

Scale Economies and Performance in the French Insurance Industry

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Abstract

The purpose of this paper is to provide for both life and non life insurance a measurement of economies of scale and an assessment of productive performance of French companies. We use a translog cost function to check the presence of scale economies and a parametric approach to construct our yardstick of productive efficiency. Our panel data covers 84 life and 243 non life companies for the period 1984-89. The main findings indicate both the existence of increasing returns to scale and a wide dispersion in the rates of inefficiency across companies. Those two results are shown to be closely linked to a number of characteristics of the companies studied, particularly their institutional form.

1. Introduction

As the completion of the internal market is getting close, a number of EEC member countries are rightfully concerned by the performance of their insurance industry. In the famous report on the "Cost of Non-Europe"¹ one finds quite striking price differentials for life and non-life insurance across eight EEC countries. Compared to the United-Kingdom, France is on average quite costlier for its various insurance products (even after controlling for differences in taxes on insurance. Within the French market, one also finds discrepancies, though less dramatic, across companies.² Many objections have been raised towards such results. We all know how much caution is needed for a meaningful price comparison. It remains that such discrepancies cannot but call for some explanation pertaining to national regulation, scale economies, market structure and productive efficiency.

This paper addresses the issues of optimal scale and productive efficiency of the French insurance industry. We believe that the existence of scale economies and a wide dispersion of the productive efficiency are two factors contributing to relatively high prices. This could

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¹ Emerson et al. (1988).

² 50 Millions de Consommateurs (1988, 1989).

endanger the European future of the whole industry. Let us note however that this study is restricted to the French market; it should be conducted across European insurance companies to allow for efficiency and scale comparisons.

In this paper, we use premiums and claims as a proxy for size and output. To measure economies of scale, we estimate a cost function including besides premiums or claims various characteristics of the companies. To assess productive inefficiency which is a more general concept than that of partial productivity, we construct a production frontier, that is the maximum possible outputs which can be produced from given quantities of a set of inputs. The indicator of productive inefficiency gives the distance between this frontier and the input-output vector of actual production in a given firm at a given period in time.

Our estimations are based on a panel of 84 life and 243 non life companies for the period 1984-89. The paper is organized as follows. Section 2 provides a quick introduction to the French insurance sector. Section 3 gives the estimates of the cost functions along with the cost elasticities for various segmentations of the insurance industry. Section 4 presents the indicators of efficiency derived from the parametric estimation of production frontiers; various characteristics of the insurance companies are used to control for the wide dispersion in efficiency that we observe.

Before proceeding, we note that using either gross premium income or claims as a measure of scale and of output has been widely questioned.³ There is little doubt that these are not good proxies, but for the time being they are the best we have. This remark should just induce one to much caution when interpreting the forthcoming results.

2. The insurance market in France

In the EEC, the French insurance market ranks number three after Germany and the U.K. with a fifth of all premiums. Paradoxically, this market is both competitive and segmented. It is dominated by state-owned and mutual insurers, which comprise eight of the top ten groups (four state-owned and four mutuals). Mutuals takes about 60% of the motor insurance market. In the life insurance sector, the banks play a major role; over the last years, they have captured over half of the new business. This competitive climate has resulted in many acquisitions both at home and across borders. In 1989, 23% of the premiums written by French insurers came from other countries. As to segmentation, it can be perceived by looking at the wide dispersion across companies of characteristics such as the reinsurance ratios, the distribution ratios or the claim ratios. Mutuals in particular are known to cater to very particular groups of people (school teachers, clergymen...).

Table 1 and Table 2 give a description of the insurance market in France; they also provide the main data used in this study.⁴ First, we have gross premiums, claims and total costs. Then, four institutional types, the reinsurance ratio (proportion of reinsurance ceded to total gross premiums), and the distribution ratio (proportion of commissions paid to total costs incurred) are introduced as characteristics of insurance companies, which might have some effect on their optimal scale and their level of performance.

³ See, e.g., O'Brien (1991), Hornstein and Prescott (1991), Hirshorn and Geehan (1977).

⁴ From an original sample of 104 life insurance and 331 non life insurance companies, we have come down to 84 and 243 companies respectively, dropping observations which looked unreliable or which concern too small companies (gross premiums below 5 million FF).

Table 1
Structure of non-life insurance in France
(Average values for 1984-89 in millions FF or in percent)

Firms characteristics	Firms number	Gross premiums	Claims	Total cost	Distribution ratio (%)	Reinsurance ratio (%)
<u>Institutional form</u>						
Foreign	78	112.9	60.9	47.1	74.7	34.8
Mutual	86	737.3	517.3	220.1	39.7	36.9
Public	4	11,949.8	8,148.9	4,092.9	54.3	15.9
Stock	75	863.5	486.2	333.5	54.0	36.5
<u>Total</u>	243	760.4	486.8	263.3	55.6	35.8
<u>Scale *</u>						
5-30	55	15.5	7.5	6.2	68.7	37.5
30-150	80	80.7	35.1	35.2	56.2	41.6
150-400	44	258.3	130.3	95.5	47.1	38.9
400-	64	2,596.4	1,701.4	885.0	49.1	25.0
<u>Total</u>	243	760.4	486.8	263.3	55.6	35.8

Table 2
Structure of life insurance in France
(Average values for 1984-89 in millions FF or in percent)

Firms characteristics	Firms number	Gross premiums	Claims	Total cost	Distribution ratio (%)	Reinsurance ratio (%)
<u>Institutional form</u>						
Foreign	15	224.8	132.5	76.8	25.3	7.4
Mutual	13	989.9	437.4	156.5	28.3	16.3
Public	4	8,628.9	6,263.1	1,508.9	25.2	4.7
Stock	52	929.0	303.3	135.8	34.6	9.1
<u>Total</u>	84	1,180.7	577.3	193.9	31.4	9.7
<u>Scale *</u>						
5-100	23	35.7	13.3	12.5	29.6	12.0
100-300	16	178.4	73.1	70.4	34.3	17.1
300-1000	20	573.4	236.4	111.9	29.4	4.1
1000-	25	3,361.6	1,691.6	505.3	32.8	7.2
<u>Total</u>	84	1,180.8	577.3	193.9	31.4	9.7

* measured by gross premium income in millions FF.

Public companies in either property-liability or life insurance have on average a disproportionate size relatively to the stock, mutual and foreign companies. Not surprisingly the distribution ratio is the lowest for mutual non-life companies and is higher in non-life than in life companies. The reinsurance rate decreases with the scale and it is particularly low in public companies.

3. Scale economies

There exists a small number of studies on economies of scale in French insurance companies. Rosa (1974) was the first to estimate the relationship of premiums to expenses in non life insurance. He concluded that increasing returns to scale exist and attributes them to the rapid growth of the insurance sector in the early seventies. Guimiot (1977) studied life insurance and looked at the relationship of unit costs to either premiums or insured amounts for the years 1971-1973. He didn't find any economies of scale. Outreville (1987) updated those studies for 1981-1982. In life insurance, he used premiums as a proxy for size and in non life, he used either premiums or claims. He consistently obtained increasing returns to scale. Dubois (1988) tested a number of models for non life insurance and concluded to the absence of economies of scale. Finally, Lahaye et al. (1990) in a study close to

Table 3
*Cost function estimators**
Non life insurance

Dependent variable		Equation (1) Gross premiums	Equation (2) Total claims
Explanatory variables	Coefficients		
Institutional form			
Intercept: Stock	α_0	-0.568 (1.9)	4.881 (15.1)
Foreign	β_1	-0.119 (5.3)	-0.367 (9.8)
Mutual	β_2	-0.182 (9.5)	0.279 (8.6)
Public	β_3	-0.025 (0.3)	-0.283 (2.4)
Output (log y)	α_1	1.028 (19.5)	0.472 (7.3)
Distribution ratio (log z)	α_2	-0.293 (4.6)	-0.627 (7.0)
Reinsurance ratio (log r)	α_3	0.365 (5.8)	1.674 (16.7)
(log y) ²	α_{11}	-0.003 (1.1)	0.016 (4.9)
(log z) ²	α_{22}	-0.055 (7.6)	-0.089 (7.4)
(log r) ²	α_{33}	0.035 (5.2)	0.157 (13.4)
(log y) (log z)	α_{12}	0.031 (5.9)	0.065 (8.1)
(log y) (log r)	α_{13}	-0.011 (2.1)	-0.054 (5.8)
(log z) (log r)	α_{23}	0.108 (9.8)	0.189 (9.3)
R ²		0.979	0.942
Observations		1284	1284

* t-tests are given into brackets.

the present one but for the period 1982-1987, found increasing returns to scale in both life and non life insurance with some variability according to a few characteristics of the companies studied.

We have chosen one of the most traditional and general cost functions used in the literature, namely the translog function which can be written as:

$$\begin{aligned} \log c_{st} = & \alpha_0 + \alpha_1 \log y_{st} + \alpha_2 \log z_{st} + \alpha_3 \log r_{st} + \alpha_{11} (\log y_{st})^2 + \alpha_{22} (\log z_{st})^2 + \\ & \alpha_{33} (\log r_{st})^2 + \alpha_{12} (\log y_{st})(\log z_{st}) + \alpha_{13} (\log y_{st})(\log r_{st}) + \\ & \alpha_{23} (\log r_{st})(\log z_{st}) + \sum \beta_j s_j + \varepsilon_{st} \end{aligned}$$

where c_{st} denotes total costs of the s -th company in year t , y_{st} , the output variable (gross premiums or claims), z_{st} , the distribution ratio and r_{st} , the reinsurance ratio. The Greek letters α and β are the regression coefficients, the s_j 's are the binary variables attached to the institutional form with the exception of stock companies to which the constant α_0 applies. The last term ε_{st} is the random term.⁵

We start with the non life insurance companies; equation (1) was estimated with OLS. The coefficients are given in Table 3. Most of them are very significant, in particular when claims are used as the output measure. The impact of the institutional form on costs is mixed. Foreign and public companies seem to be less costly than mutuals and stock companies. In view of important cross effects, one has to compute the total cost elasticities to check the effect of scale (proxied by either gross premiums or claims), reinsurance and distribution. These elasticities are presented on Table 4.

Table 4
Cost elasticities in non life insurance
Average values by institutional form

Firms characteristics	Equation (1)			Equation (2)		
	w. r. t. gross premiums	w. r. t. distribution ratio	w. r. t. reinsurance ratio	w. r. t. claims	w. r. t. distribution ratio	w. r. t. reinsurance ratio
<u>Institutional form</u>						
Foreign	0.979	-0.077	0.118	0.845	-0.198	0.640
Mutual	0.940	0.087	0.005	0.819	0.081	0.419
Public	0.945	0.091	0.005	1.046	0.178	0.150
Stock	0.956	0.041	0.070	0.872	0.013	0.524
<u>Total</u>	0.957	0.023	0.060	0.847	-0.023	0.514

w. r. t.: with respect to

⁵ We have not introduced here a time variable. In previous tests, it didn't appear significant which is consistent with the findings of Baumol (1991) and Wolff (1991) for whom in the U.S. there is hardly any technical progress in the insurance industry.

Overall one notes some increasing returns to scale (that is elasticities below 1). There are few differences between institutional forms. There is just one exception which concerns the four public companies; this is not surprising given their size. The cost elasticities with respect to the distribution ratio are positive for all types of companies but the foreign ones. The cost elasticities with respect to reinsurance are everywhere positive; they are much lower with premiums than with claims. It is also particularly low for public companies, which are known to have both low reinsurance ratios and large scale.

Turning now to life insurance companies, the OLS regression estimators are given in Table 5. The coefficients are less significant than those obtained for non life insurance. We present the cost elasticities in Table 6. Again, we notice overall the existence of economies of scale. This holds for all companies but the public ones. The distribution ratio has a negative effect on costs overall and in most of the cases studied. In that respect, one has to keep in mind that the distribution ratio and the role of banks in life insurance are inversely related. For obvious reasons, costs tend to be lower in companies linked to bank networks. Finally, the cost elasticities with respect to the reinsurance ratio is consistently positive; this finding agrees with the hypothesis that less efficient firms tend to seek reinsurance; we shall come back to this in the next section.

Table 5
*Cost function estimators**
Life insurance

Dependent variable		Equation (1) Gross premiums	Equation (2) Total claims
Explanatory variables	Coefficients		
Institutional form			
Intercept: Stock	α_0	2.681 (1.6)	8.446 (12.9)
Foreign	β_1	0.431 (4.9)	0.128 (1.6)
Mutual	β_2	-0.101 (1.1)	-0.012 (0.2)
Public	β_3	0.196 (0.9)	-0.295 (1.7)
Output (log y)	α_1	0.486 (1.7)	-0.046 (0.4)
Distribution ratio (log z)	α_2	-0.233 (0.9)	1.017 (6.8)
Reinsurance ratio (log r)	α_3	-0.214 (1.0)	-0.084 (0.5)
(log y) ²	α_{11}	0.018 (1.6)	0.036 (6.2)
(log z) ²	α_{22}	-0.120 (4.4)	0.126 (5.4)
(log r) ²	α_{33}	-0.066 (2.8)	-0.139 (6.0)
(log y) (log z)	α_{12}	-0.002 (0.1)	0.007 (0.5)
(log y) (log r)	α_{13}	0.029 (1.7)	0.007 (0.7)
(log z) (log r)	α_{23}	0.091 (2.4)	0.146 (4.8)
R ²		0.863	0.887
Observations		430	428

* t-tests are given into brackets.

Table 6
Cost elasticities in life insurance
Average values by institutional form

Firms characteristics	Equation (1)			Equation (2)		
	w. r. t. gross premiums	w. r. t. distribution ratio	w. r. t. reinsurance ratio	w. r. t. claims	w. r. t. distribution ratio	w. r. t. reinsurance ratio
<u>Institutional form</u>						
Foreign	0.812	-0.170	0.348	0.692	-0.008	0.194
Mutual	0.857	-0.024	0.334	0.740	0.169	0.094
Public	0.957	-0.184	0.516	1.031	0.007	0.112
Stock	0.843	-0.215	0.433	0.724	-0.064	0.116
Total	0.845	-0.174	0.405	0.736	-0.012	0.127

w. r. t.: with respect to

4. Firm-specific productive efficiency⁶

On the basis of that same panel data, we now analyze the productive efficiency of non life insurance on the basis of a stochastic production frontier that we represent by the following Cobb-Douglas function:

$$(2) \quad \log y_{st} = \lambda_0 + \lambda_1 \log x_{1st} + \lambda_2 \log x_{2st} + \omega_{st}$$

where y_{st} represents the output of the s -th company in year t , x_{ist} ($i = 1, 2$) denotes input i , λ_0 , λ_1 and λ_2 are parameters to be estimated. The term ω_{st} is a composed error term such that $\omega_{st} = v_{st} - \mu_s$, with v_{st} , a symmetric normal term capturing randomness outside of the control of the firm and μ_s (≥ 0), a one-sided component, independent of v_{st} , capturing randomness assumedly under the control of the firm. This latter term is used to derive the indicator of technical efficiency. Within this approach we use gross premiums as our output variable. The two inputs are labor costs including commissions taken as a proxy for the labor input and all the other expenses taken as a proxy for intermediate inputs.

In order to estimate technical efficiency we choose the maximum likelihood procedure proposed by Battese and Coelli (1988). Specially designed to deal with panel data, this procedure amounts to estimating the conditional expectations of the individual efficiencies μ_s , assumed to follow a normal distribution, $N(m, \sigma^2)$, with truncation at zero. Compared with the traditional half-normal distributional hypothesis this maximum likelihood procedure⁷ allows for a more flexible modelisation of inefficiencies, including the half-normal distribution as a special case corresponding to $m = 0$. Table 7 and 8 present the main results for life and non life companies, respectively. The corresponding estimators are reported in the Appendix.

⁶ This section is heavily based on Fecher et al. (1991).

⁷ To estimate this model we use the econometric package FRONTIER written by Coelli (1989) and specially conceived to deal with unbalanced panel data.

Overall the average level of efficiency is very low and the dispersion very high. This variability can be explained in part by the nature of the data. They come from the annual accounts of individual insurance companies which often provide questionable figures. It is also due to the volatility of the insurance markets. In our sample, there are a number of companies which either started or disappeared during the short period 1984-1989.⁸ This variability is also due to the high segmentation of the insurance market in France.

We shall try to see whether some characteristics of non life insurance companies can account for differences in efficiency. Table 7 shows how those these efficiency measures vary with the institutional type, the reinsurance ratio, the scale proxied by gross premiums, the claims to premiums ratio, and the distribution ratio of companies. Efficiency is higher in public companies than in the three other institutional types of companies. Efficiency increases with size and this is not just due to the large size public companies. Efficiency seems to

Table 7
Efficiency measure and firms' characteristics
in non-life insurance

Characteristics	Number	Range	Efficiency measure
Institutional form			
Foreign	78		0.493
Mutual	86		0.477
Public	4		0.574
Stock	75		0.386
Distribution ratio	86	0 – 50	0.477
(%)	102	50 – 75	0.373
	105	75 – 100	0.382
Reinsurance auto	85	0 – 20	0.466
(%)	86	20 – 50	0.404
	72	50 – 100	0.359
Scale (millions FF)	55	5 – 30	0.347
	80	30 – 150	0.351
	44	150 – 400	0.465
	64	400 –	0.509
Claims to Premium ratio	58	1 – 30	0.337
(%)	72	30 – 50	0.381
	88	50 – 75	0.449
	25	75 – 100	0.550
<u>Total</u>	243		0.412
Standard deviation			0.154
Range			0.18 – 0.97

⁸ We have a balanced panel for 48 life and for 164 non-life companies.

Table 8
Efficiency measure and firms' characteristics
in life insurance

Characteristics	Number	Range	Efficiency measure
Institutional form			
Foreign	15		0.076
Mutual	13		0.250
Public	4		0.183
Stock	52		0.293
Distribution ratio	23	0 – 20	0.260
(%)	34	20 – 40	0.181
	27	40 – 100	0.304
Reinsurance auto	17	0 – 1	0.507
(%)	29	1 – 5	0.246
	25	5 – 20	0.135
	15	20 – 100	0.095
Scale (millions FF)	23	5 – 100	0.117
	16	100 – 300	0.144
	20	300 – 1000	0.320
	25	1000 –	0.359
Claims to Premium ratio	23	0 – 20	0.426
(%)	18	20 – 40	0.265
	18	40 – 60	0.131
	25	60 – 100	0.138
<u>Total</u>	84		0.242
Standard deviation			0.239
Range			0.04 – 0.95

decrease with the distribution ratio. Reinsurance seems to have a depressive impact on efficiency whereas the claims ratio⁹ has on the contrary a positive effect. The latter result is not surprising. One must realize that in a steady-state world, the difference between premiums and claims should just include costs and profits, which both are minimized in a competitive setting.

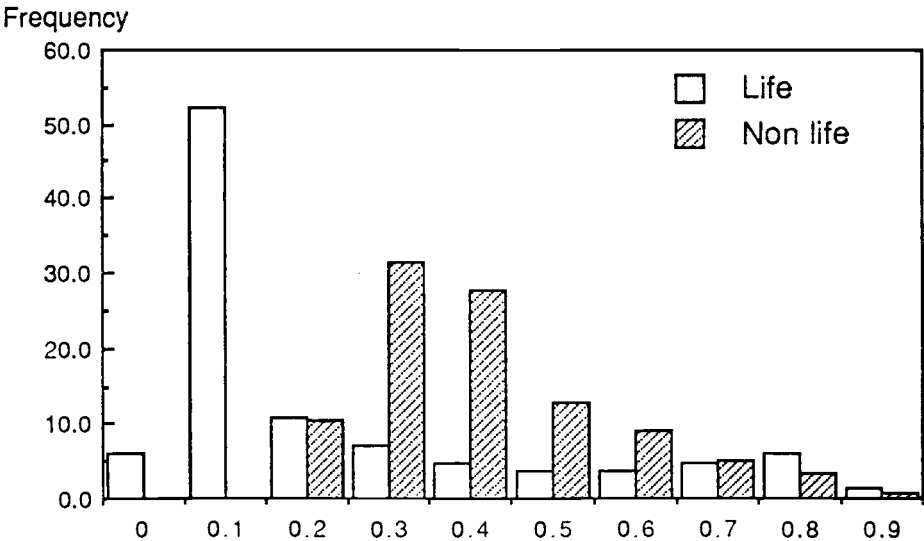
We shall proceed with life insurance companies in the same way as with the non life insurance companies. The efficiency measures so derived are presented in Table 8 in terms of overall average values, average values per institutional type and other characteristics. Again, average efficiency is quite low, lower indeed that for non life. The dispersion of estimates is large with companies ranging from almost complete inefficiency to full efficiency.

⁹ That is, the ratio of incurred losses to earned premiums.

With regard to the institutional form, public life insurance companies are no longer the most efficient. In fact, mutual and stock companies perform better than public ones. In Table 8, we can also see the effects on efficiency of other characteristics of life insurance companies. We find the following pattern: (i) efficiency increases with scale; (ii) it decreases with the reinsurance ratio and with the claims ratio; (iii) it first decreases and then increases as the distribution ratio increases. The effect of scale is the same as in non-life insurance. This is an interesting result particularly if we note that productive scale effects are already taken into account in constructing the efficiency frontier. The effect of the claims ratio is totally different from that observed in non life insurance. In fact, this ratio reflects two opposite characteristics: the pressure on costs and on profits as observed before and the maturity of the company. The latter characteristic is particularly important in life insurance where the time gap between paying premiums and getting benefits can be long. In this particular instance, this is the dominant characteristic. Young companies which cash in premiums while hardly paying any claims are unexpectedly “more efficient”. To put it another way, if we use claims as a measure of the output, that effect would disappear. Efficiency decreasing with reinsurance might pertain to issues of self-responsibility and incentives. These factors can also explain the ambiguous relation between efficiency and the distribution ratio.

In Figure 1, we compare the distribution of productive efficiency indicators for the two types of insurance. One clearly sees their wide dispersion and the differences between life and non life sectors.

Figure 1
Frequency distribution of firm-specific efficiency measures in life and non life insurance



5. Conclusions

In this paper, we have attempted to measure two factors which might contribute to endangering the French insurance industry in the increasingly competitive European setting, namely, the presence of scale economies and the existence of productive inefficiencies. We have found that most companies don't have an optimal size, though to a lesser extent for the public ones. Second, in both life and non life insurance, there is a wide dispersion of efficiency, the average efficiency being about 40% for non life and 25% for life insurance; however, a sizeable part of that dispersion can be accounted for by the huge segmentation of the French insurance market. Indeed, efficiency seems to depend on various characteristics of insurance companies.

In view of the problems related to measuring size and outputs of insurance companies, those conclusions are to be taken as indicative and not firm. The combined introduction of better concepts for the outputs of insurance and better data on output functions seems to be the only way for obtaining more reliable findings.

In any case, such study is only one step towards a true comparative study of efficiency and economies of scale of the European insurance industry. The next step will be to apply the same tests to other countries and then to proceed with comparisons.

APPENDIX

Estimation of Cobb-Douglas stochastic production frontiers for non life and life insurance¹

Variables Parameters	Intercept λ_0	Labor λ_1	Composite input λ_2	$\sigma^2_{(v+\mu)}$	$\gamma^{(2)}$	m
Dependent Variables						
Non life gross premiums	0.32 (43.9)	0.72 (55.6)	0.20 (16.7)	0.153 (10.0)	0.927 (162.5)	0.981 (16.5)
Life gross premiums	4.27 (17.1)	0.40 (13.9)	0.61 (16.4)	1.06 (8.2)	0.97 (330.7)	1.53 (10.9)

¹⁾ t-tests are given into brackets.

²⁾ $\gamma = (\sigma_\mu)^2 / (\sigma_{v+\mu})^2$.

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