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Abstract

This article focuses on the life insurance industry in France and attempts to shed light on whether the insurers behave in a competitive fashion, or whether, on the contrary, they take coordinated decisions. We propose several empirical tests, which entail the estimation of the Boone indicator, a tool which explores the relationship between firms' relative costs and profits, the evaluation of the switching costs beard by consumers when they decide to change insurer, and the construction of a structural model, which is based on an oligopolistic framework where insurers propose differentiated products. Our results suggest unambiguously that firms do follow a competitive behavior.

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1. Introduction

The life insurance industry in France represents roughly 5 percent of the French GDP in 2014.[3] Given that the products supplied depend on future investment returns, it is important for each consumer to choose an insurer adequately, and to make sure that firms propose good quality services. The question of the existence and the degree of competition in this sector is therefore crucial in terms of the consumer welfare.

Various factors that are specific to the life insurance industry, mostly on the demand side, may affect the intensity of competition across insurers. In particular, high switching costs are standard in life insurance policies, given that contracts are of a long-term nature and that early termination on the part of the consumer entails monetary costs. Moreover, the consumer power may be limited due to the very high complexity of life insurance products and the fact that insurers use product differentiation. This paper attempts to shed light on whether the insurers behave in a competitive fashion, or whether, on the contrary, they coordinate their decision in one way or another.

The methodology we propose here is quite different from what has been proposed so far in the economic literature interested in the detection of the existence of competition in the life insurance industry. Previous studies have appraised the intensity of competition through the estimation of firms' cost functions to evaluate the returns to scale in the industry and measure efficiency. It is expected that efficiency is observed in market with increased competition; however, substantial cost economies may result in a more concentrated industry that would facilitate collusive pricing behavior, while decreasing returns may entail a large number of firms producing only a small range and scale of outputs, which facilitates competition in the industry. Grace and Timme (1992), Gardner and Grace (1993), and Cummins and Zi (1998) produce several types of results which exploit this line of research. They use data on U.S. life insurers and shed light on the existence of scale economies for smaller firms while larger companies seem to face constant (or even decreasing) returns. Other studies have used reduced forms techniques such as the Boone indicator, which is based on the idea that an efficient firm beneficiates from higher market shares and hence higher profits than a less efficient one; the more vigorous this effect, the more competitive the market. Bikker and Van Leuvensteijn (2008) apply this technique to the Dutch life insurance industry and conclude that competition is rather limited.

[3] Source : Fédération Française de l'Assurance (FFA), http://www.ffa-assurance.fr/.

Here, we adopt an approach which consists in evaluating the intensity of competition. Three main methods are proposed: First, we propose an indirect measure of competition using the Boone indicator.

Second, we evaluate consumers' switching costs for each insurance company's and each year. Economists have suggested that switching costs confer market power to firms and thus reduce the competitive pressure within a market. These costs are usually endogenous in the sense that they are the result of economic strategies to attract or lock-in consumers. We show, using a theoretical model of competition between several companies, how optimal saving rates are determined and how switching costs affect these rates. A comparison with other industries is proposed to quantify the magnitude of these switching costs.

Finally, we propose a structural approach which is based on an oligopolistic framework where insurers propose differentiated products; we build a full equilibrium system where consumers' demand and firms' markups are considered jointly. On the one hand, the elasticity of demand determines how attractive it is for a firm to unilaterally change its prices. On the other hand, the expression of firms' markups captures the essence of firms' strategic interaction, and allows us to test whether companies compete against each other as predicted by the theory, or whether they are engaged in a collusive arrangement. Differentiated product industries present complex strategic interactions among asymmetric products and insurers. Our methodology comprises a logit-type model to represent consumer choice and to explain market shares measured in terms of the number of policies held by each insurer. The logit model is rich enough to capture the basic nature of the competitive interaction and has been used extensively in the estimation of demand parameters. Earlier applications have been to transportation (see for instance Ben-Akiva and Lerman, 1985, or Train, 1986), but it is used nowadays in the modeling of competition in differentiated products industries (see Anderson and de Palma, 1992, and Anderson, de Palma and Thisse, 1992). Our empirical strategy decomposes into two steps: First, we estimate a demand function based on a logit specification in order to evaluate the elasticity of demand. Second, this elasticity is incorporated into two pricing equations which state that the observed firms' markups are equal to (i) a theoretical markup which assumes that firms behave in a (Nash-Bertrand) competitive fashion, or (ii) a theoretical markup which states that firms collude. Our results suggest unambiguously that firms do follow a competitive behavior.

Our paper is organized as follows: Section 2 presents our dataset and the different variables that are used in the empirical analysis. Section 3 proposes an indirect measure of competition using the Boone indicator. Section 4 focuses on the evaluation of the insurers' switching costs, while Section 5 discusses how these costs change with firms' size. Section 6 presents the structural model. It discusses the empirical results based on the estimation of the demand function and presents two formal tests based on the competitive behavior of the insurers. Section 7 concludes.

2. Data

We use the accounting database provided by the Fédération Française de l'Assurance (FFA) over the period 2005-2011. In order to elaborate the profit functions of the insurance companies, we extract information from the so-called C1 ratios, 'Etats C20', 'compte de résultats techniques', and 'états récapitulatifs des placements'.[4] We focus exclusively on individual/group insurance contracts, which are opened in euros (or any other currency) since insurance companies commit in this activity to pay consumers a specific saving rate. In other words, the process in which insurance companies propose a saving rate to attract consumers is the competitive game we want to model. Considering unit-linked policies would not allow testing an economic model in which the insurance companies have a clearly defined strategic behavior, given that the outcome is uncertain in this case. [5]

The initial database contains 113 different insurance contracts observed between 2005 and 2011. Considering all these contracts is problematic as the heterogeneity between the different companies may be very important. For example, AXA France Vie opened 434.552 new contracts in 2009 while Avip Life received only 385 new contracts in 2008. It is therefore not reasonable to consider that these two companies are direct competitors. Another type of difficulty is that the same company may offer several types of products, some of which are more important than others in terms of visibility to consumers. This is the case for example of Crédit Agricole which holds Dolcea Life (1674 new contracts in 2011), Spirica (6,454 new contracts in 2011) and Predica (604,389 new contracts in 2011). We chose to retain only the largest life insurance product for each company. We have also chosen to

[4] The so-called ratios C1, 'états C1', and 'états C20' provide information on the individual financial accounts of the insurers. The ratios C1 focus mainly on interest rates such as the management cost of a life insurance contract or the saving rate on investment. The 'états C1' concern the financial flows that are specific to each company and the états C20 include information on the quantities of contracts held by insurer. The 'compte de résultat' technique and the 'état récapitulatif des placements' focus on the investments made by the insurer with the help of the capital of the holders of the life insurance contracts.

[5] When a customer purchases a life insurance contract, he has the choice between a contract in euros and a contract in unit-linked policies which are invested in the stock market. Unlike a contract in euros, the capital in this latter case is not guaranteed; the consumer is therefore the one who supports the risk. As the capital is invested in financial markets, it is subject to upwards and downwards fluctuations.

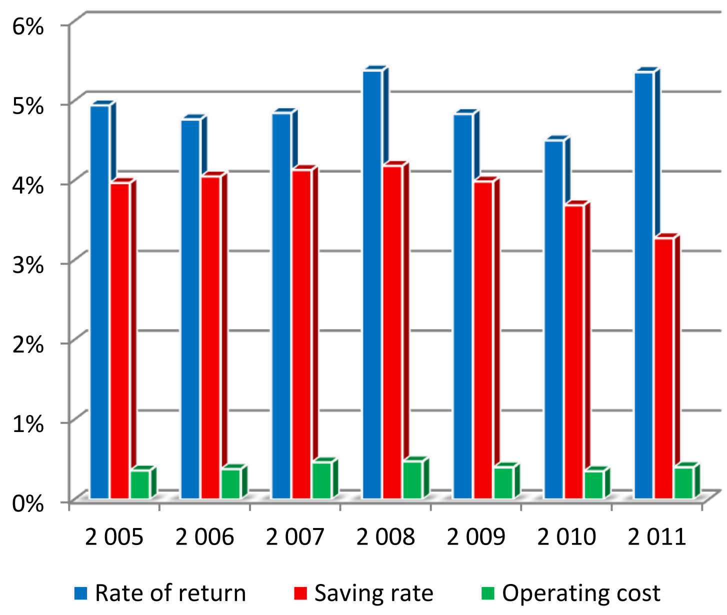
eliminate the insurance companies for which the stock of contracts is less than 100,000 in 2011 to avoid the heterogeneity issues mentioned above, and because it is not clear that small companies are located throughout the country and constitute relevant competitors to large companies.

The final database therefore includes the following 13 life insurance companies: Allianz, Groupama, Generali, Sogecap, Axa, BNP-Paribas, Covea, Macif, MAIF, Credit Mutuel, Credit Agricole, Swiss Life, and CNP Assurances. Note that two contracts are proposed by Covea, which implies a total of 14 life insurance contracts. Table 1 provides descriptive statistics of the variables that are used in our economic model. Note that the average saving rate in the database is 3.9%, while the average rate of return is 5%, and the average operating cost (management fee) is equal to 0.4%. In other words, the average margin per contract is computed as the difference between the rate of return, the saving rate, and the operating cost, which is equal to 0.7%. Also note that each insurance company opened an average of 122.912 new contracts each year. Moreover, there is still a significant gap across companies' production levels since the minimum and maximum are 898 and 1,238,934 new annual contracts respectively.

Table 1: Descriptive statistics (period 2005 - 2011)

Variable	Description	Mean	Standard Deviation	Min	Max
w_i	Rate of return : Investment product divided by total investment	5.0%	0.4%	3.2%	8.1%
r_i	Saving rate	3.9%	0.2%	2.7%	4.9%
c_i	Operating cost	0.4%	0.1%	0.01%	1.5%
N_i	New contracts at date *t*	122,912	78,711	898	1,237,934

Figure 1: Average margins (2005-2011)



The average margin per life insurance contract can be computed for each year of our observation period (2005-2011), as shown in Figure 1 above. It is noteworthy that the average saving rate proposed to the consumers increases slightly between 2005 and 2008, but decreases significantly afterwards. At the same time, the average rate of return received by the insurance companies and their operating costs are more or less constant over the same period. This suggests a significant increase in the margins of the insurance companies after 2008, and calls for further investigation on the behavior of firms. Indeed, higher margins could be a signal that the degree of competition is lessened. Whether this is actually the case in the French life insurance sector is an important issue that needs to be addressed with economic tools that account for consumers' demand and firms' strategic behavior. We turn now to the description and the implementation of these tools.

3. An evaluation of competition with the Boone indicator

An indirect measure of competition can be derived in terms of firms' efficiency. This approach, proposed by Boone (2004), is based on the idea that competition helps identifying the most efficient companies. Indeed, a more efficient company enjoys a larger market share and gets higher profits than a less efficient one. A crucial point of this theory is that the stronger this effect, the more competitive the market.

The intuition to test this idea is simple: If the industry is competitive, it should be true that the relative benefit between pairs of firms is inversely proportional to the relative marginal cost. In other words, firm *i*'s relative benefit (with respect to firm *j*) should increase if firm *i*'s relative marginal cost (with respect to firm *j*) decreases. Hence, the empirical model consists in estimating the following relation in logarithmic terms:

$$\ln\frac{\pi_{it}}{\pi_{jt}} = \beta_1 + \beta_2 \ln\frac{c_{it}}{c_{jt}} + \beta_3 t + \theta_i + \varepsilon_{it}, \qquad (1)$$

where β_1, β_2, and β_3 are parameters to be estimated, π_{it} is the profit of firm *i* at period *t*, c_{it} is the marginal cost of firm *i* at period *t*, *t* is a trend, and ε_{it} is an error term.

Note that the estimation of Equation (1) requires constructing relative profit π_{it}/π_{jt} and marginal cost c_{it}/c_{jt} indexes for all potential insurers' pairs of our database. To account for possible differences in unobserved characteristics of insurers, which cannot be explained by the relative marginal cost, we rely on the panel data structure of our dataset and introduce firms' fixed effects θ_i. These unobserved characteristics cover items like the productive efficiency of insurers, the productivity of inputs, the managerial effort, or marketing strategies. We provide estimates of these unobserved individual effects.

The main parameter of interest is the Boone indicator β_2. This parameter must be negative since the insurance companies that have the lowest relative marginal costs are those that have the highest relative profits. The larger this parameter (in absolute value), the more competitive the market. The parameter β_3 which is associated with the trend *t* is also an important factor since it measures the extent by which the average difference between the profits of the insurance companies varies over time. A positive parameter indicates that the average difference between profits increases, which would contradict the fact that the companies collude on the saving rate. In other words, a positive parameter β_3 setting is good news at the moment of trying to prove that the life insurance market is competitive.

The ordinary least squares estimates of Equation (1) are presented in Table 2 below. Several types of estimates are presented. First, the seven left columns provide results based on cross section data, that is to say, a specific year is used for each estimate. The two right columns consider all years simultaneously with or without fixed effects. In all cases, the parameter β_2 is negative and highly significant, suggesting that the insurance industry is indeed competitive. This impression is reinforced by the parameter β_3 which is positive and highly significant as well, suggesting that the average difference between the profits of the insurance companies increases over time.

The value of the Boone parameter that seems most reliable is the one associated with the panel data framework and the fixed effects, that is to say, $\beta_2 = -0,36$. This value indicates that a 1% decrease in the relative marginal cost of a company leads to an increase of its relative profit of 0.36%. To ease the interpretation of this value, it may be useful to compare it with those obtained in other studies. For instance, Bikker Leuvensteijn and Van (2008) use the same type of indicator in order to measure competition in the life insurance sector in the Netherlands between 1995 and 2003. They obtain an indicator of a similar average magnitude (-0.45) and acknowledge the existence of a significant competition in the Netherlands. It may also be useful to focus on the results obtained by researchers working on other industries such as the manufacturing sector: Creusen, Minne and van der Wiel (2006) obtain values that range between -5.7 and -2.7 for the Dutch case between 1993 and 2001. While it is problematic to compare indicators obtained in different industries, these results suggest that the Dutch manufacturing industry is certainly more competitive than the life insurance in France.

Table 3 presents estimated values of the companies' fixed effects. It illustrates the fact that there are indeed differences in unobserved characteristics of several insurers, which cannot be explained by the relative marginal cost. In other words, insurers' know-how may also be an important ingredient to explain differences in profits.

Table 2: Evaluation of insurers' economic efficiency

Year / *Parameter*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2005-11*	*2005-11*
β_1	-1.49*** (0.26)	-0.49 (0.30)	-0.38 (0.22)	0.53*** (0.20)	-0.04 (0.19)	0.46** (0.22)	-0.09 (0.14)	-1.51*** (0.21)	-1.18*** (0.50)
β_2	-0.49*** (0.14)	-0.15 (0.17)	-1.11*** (0.15)	-1.22*** (0.17)	-1.28*** (0.18)	-0.85** (0.19)	-0.70*** (0.13)	-0.69*** (0.06)	-0.36*** (0.07)
β_3								0.35*** (0.05)	0.34*** (0.05)
σ_ε	2.05*** (0.14)	2.29*** (0.16)	1.56*** (0.11)	1.66*** (0.12)	1.45*** (0.11)	1.96*** (0.15)	1.39*** (0.10)	1.89*** (0.05)	1.72*** (0.05)
Fixed effects								No	Yes
R^2									0.32
# of observations	69	69	61	69	55	79	105	507	507

Table 3: Individual fixed effects

Firm	*Parameter*	Estimation
X	θ_1	0.79** (0.33)
Y	θ_2	0.57* (0.31)
Z	θ_{10}	0.80*** (0.31)
V	θ_{12}	-0.64* (0.35)
W	θ_{14}	-2.32*** (0.33)

Note : Non-significant fixed-effects are not shown.

4. An evaluation of switching costs

Switching costs include all monetary or psychological costs incurred by a consumer when changing insurer. These costs are of different types. They comprise direct costs, such as transaction costs (e.g., cost of opening or closing a bank account), indirect costs such as research costs (when a consumer chooses a product best suited to its needs) or learning (costs that could be involved when investing in a new product) and finally psychological costs.

If these costs are small, one can assume that clients can easily move between contracts and between suppliers. It would then be a signal of a competitive market. In other words, measuring the level of switching costs is a measure of the degree of competition.

There are very few empirical studies providing orders of magnitude on the switching costs or attempting to identify their determinants. Three types of empirical analysis are usually implemented in the literature: (i) A direct measure of switching costs, (ii) the identification of the determinants of individual choices, using an analysis on stated preferences (marketing approach), or an analysis on revealed preferences (econometric approach), and (iii) the analysis of market frictions, in a static or a dynamic setting, through the identification of supply and demand forces using econometric methods.[6]

The first type of analysis is historically the oldest. It has the advantage of providing a measure of switching costs with a minimal information requirement but it does not allow to identify the determinants of these costs. Moreover it has become "standard" in the sense that it is frequently used by competition authorities in their analysis of the degree of competition. It is also often supplemented by direct measurements of the degree of competition. In a way, a direct measurement of the switching costs and the level of competition are preliminary steps that are both necessary to provide a fair descriptive analysis of the sector under consideration and to provide a first response to concerns regarding the competitive forces at stake in an industry. This is the type of analysis that we consider here.

We propose a model of competition between insurance companies based on Shy (2002), which allows us to assess the switching costs imposed by companies to consumers. The equilibrium concept used here differs slightly from the Bertrand-Nash behavior, and is denoted the improvement-proof equilibrium. Unlike the Nash-Bertrand type of behavior, where each competitor assumes that the rival insurer does not alter its saving rate, the improvement-proof environment allows firms to be "ready" to improve their saving rate whenever profitable. It is assumed that life insurance companies take two types of strategic decision: (i) First, they set a switching cost for consumers, and (ii) second, they set a saving rate for their life insurance contract. We focus on the second step and build a competition model in which life insurance companies compete in saving rates. They determine the saving rate that maximizes their profit, and this saving rate is conditional on the switching cost set in the first step (i). Once we have determined the strategic behavior of insurance companies, we can retrieve the values of the switching costs for each company using our data

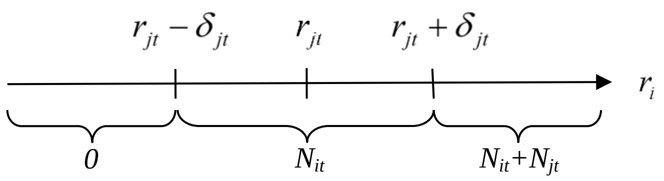
We proceed now to the construction of the economic model. The profit function of a life insurance company is denoted as

$$\pi_{it} = \left(w_{it} - r_{it} - c_{it}\right) N_{it}\,, \tag{2}$$

[6] In a study on the existence of competition in an industry, the third type of analysis is by far the most relevant. However it requires richer databases insofar as it must include observations on the quantities and prices of all goods and services produced to allow a successful implementation. The second type of analysis involves conducting consumer surveys to identify the determinants of their individual choices between different products. The advantage of this approach is that it would allow to better capture the observable heterogeneity of individuals and products in the analysis.

where π_{it} measures the profit of company *i*, w_{it} is the rate of return, r_{it} is the saving rate, c_{it} is the operating cost, and N_{it} is the quantity of contracts sold at period *t*. Moreover, we need to model customers' choice. The utility of the consumer of product *i* is $U_{it} = r_{it}$ if it sticks to the same insurance company, and $U_{it} = r_{it} - \delta_{it}$ if it changes company. Note that δ_{it} is specific to a life insurance company (not consumer specific).

Take the case of two firms *i* and *j* which are competing against each other. They are characterized by distinct switching costs and saving rates. They beneficiate from N_{it} et N_{jt} customers, meaning that, at the beginning, N_{it} consumers have purchased company *i*'s product and N_{jt} consumers have purchased company *j*'s product. For company *i*, the choice of a saving rate r_i impacts the level q_i of its own demand. The latter depends on the position of r_i with respect to r_j and δ_i as suggested by the following graph:



Graph 1: Setting the saving rate r_{it}

Improving the saving rate of the competitor, i.e., setting $r_{it} \geq r_{jt} + \delta_{jt}$, allows capturing the competitor's demand. Hence, the quantity q_{it} of consumers that purchase company *i*'s product is defined as follows :

$$q_{it} = \begin{cases} N_{it} + N_{jt} & \text{if} \quad r_{it} \geq r_{jt} + \delta_{jt}, \\ N_{it} & \text{if} \quad r_{jt} - \delta_{jt} \leq r_{it} < r_{jt} + \delta_{jt}, \\ 0 & \text{if} \quad r_{it} < r_{jt} - \delta_{jt}. \end{cases}$$

To capture a consumer, a firm must subsidize the switching cost δ_{it} beard by the consumer. One can then determine for each firm *i* the optimal saving rate r_{it} which maximizes its profit. A higher rate allows capturing more consumers but is more costly. On the other hand, a lower rate is more profitable for the insurance company but increases the probability that the competitor sets a higher saving rate and captures the whole demand. Hence, each firm *i* determines the optimal rate r_{it} under the constraint:

$$\pi_{jt} = \left(w_{jt} - r_{jt} - c_{jt}\right)N_{jt} \geq \left(w_{jt} - \left(r_{it} + \delta_{it}\right) - c_{jt}\right)\left(N_{it} + N_{jt}\right). \tag{3}$$

This constraint implies that firm *j* must not obtain a higher profit by improving the rate r_{it} and capturing the whole demand $N_{it} + N_{jt}$ compared to a situation where it serves only its own base N_{jt}.

Omitting the index *t* for simplification, a pair of saving rates $\left(r_i^{ER}, r_j^{ER}\right)$ constitutes an improvement proof equilibrium if

$$\begin{cases} \pi_j = \left(s_j - r_j - c_j\right)N_j \geq \left(s_j - \left(r_i + \delta_i\right) - c_j\right)\left(N_i + N_j\right) \\ \pi_i = \left(s_i - r_i - c_i\right)N_i \quad \geq \left(s_i - \left(r_j + \delta_j\right) - c_i\right)\left(N_j + N_i\right) \end{cases}$$

To find the equilibrium pair $\left(r_i^{ER}, r_j^{ER}\right)$, one needs to solve the system :

$$\begin{cases} \pi_j = \left(s_j - r_j - c_j\right)N_j = \left(s_j - \left(r_i + \delta_i\right) - c_j\right)\left(N_i + N_j\right) \\ \pi_i = \left(s_i - r_i - c_i\right)N_i \quad = \left(s_i - \left(r_j + \delta_j\right) - c_i\right)\left(N_j + N_i\right) \end{cases}$$

Then one obtains the expression of the optimal saving rate for each insurer:

$$r_i = \frac{\left(s_i - c_i\right)N_j^2 + \left(s_j - c_j\right)N_i\left(N_i + N_j\right) - \delta_i\left(N_i + N_j\right)^2 - \delta_j N_j\left(N_i + N_j\right)}{N_i^2 + N_j^2 + N_i N_j}, \tag{4}$$

and

$$r_j = \frac{\left(s_j - c_j\right)N_i^2 + \left(s_i - c_i\right)N_j\left(N_j + N_i\right) - \delta_j\left(N_j + N_i\right)^2 - \delta_i N_i\left(N_j + N_i\right)}{N_j^2 + N_i^2 + N_j N_i}. \tag{5}$$

These expressions allow performing several types of simulation. Knowing the different characteristics of each insurance company, it is possible to simulate any pair of saving rate r_i and r_j.

Note that, according to Equations (4) and (5), increasing the switching costs reduces the saving rates. Indeed, higher switching costs make it harder for the consumer to move from an insurance company to another, which reduces the competitive pressure within the industry.

To measure the state of competition in the industry, it is important to assess the switching costs imposed by insurance companies onto the customers. As companies behave optimally and maximize profits, the optimal saving rates defined in equations (4) and (5) are those that we observe in our database. We can then retrieve an assessment of the switching costs from the same maximization program as the one defined above. However, since we want to evaluate the switching cost for each company, we need to generalize the previous program to a case where more than two companies compete.

Assume now that I firms compete against each other. In each period t, insurers determines the optimal saving rate r_{it}, $i = 1,..., I$. The most profitable company is the one with the largest market share. The least profitable is the one with the smallest market share. The smallest firm has the highest incentives to improve the profitability of the others. We rank the companies by size:

$$N_{1t} > N_{2t} > ... > N_{it} > ... > N_{I-1t} > N_{It}.$$

Each firm i competes against I and determines the optimal r_{it} under the constraint

$$\pi_{It} = (s_{It} - r_{It} - c_{It})N_{It} \geq (s_{It} - (r_{it} + \delta_{it}) - c_{It})(N_{it} + N_{It}). \tag{6}$$

Firms that propose their consumers a saving rate that is too small face the risk that their competitors improve their offer. From this condition one derives directly:

$$\delta_{it} = (w_{It} - r_{it} - c_{It}) - (w_{It} - r_{It} - c_{It})\frac{N_{It}}{N_{it} + N_{It}}. \tag{7}$$

This expression allows computing a switching cost for each firm and each year. As the smallest firm I is the reference that allows computing a switching cost for all the other competitors, we cannot compute r_{It}.

Recall that we suggested above that the switching cost δ_{it} is specific to the insurer i. However, it also provides an indication on the characteristics of the consumers who purchase their products from i. Indeed, at the equilibrium, the distribution of consumers across the different insurance companies depends on consumers' switching costs. The difference in the switching costs is highlighted by the fact that the consumers with the lowest switching costs are those who change insurer more easily and therefore buy products from insurance companies that offer higher saving rates. Conversely, consumers with the highest switching costs are present within insurance companies that offer the lowest saving rates. It is therefore expected that the larger institutions are those that offer the lowest saving rates and capture the consumers who have the highest switching costs.

The results of the computation of switching costs from Equation (7) are presented in Tables 4a and 4b below. Annual values for the entire industry are presented as well as individual values for each insurance company over the 2005-2011 period. The average switching cost for the whole period is equal to 1.3%, suggesting that a consumer will have to bear a cost equivalent to 1.3% of the amount of its life insurance contract if s-he wishes to change insurer. Annual assessments suggest an increase of the switching cost over the period studied. In addition, individual assessments shed light on potentially large differences between the different insurers, as switching costs vary between 0.58%. and 2.21%.

How should we interpret these results? First we compare them with other values obtained by other researchers in studies conducted in other industries. For example, Shy (2002) estimates the costs of switching costs for banks in Finland in 1997 and obtains values close to 10 to 20% of the amounts held on current accounts of consumers. In addition, Kim Kliger and Vale (2003) estimate the switching costs in the bonds market in Norway between 1988 and 1996. They obtain mean values that are equivalent to changes in interest rate equal to 4.12%. If we stick only to these results, the values obtained in our study suggest that the switching costs in the life insurance industry in France are rather low. Moreover, as we have already noted, switching costs are quite heterogeneous from an insurance company to another, which eases customer mobility across firms. These empirical evidences are consistent with a rather competitive industry.

Table 4a: Average switching cost in the industry

	Switching cost δ_i (in %)							
	2005	2006	2007	2008	2009	2010	2011	2005-11
All firms	1.18	0.77	0.99	1.37	1.31	1.63	1.51	1.30

Table 4b: Average switching cost per insurer

Insurer	2005 - 2011
A	1.13
B	0.58
C	0.90
D	1.61
E	1.60
F	1.90
G	0.72
H	1.52
I	0.78
J	2.21
K	2.12
L	Réf
M	0.58
N	1.91
O	0.66

5. Switching costs and firms' size

We now propose to assess empirically the link between the switching cost and the characteristics of the insurance companies with the following equation:

$$\ln \delta_{it} = \alpha_1 + \alpha_2 \ln N_{it} + \alpha_3 t + \alpha_4 X_{it} + \xi_i + \varepsilon_{it}, \qquad (8)$$

where the switching cost δ_{it} of firm *i* at time *t* is computed from Equation (7), α_k, $k = 1,...,4$, is a set of parameters to be estimated, N_{it} is the quantity of life-insurance contracts sold, *t* is a trend, X_{it} accounts for the characteristics of observed health insurance company, namely the nature of the company (1 if mixed, 0 if life/capitalization), or the distribution mode (which takes value 1 if *i* is a company with intermediaries, and 0 if the latter is a company with financial offices or direct sales), ξ_i is a set of individual and non-observable fixed-effects, et ε_{it} is an error term.

Once again, the introduction of fixed effects ξ_i for each insurance company allows us to take into account the possible presence of differences in the unobserved characteristics of the insurance companies, which influence the switching cost δ_{it} and cannot be explained by the factors introduced in equation (8). These unobserved characteristics may be related to the productive efficiency of the insurance companies, the productivity of the inputs, the managerial effort or the strategies implemented by the company. The fixed effects are also appropriate here to address the particular nature of our panel dataset as each insurance company is observed over several periods.

The results are shown in Table 5 below. The first column does not take into account the nature of the company or the distribution method contrary to columns 2 and 3. The results suggest that the size of the company, measured by the quantity of contracts sold, influences positively and significantly the switching cost. If the number of contracts increases by 1%, the switching cost rise is of 0.21%. One may argue that the larger the company's market share, the less risky, and the higher the associated switching cost. Only a structural model could be used to test this conjecture.

Moreover, the parameter α_3 associated with the trend t is positive and significant, which implies that the average switching cost of the industry increases over the period, all other things being equal. The nature of the company (mixed or life/capitalization) does not seem to impact on the switching cost since the associated parameter is not significant. However, the results suggest that companies with intermediaries are characterized by lower switching costs compared to those with financial desks or direct sales.

Table 5: Determinants of the switching costs

Parameter	Variable	Estimation		
α_1	Constant	-3.10*** (0.17)	-2.42*** (0.43)	-2.48 (3.06)
α_2	N_{it}	0.21*** (0.02)	0.21*** (0.02)	0.21*** (0.02)
α_3	Trend	0.06*** (0.01)	0.06*** (0.01)	0.06*** (0.01)
α_4	Mixed			-0.61 (3.05)
α_4	Life/capitalization		-0.67* (0.38)	
σ_ε		0.17*** (0.00)	0.17*** (0.00)	0.17*** (0.00)
Fixed effects		Yes	Yes	Yes
# of observations		96	96	96

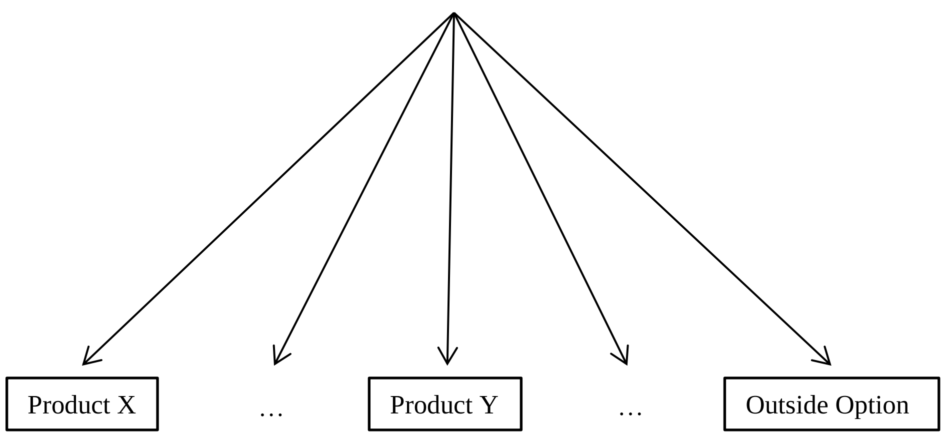
6. A structural model

The objective now is to produce a direct measure of the degree of competition. To do so our empirical strategy consists in estimating an equilibrium model of the insurance industry in order to identify the conduct of players on the supply side, i.e., insurers. We first estimate a demand function in order to retrieve information on the demand elasticity parameter. In a second step, we use this information to test whether insurers behave competitively or ccoperatively. This require to derive the two pricing conditions which assume that the industry is competitive, or is affected by collusion between firms.

6.1. Demand

The demand for life insurance is derived from a qualitative choice model which describes situations in which consumers choose from a finite and exhaustive set of mutually exclusive alternatives. The structure of preferences for a representative consumer is represented by a logit specification. (See Werden, Froeb and Tardiff, 1996, for an extended pedagogical discussion of this methodology.) A consumer chooses a life insurance product among a set of I possible products, which are indexed by i, and are supplied by I different insurers. Hence, i may denote alternatively a product or the insurer who proposes this product. There is an additional choice, denoted as the outside option, which is referred by index 0 in what follows. The outside option corresponds to any alternative which is not a life insurance product, i.e., it may be for instance another saving product, or any regular checking account. Hence, there are a total of $I+1$ products. See figure 2 below.

Figure 2: **Structure of choices**



The consumer selects at period *t* the alternative *i* to maximize utility U_{it}. The utility associated to the choice *i* at period *t* is denoted as

$$U_{it} = \alpha\, r_{it} - \delta_i + \zeta_{it}\,. \tag{9}$$

Hence, each choice *i* depends on three components: The saving rate r_{it}, a firm fixed-effect δ_i, and a random term ζ_{it}. The sensitivity of the utility to the saving rate is measured by the parameter α. The latter is expected to be positive as consumers value a higher saving rate, i.e., the demand for a life insurance product *i* increases with the saving rate proposed by the insurance company *i*. The firm fixed-effect δ_i may also be re-interpreted as a switching cost. We return on this point in more details below. Finally, the random component ζ_{it} combines all variables that are not observable by the analyst and play a role in the consumer choices.

Individual utility maximization yields choice probabilities. Indeed, a consumer prefers insurer *i* over insurer *j* if

$$U_{it} > U_{jt}\,. \tag{10}$$

Hence, the probability that the insurer *i* is selected is

$$\Pr\left(U_{it} > U_{jt}\right) = s_{it} = n_{it} / N_t\,. \tag{11}$$

In the previous expression, n_{it} measures the total number of life insurance policies held by the insurer *i*, and N_t denotes the market size, such that

$$N_t = n_{0t} + n_{1t} + n_{2t} + n_{3t} + ... + n_{It}\,. \tag{12}$$

Thus, the probabilities are expressed in terms of insurers' market shares. An important issue, which is related to the number of policies associated with the outside alternative n_{0t}, will be discussed in more details in what follows.

The logit model allows us to transform the probability expressed in Equation (11) and derives the market share s_{it} as

$$\ln s_{it} - \ln s_{0t} = \alpha\, r_{it} - \delta_i + \varepsilon_{it}\,, \tag{13}$$

where s_0 is the market share of the outside alternative. This expression is referred as the demand equation which relates the (relative) market share s_{it} of insurer *i* to a saving rate r_{it}, a fixed effect δ_i, and a random term ε_{it}.

6.2. Pricing

Two pricing scenarios, which constitute the core of our test on competition, are now considered: In the competitive situation, firms adopt a Bertrand-Nash behavior; otherwise, in a collusive case, firms tacitly coordinate their pricing strategies. We now present these two hypotheses of market equilibrium.

Competition

In a competitive environment, insurance companies are said to adopt a Bertrand-Nash behavior in the sense that they compete against each other strategically. Each company chooses the saving rate r_{it} that maximizes profit π_{it}, given that the other companies are choosing their saving rates in the same way. Hence, the objective of each firm is

$$\underset{r_{it}}{Max}\,\pi_{it} = \left(w_{it} - r_{it} - c_{it}\right)n_{it}. \tag{14}$$

Each company trades off two effects when considering a decrease in the saving rate r_{it} proposed to the consumers: On the one hand, it increases profits, and this increase is proportional to the current number of life insurance policies n_{it} held by the firm. On the other hand, it reduces the size of the consumer base n_{it}, since consumers are attracted to the life insurance policies that propose the highest saving rates, and this lowers profits proportional to the current markup $w_{it} - r_{it} - c_{it}$. When the demand is specified as in Equation (13), this trade-off is summarized by the pricing equation

$$\frac{w_{it} - r_{it} - c_{it}}{r_{it}} = \frac{1}{\alpha\left(1 - s_{it}\right)r_{it}}. \tag{15}$$

This expression suggests that, if firms behave in a competitive fashion, the observed markup $w_{it} - r_{it} - c_{it}/r_{it}$ should be equal to the inverse of the absolute value of the own-price elasticity $\alpha\left(1 - s_{it}\right)r_{it}$. In this expression, all the variables w_{it}, r_{it}, c_{it}, and s_{it} can be computed from our dataset. An estimated value $\hat{\alpha}$ can be obtained from the demand expression (13). Hence, we can construct a test of whether the observed margin (left-hand side of Equation 15) is equal to the theoretical *competitive* margin (right-hand side of Equation 15). This can be performed with a simple *t*-test.

Collusion

In a collusive environment, insurance companies set saving rates jointly in order to maximize the sum of all firms' profit, in a similar fashion to what a monopoly would do. In this case, the pricing Equation (15) transforms into the following expression:

$$\frac{w_{it} - r_{it} - c_{it}}{r_{it}} = \frac{1}{\alpha \; s_0 \; r_{it}} . \qquad (16)$$

This expression suggests that, if firms adopt a collusive behavior, the observed markup $w_{it} - r_{it} - c_{it} / r_{it}$ should be equal to the inverse of the absolute value of the own-price elasticity $\alpha \; s_0 \; r_i$. Once again, in this expression, all the variables w_{it}, r_{it}, c_{it}, and s_0 can be computed from our dataset. An estimated value $\hat{\alpha}$ can be obtained from the demand expression (13). Hence, we can construct a test of whether the observed margin (left-hand side of Equation 16) is equal to the theoretical *collusive* margin (right-hand side of Equation 16). This can, again, be performed with a simple *t*-test.

6.3. Empirical results

We turn now to the empirical side of our exercise. We first present in this section the empirical results associated with the estimation of our demand equation (13). We exploit the panel structure of our dataset and estimate firms' individual fixed-effects together with the demand elasticity. We then shed light on a possible re-interpretation of these fixed-effects from the perspective of the switching costs that may affect consumers' mobility from one insurer to another.

The estimation results are presented in Table 6 and Table 7 below. The demand Equation (13) is estimated by means of two-stage least squares (2SLS) as the saving rate r_i is determined simultaneously with the market share s_i and is therefore endogenous.

The procedure requires the use of instrumental variables. The instrument we have selected is the exogenous variable c_i, which measures the operating cost of one life insurance contract beard by the insurance company. The first-step of the 2SLS procedure consists in, first, regressing the endogenous variable $\ln r_{it}$ on the exogenous instrument $\ln c_{it}$ plus a constant, and then, obtaining a predicted $\hat{r}_{it}$ from the estimated parameters of the equation. The first-step estimates are presented in Table 6 above. All parameters are significant at the one percent level, while the estimated R^2 is equal to 0.07, which suggests that a reasonable fraction of the explained variable $\ln r_{it}$ is explained by our instrument $\ln c_{it}$.

Table 6: Estimation results (First step: Dependent variable: $\ln r_{it}$)

Variable	Estimates
Constant	-3.03*** (0.03)
$\ln c_{it}$	0.04*** (0.00)
Standard error σ_ε	0.05*** (0.00)
R^2	0.07
Number of observations	98

Note : Standard errors are in parenthesis.
***significant at 1 percent.

The second step of the 2SLS procedure fits the endogenous variable $\ln s_{it} - \ln s_0$ on the predicted saving rate $\hat{r}_{it}$ plus a constant and a series of firms' fixed effects.[7] The estimates are presented in table 7 below (Model 2). Most parameters are significant at the one percent level, while the estimated R^2 is equal to 0.76, which suggests that the fit of the model is quite good. The first column of Table 7 (Model 1) presents a simple OLS estimation where the relative share $\ln s_{it} - \ln s_0$ depends on the observed saving rate r_{it}, hence ignoring the potential endogenous nature of the explanatory variable. Several comments are worth emphasizing:

[7] The size of the outside alternative is set equivalent to the sum of all the life insurance contracts offered by all the insurers of our dataset at *t*, i.e. $n_{0t} = n_{1t} + n_{2t} + n_{3t} + ... + n_{It}$. Hence, the total number of potential consumers N_t is set equal to $2 \times (n_{1t} + n_{2t} + n_{3t} + ... + n_{It})$. Market shares s_{it} and s_0 are computed accordingly.

Table 7: Estimation results (Second step: Dependent variable: $\ln s_{it} - \ln s_0$)

Variable	Estimates	
	Model 1	Model 2
onstant		-7.27*** (1.70)
r_{it}	-0.12 (1.69)	
$\hat{r}_{it}$		130.39*** (42.94)
FE *A*		1.28*** (0.14)
FE *B*		-0.20 (0.14)
FE *C*		0.90*** (0.14)
FE *D*		2.07** (0.16)
FE *E*		2.01*** (0.14)
FE *F*		2.30 (0.16)
FE *G*		3.13*** (0.14)
FE *H*		1.88 (0.19)
FE *I*		1.60*** (0.14)
FE *J*		1.53 (0.15)
FE *K*		3.68*** (0.19)
FE *L*		-1.09*** (0.14)
FE *M*		3.34*** (0.17)
Standard error σ_ε		0.26*** (0.00)
R^2		0.76
Mean log-likelihood	5.550	5.596
Number of observations	98	98

Note : Standard errors are in parenthesis.
***significant at 1 percent; **significant at 5 percent; *significant at 10 percent.

- A simple OLS estimation is misleading since it suggests that the saving rate r_{it} has no significant impact on the relative share $\ln s_{it} - \ln s_0$.
- Our 2SLS model shows that the saving rate r_{it} has a significant and positive impact on the relative share $\ln s_{it} - \ln s_0$. Thus, according to the economic intuition, consumers value higher saving rates. The direct share-saving rate elasticity can be computed as $\eta_{s/r} = (\partial s_{it} / \partial r_{it}) \times (r_{it} / s_{it}) = \alpha r_{it}$. For the average life insurance over our period of observation, $\eta_{s/r} = 5.08$, which suggests that a 1% increase of the saving rate r would lead to a 5.08% increase in the market share s of the firm. This is a highly elastic demand.
- The firms' fixed effects vary significantly across productive units. A higher fixed effect implies a higher valuation of the observed life insurance company by consumers. We discuss this latter result in more details in the next section.

6.4. Firms' valuation and switching cost

The individual fixed effects presented in Table 7 indicate how the different life insurance companies are ranked according to consumers' mean valuation. Thus, for instance, Insurer *F* receives a higher mean valuation than Insurer *B*. This result is obtained everything else being equal, i.e., the life insurance product offered by *F* is preferred upon the one supplied by *B* even if both companies set the same saving rate r_{it}.

Fixed effects capture product characteristics that are non-observable to us and that have a significant impact on the loyalty of consumers to their life insurer. An obvious candidate for factors that build loyalty is product quality. Consumers' utility is higher with greater quality and demand increases accordingly.

Another potential candidate is switching cost. We have evaluated these switching costs in Section 4. Table 8 below reports the average switching costs estimates obtained for each life insurance company and proposes a comparison with the fixed-effects presented in Table 7. It suggests that, although fixed-effects are almost systematically higher than our previous measures of switching costs, they are usually in the same order of magnitude. Hence, the fixed-effects that are estimated through our demand specification (13) may be alternative measures of firms' switching costs, and may potentially include other explanatory factors such as quality. A higher switching cost involve higher demand given that consumers are locked-in in this case and find it more difficult to change supplier in order to obtain a better commercial deal.

Table 8: Demand fixed-effects and switching costs

Life insurance company	Demand fixed-effects	Switching costs
A	1.28	1.13
B	-0.20	0.58
C	0.90	0.90
D	2.07	1.61
E	2.01	1.60
F	2.30	1.90
G	3.13	0.72
H	1.88	1.52
I	1.60	0.78
J	1.53	2.21
K	3.68	2.12
L	-1.09	0.58
M	3.34	1.91

6.5. Testing for competition in the life insurance industry

We are now ready to test whether the French life insurers adopt or not a competitive behavior. We consider a five-step procedure which is described in what follows:

- Step 1: We estimate the demand Equation (13) in order to retrieve the estimated demand elasticity parameter $\hat{\alpha}$.
- Step 2: We plug back the estimated $\hat{\alpha}$ in Equations (15) and (16) and obtain values of the variables w_i, r_i, c_i, and s_0 from the dataset.
- Step 3: We perform a *t*-test of the hypothesis H_0^{comp} that the left-hand side and the right-hand side of Equation (15) are equal.
- Step 4: We perform a *t*-test of the hypothesis H_0^{coll} that the left-hand side and the right-hand side of Equation (16) are equal.

- Step 5: If H_0^{comp} is not rejected and H_0^{coll} is rejected, we conclude that the life insurance industry is competitive. If H_0^{comp} is rejected and H_0^{coll} is not rejected, we conclude that the life insurance industry is not competitive. If H_0^{comp} and H_0^{coll} are both rejected, the test is inconclusive.

The first step of our testing procedure has allowed us to retrieve $\hat{\alpha} = 130.39$. In a second step, we plug back $\hat{\alpha}$ in the right-hand side of Equation (15) and Equation (16) and compute $1/\hat{\alpha}\,(1-s_{it})\,r_{it}$ and $1/\hat{\alpha}\; s_0\; r_{it}$ respectively for each firm *i* and each period *t* of our sample. The left-hand side of each equation, $w_{it} - r_{it} - c_{it}/r_{it}$ is easily predicted, using observed values of the variables w_{it}, r_{it}, c_{it} in the dataset.

Hence, the *t*-statistic of the hypothesis H_0^{comp} is equal to 1.43, while the *t*-statistic of the hypothesis H_0^{coll} is equal to 8.38. This suggests that H_0^{comp} is not rejected and that H_0^{coll} is rejected. We therefore conclude that the life insurance industry is competitive.

6.6. Robustness check

An alternative estimation procedure consists in estimating simultaneously the demand and pricing expressions pairs (13)-(15), and (13)-(16). Hence, we consider the following two systems:

$$\left(S_{COM}\right)\begin{cases} \ln s_{it} - \ln s_{0t} = \alpha\left(1-\delta_{it}\right) r_{it} + \alpha_t\, t + \varepsilon_{it} \\ w_{it} - r_{it} - c_{it} + \alpha_c\, t = \dfrac{1}{\alpha\left(1-s_{it}\right)}, \end{cases} \tag{17}$$

and

$$\left(S_{COL}\right)\begin{cases} \ln s_{it} - \ln s_{0t} == \alpha\left(1-\delta_{it}\right) r_{it} + \alpha_t t + \varepsilon_{it} \\ w_{it} - r_{it} - c_{it} + \alpha_c\, t = \dfrac{1}{\alpha\; s_0}, \end{cases} \tag{18}$$

where S_{COM} accounts for a pricing condition which assumes that competition is the relevant scenario, while S_{COL} assumes that collusion is the relevant setting. Note that, here, an additional trend *t* is introduced in both demand and pricing expressions. Moreover, δ_{it} is not considered as a fixed-effect, as in Section 6.3, but is directly obtained from our switching cost analysis in Section 4. We thus emphasize the fact that switching costs and saving rates are two control variables that have insurers' profits and consumers' demand. However, setting a switching cost is a long-run decision while saving rates can be altered in the short run. Our demand elasticities in S_{COM} and S_{COL} are thus specific to each saving rate r_{it}, but they are conditional on the switching costs δ_{it}. The results are presented in Table 9 below.

Table 9: Demand-pricing system estimation

Variable	Estimates	
	S_{COM}	S_{COL}
α	4.452 (0.75)	4.405 (0.54)
α_t	-0.365 (0.06)	-0.365 (0.06)
α_c	-0.052 (0.01)	-0.058 (0.01)

To determine whether competition or collusion is the most appropriate scenario, we construct a test of S_{COM} versus S_{COL}. Since the two systems are not nested, we use a test proposed by Vuong (1989). The null hypothesis is that both models are equally far from the true data-generating process in terms of Kullback-Liebler distances. The alternative hypothesis is that one of the two models is closer to the true data-generating process. When the Vuong statistic is less than two in absolute value, the test does not favor one model above the other. Here, the Vuong statistic is equal to 3.49, which strongly supports the assumption that competition fits better the real working of the French insurance industry than collusion.

7. Conclusion

This article provides a contribution to the evaluation of competition in the life insurance industry. Previous studies have proposed different indicators to appraise the strategic behavior of the insurers. The menu of possibilities includes questioning whether supplier and consumer power is limited or not, or more sophisticated tools which entail the estimation of cost functions or cost frontiers in order to identify the potential existence of economies of scale in the industry, or the estimation of efficiency indexes for each competitor. It is well accepted that scale economies lead to a consolidation of the industry while large efficiency indexes are expected in markets with increased competition. Other possibilities are the evaluation of the magnitude of the switching costs imposed by firms onto the consumers and the construction of the Boone indicator. In the presence of high switching costs, consumers' mobility is reduced, and competition is therefore limited. The Boone indicator assumes that, in competitive markets, efficient firms enjoy higher profit rates.

This paper revisits two of these methods, namely the evaluation of switching costs and the estimation of the Boone indicator, and it proposes a more original contribution based on the construction of a structural model. The main results and the conclusion of our analysis are as follows:

- The relative position of French companies in terms of profit reflects their relative efficiency;
- The industry is characterized by small switching costs, which moreover vary significantly from one company to another. In other words, consumers are ready to change insurers when they are offered more attractive saving rates;
- The market conditions of the life insurance industry fits a competitive setting among firms proposing differentiated products.

Taken together, these results suggest that the life insurance industry in France is competitive.

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