
Central trend tests : Mu0=0		
Student statistic	-8,98824	-15,1598
Pr > |t|	<.0001	<.0001
The M sign test	-11,5	-40,5
Pr >= |M|	<.0001	<.0001
Wilcoxon S test	-138	-2962,5
Pr >= |S|	<.0001	<.0001

- Main Findings
  - For the 1942 generation, there are less observed deaths than expected by the tables,
  - This gap is confirmed by parametric tests as well as non parametric tests,
  - That gap rise to (-0.55%) for women and (-0.52% for men),
  - The results can however be very different from a generation to another (because of basic risk) as the 1941 generation shows

4. Results

- **Approach 3 : Comparison of survival probability by generation**

- Table 3 – Statistics and central trend tests on probability spreads for the sixteen generations of the sample

1930 – 1945 generations	Women	Men
Number of observations	982	3896
Average	0,50%	0,63%
Standard error	0,84%	0,89%
Central trend tests : Mu0=0		
Student statistic	18,85	44,37
Pr > |t|	<.0001	<.0001
The M sign test	187	875
Pr >= |M|	<.0001	<.0001
Wilcoxon S test	142582,5	2537625
Pr >= |S|	<.0001	<.0001

- Main findings
  - On average, there are more observed deaths than expected by the tables: +0.50% for women and +0.63% for men, this confirms the result sets of the first approach,
  - These results contradict those of the 1942 generation,
  - The instability of the results is a sign of a presence of heterogeneity among members of the sample,
  - Cautious: the annuitants of the generations 1930 to 1945 represent only 42.7% of the annuitants of the sample.

5. Conclusion

- Before we sum up our main findings, let's remind again the two points around which our problematics
  - Compare observed deaths from our sample to those expected from the regulatory tables
  - Compare sinistrality of an individual scheme to one of a collective scheme
- More deaths are observed in our sample than expected by the tables TGH05 and TGF05,
- There is therefore a gain in numbers for the insurer. However, this gain in numbers turns to a loss in reserves,
- The loss in reserves comes from the fact that annuitants with higher annual pension live longer than annuitants with weaker annual pensions
- The sample is undoubtly characterised by an heterogeneity which leads to instable results,
- Traditional criteria like age, gender and born generation seem not to be enough to correctly assess the longevity risk. As some other have shown for the UK, socioeconomic features can help to improve the assessment of longevity risk.

THANK FOR YOUR ATTENTION !

We welcome questions and suggestions !