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Efficiency and Financial Health in the European Insurance Market

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Abstract

This paper analyses the relationship between the financial health of insurers and their efficiency through a two-stage methodology. In a first stage, efficiency is calculated using a nonparametric data envelopment analysis approach. In a second stage, a Tobit model, with panel data, is used to study how financial health – measured by financial ratios – is related to the efficiency scores. 424 insurers, both life and non-life, from 14 different European countries during the period 2007-2011 are analysed. The results confirm that insurers with the best financial health also happen to be the most efficient.

Keywords: Efficiency, DEA, Tobit, financial health.

1. Introduction

Insurers' efficiency has aroused the interest of empirical literature over the last decades, particularly since the deregulation of the insurance sector. This fact has meant the transition from protected markets, which basically operated nationwide, to a more competitive and international market. Research on efficiency of the insurance markets has increased exponentially in the last two decades, methodologies and objects of study have been redefined and the geographical areas used for the analyses have been expanded. At the beginning of the 21stcentury, research was focused on local analyses, initially in the US and in a few European countries. These studies focused in measuring the extent to which efficiency was affected by the deregulation and consolidation of the insurance market, by the organizational form of companies (property) and by certain business variables such as sector or scale (Klumpes 2007, Cummins and Xie 2008, 2009).

The comparison amongst different countries' efficiency was a matter of interest right from the beginning; however, research on this topic was not carried out until later on time due to the difficulty of finding comparable data and the caution required to interpret the results. For instance, Weiss (1991) draws the first comparison amongst countries, including the US, Japan, Germany, France and Switzerland markets in his study. The United States and Germany take shape as the most efficient. Donni and Fecher (1997) compare 15 OECD countries, again, US leads the country ranking in efficiency, followed by the United Kingdom, France and Germany.

Delhausse et al (1995) is one of the first studies in comparing countries using company-level data, specifically 191 Belgian companies and 243 French ones. The results raise France over Belgium in terms of efficiency. France also comes out well in Rai (1996), establishing itself, together with Finland, ahead of the United Kingdom in the ranking.

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One of the most influential papers regarding international comparisons is Diacon et al. (2002), whose insurance companies' efficiency comparison is conducted on a sample of 15 European countries during the 1996 – 1999 periods. In this analysis, the UK, Spain, Sweden and Denmark are less likely to have high levels of technical efficiency. Besides, a reduction in that efficiency can be observed throughout the analysed period.

More recent papers use a greater number of countries and observations, which ensures more consistency to the findings. Eling and Luhnen (2010) use data from 6,462 insurance companies from 36 countries worldwide during the period 2002 – 2006. Results show that Denmark and Japan have the highest levels of efficiency whereas Philippines is the least efficient country.

Biener and Eling (2012) focus their analysis on the same period, 2002 – 2006, but use a higher number of observations (23,807) belonging to 21 North American and European countries. In this case, their research concluded that the European market, on the whole, is more efficient than the North American one. In addition to this, when analysing by country, they find considerable differences between life and non-life insurers, as well as in the type of efficiency analysed.

Efficiency comparisons amongst nations and geographical areas have become a topic of great interest in recent insurance literature. There is a general consensus that legislation and market structure are very different from one country to another; and also that both are part of the environment variables that would partly explain the difference in firms' efficiency. However, if a list of the most efficient countries needed to be drawn up, there would be many doubts as well as many contradictory empirical results.

The purpose of this paper is to analyse the level of efficiency in the main European countries through a longitudinal approach and using company-level data. Moreover, this paper proposes an in-depth analysis of the relation between efficiency and financial health with the aim of find a positive relation.

2. Methodology

The methodological approach involves a two-phase analysis: first, efficiency values are calculated using Data Envelopment Analysis (DEA), and second, in order to study the relation between European insurers' financial health and their efficiency a Tobit model with panel data is employed.

Tobit models have already been employed to explain efficiency in the insurance sector: Diacon et al. (2002) focus on studying the relation between the size of the company and efficiency; Hussels and Ward (2007) take into consideration the acquisition and administrative expenses, the claims rate, the size and the investments as possible explanatory factors; and Biener and Eling (2012) include the different countries under consideration in the analysis.

The main contribution of this paper is to analyse the relation between efficiency and the financial health of insurance companies, measuring this by the key financial ratios in the sector.

2.1. Data Envelopment Analysis

The Data Envelopment Analysis (DEA) is an extension of the work done by Farrell (1957), consisting in a mathematical programming technique introduced by Charnes, Cooper and Rhodes (1978). DEA uses linear programming techniques in order to build a production frontier, and to which we can refer to establish the efficiency or inefficiency of each one of the insurers from the sample. Efficient firms –according to the input orientation applied in this paper[5]– are placed over the production frontier. Any other firm that produces below this efficient production frontier will be classified as inefficient, measuring that inefficiency according to how far they are from the frontier. DEA allows considering the presence of different returns to scale: constant or variable.

[5] Use an input orientationmodelimpliesthateach insurer obtains a specific output using the minimum combination of inputs.

The model with constant returns, the DEA–CCR, was developed by Charnes, Cooper and Rhodes (1978), while the DEA–BBC, developed by Banker, Charnes and Cooper (1989) relaxes this assumption and allows variable returns to scale. This facilitates to show scale inefficiency associated with the size of the company.

The analytical description of the model is the following: Each producer $j = 1,\ldots,N$ uses *M* inputs to produce *S* outputs; the input and output vectors are respectively defined as follows:

$$x = (x_{1j}, x_{2j}, \ldots, x_{mj})$$
$$y = (y_{1j}, y_{2j}, \ldots, x_{sj})$$

Where x_{mj} and y_{sj} represent the quantity, used by the company *j*, of the input *m* and the output *s*, respectively. The DEA methodology with constant returns implies to solve the following linear programme for each production unit under consideration.

$$\begin{aligned} & Min\ \theta \\ & s.a.: \\ & \sum_{j=1}^{N} y_{sj}\lambda_j \geq y_{si}, \quad s = 1,\ldots,S \\ & \sum_{j=1}^{N} x_{mj}\lambda_j \leq \theta x_{mi}, \quad m = 1,\ldots,M \\ & \lambda_j \geq 0, \quad j = 1,\ldots,N \end{aligned}$$

The global technical efficiency takes values between 0 and 1: if $\theta = 1$, the firm is efficient and placed in the productive frontier, but, if $\theta < 1$, the firm will be classified as inefficient and, therefore, it would be able to obtain the same amount of output with a lower input consumption.

DEA–BBC model incorporates the existence of variable returns to scale by including the restriction $\sum_{j=1}^{N}\lambda_j = 1$. Thus, the structure of the programme would be:

$$\begin{aligned} & Min\ \theta \\ & s.a.: \\ & \sum_{j=1}^{N} y_{sj}\lambda_j \geq y_{si}, \quad s = 1,\ldots,S \\ & \sum_{j=1}^{N} x_{mj}\lambda_j \leq \theta x_{mi}, \quad m = 1,\ldots,M \\ & \sum_{j=1}^{N} \lambda_j = 1 \\ & \lambda_j \geq 0, \quad j = 1,\ldots,N \end{aligned}$$

So, the rate of global technical efficiency (GTE) can be disaggregated in two measures: the part of inefficiency generated by the production activity itself (pure technical efficiency: PTE) and that generated by problems with the size of the analysed unit (scale efficiency: SE), giving the following equation the relationship between the different measures.

$$GTE = PTE \times SE$$

2.2. Tobit model with panel data

In this paper a complete or balanced micro panel will be used. The dependent variables correspond to the efficiency rates obtained previously and they are continuous variables that take values between zero and one, depending on whether the insurer is more or less efficient. These are, therefore, variables with two limits. The most suitable model to explain this type of variables is the Tobit model with both limits, which would be:

$$y_i^* = \beta' x_i + \varepsilon_i \quad \begin{array}{ll} y_i = 0 & if\ y_i^* \leq 0 \\ y_i = y_i^* & if\ 0 < y_i^* < 1 \\ y_i = 1 & if\ y_i^* \geq 1 \end{array}$$

Where β the parameter vector to estimate and xi is is the independent-variable vector of the model.

3. Data and variables section

The information from the European insurers has been obtained from the Standard and Poor's "Global Credit Portal" database. During the 2007–2011 period, 424 companies from 14 European countries were selected, 300 from the non-life sector and 124 from the life insurance sector (Table 1).

Table 1: Number of sampled insurers

Country	Total	Life	Non-life
Austria	23	3	20
Belgium	22	3	19
Denmark	19	7	12
Finland	13	3	10
France	41	6	35
Germany	142	65	77
Ireland	21	5	16
Italy	10	1	9
Luxembour	9	3	6
Netherlands	17	5	12
Portugal	8	1	7
Spain	11	0	11
Sweden	13	3	10
U.K.	75	19	56
TOTAL	424	124	300

3.1. Efficiency: Inputs and Outputs

In order to estimate the different types of efficiency, it is necessary to select a series of inputs and outputs. There is widespread agreement in literature with regard to the choice of inputs, as shown in Cummins and Weiss (2012). The first input selected is operating expenses which include employee salaries, commissions and amortization, as well as management costs, study, processing or formalisation of policies. Cummins and Rubio-Misas (2006) explain the relevance of these expenses as only the labour costs represent two thirds of the total amount of costs, with the exception of claims. Equity capital and debt capital are also selected as input variables, since they are the two main sources of funding for these companies. Net reinsurance premiums, technical provisions and assets investment have been selected as output variables. Premiums represent the most important part of the income. Furthermore, premiums are considered as the primary quantification of the insurers' volume of activity.

In this sense, Fecher et al. (1993) and Fuentes et al. (2001) support the idea that premiums show, on the one hand, the insurer's ability to sell products, to reach customers and to cover risks; and, on the other hand, the price that customers are freely willing to pay for the insurance policy they are looking for.

Another output variable is that of technical provisions, because they include the amount of both risks and costs that correspond to the deferred coverage period on the data of reference that the insurer needs to cover (Cummins et al 2010). The assets investment variable – selected by almost all the analysed authors – reflects the investment in the insurers' funds that, in the future, will allow the company to face the risks it has taken before, as stated by Cummins et al. (1999).

3.3. Financial Health: Ratios

In this section, the different economic-financial ratios, which will be employed as indicators of financial health, will be described. Seven ratios have been selected taking into consideration the features of the sector. The evolution of these ratios over the analysed period is shown in Table 2.

Table 2: Evolution of the ratios

		2007	2008	2009	2010	2011
ROA	Profit/Asset	0,024	0,018	0,014	0,015	0,016
ROE	Profit/Equity	0,149	0,111	0,101	0,113	0,107
Guarantee	Asset/Liability	8,848	9,304	9,694	9,894	10,509
Percentage of retention	Net premiums/Gross premiums	0,892	0,902	0,901	0,911	0,906
Combined ratio	(Claims +Expenses)/ Net premiums	0,847	0,850	0,868	0,849	0,857
Premium growth	Net Premium growth		0,019	0,022	0,044	0,029
Technical provisions ratio	Technical provisions/ (Liability+Equity)	0,641	0,660	0,657	0,657	0,665

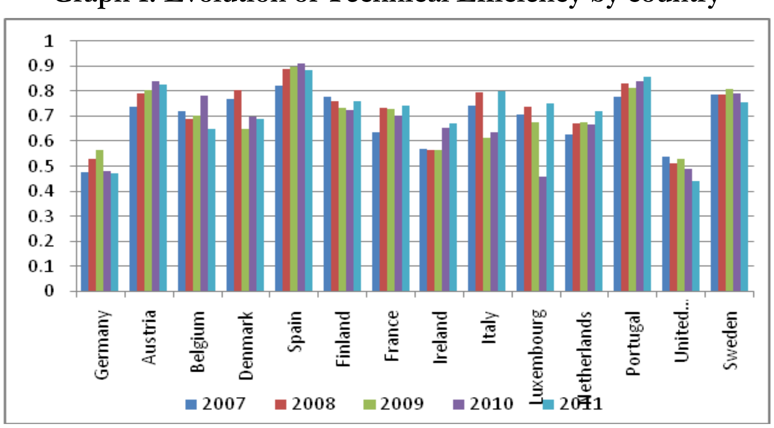
The analysis of the ratios states the good financial health of the European insurance companies. This financial health is characterised by positive returns for both ROA and ROE, a guarantee ratio highly above the unit, very little reinsurance activity, a high and stable combined ratio, positive growth of premiums and little fluctuation in the provisions ratio.

4. Empirical results

4.1. Efficiency scores

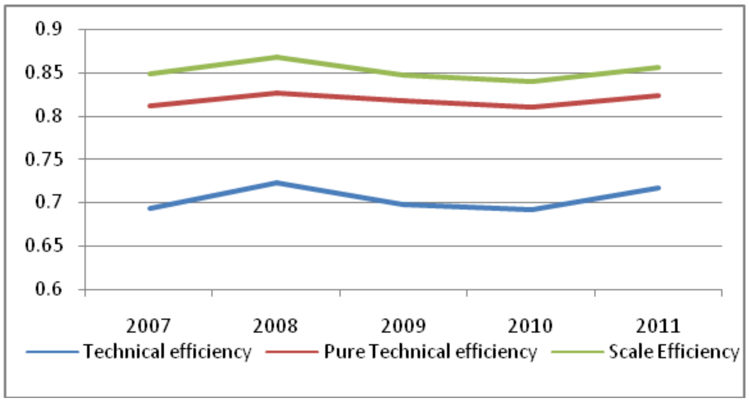
In order to calculate the efficiency levels, a DEA input oriented model has been applied. The efficiency in all the examined countries is above 50% during the analysed period, which indicates that the efficiency of European insurers is good. In addition to this, most of the countries maintain or improve their initial efficiency levels at the end of the period. The evolution of the average technical efficiency reached in each country, as well as its decomposition into pure technical efficiency and scale efficiency can be respectively seen in graphs 1 and 2.

Graph 1: Evolution of Technical Efficiency by country



The average global efficiency level of the European firms under analysis is placed around a 0.7 score and remains constant over the five-year period studied. Furthermore, by breaking down the efficiency into pure technical efficiency and scale efficiency, it is observed that, on average, pure efficiency is lower than scale efficiency. This reveals that decreasing the quantity of inputs used in the development of the activity is a means of improving the level of efficiency. It also indicates that firms are, in average well dimensionated, as most of the inefficiency is given not by the scale efficiency but for the technical efficiency, which is related with the level of the inputs employed.

Graph 2: Decomposition of Technical Efficiency



Analysing the obtained results for technical efficiency by countries during the five-year period (Table 3), it can be observed that in 2007 the efficiency levels of nine countries is above a score of 0.7, with Spain having the highest level of efficiency with a value of 0.8249. In 2008, Denmark, Spain and Portugal have an efficiency level placed around 0.8. In 2009, 2010 and 2011, Spain stands out again as the country with the highest level of efficiency: scoring 0.89, 0.91 and 0.88, respectively.

Table 3: Average Efficiency indices by country

	Technical Efficiency					Pure Technical Efficiency					Scale Efficiency				
	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
Germany	0,4761	0,5312	0,5675	0,4807	0,4748	0,5790	0,6095	0,6322	0,5998	0,6096	0,7930	0,8495	0,8962	0,7888	0,7764
Austria	0,7384	0,7904	0,8064	0,8418	0,8292	0,8098	0,8500	0,8672	0,8761	0,8669	0,8912	0,9149	0,9129	0,9459	0,9380
Belgium	0,7197	0,6915	0,7032	0,7831	0,6494	0,8702	0,8372	0,8405	0,8568	0,8179	0,8298	0,8207	0,8343	0,9079	0,7889
Denmark	0,7688	0,8032	0,6506	0,6992	0,6893	0,8640	0,9199	0,8881	0,9257	0,8652	0,8960	0,8689	0,7341	0,7563	0,7895
Spain	0,8249	0,8908	0,8994	0,9107	0,8867	0,8644	0,9009	0,9053	0,9234	0,8935	0,9435	0,9833	0,9930	0,9843	0,9807
Finland	0,7766	0,7628	0,7328	0,7240	0,7627	0,8531	0,8723	0,8740	0,8578	0,8476	0,8999	0,8615	0,8278	0,8324	0,8984
France	0,6382	0,7356	0,7298	0,7027	0,7447	0,7850	0,8359	0,8343	0,8360	0,8390	0,8079	0,8682	0,8702	0,8316	0,8787
Ireland	0,5696	0,5681	0,5647	0,6528	0,6741	0,7036	0,6825	0,7177	0,7995	0,7870	0,8171	0,8255	0,7873	0,8152	0,8343
Italy	0,7426	0,7986	0,6142	0,6384	0,8006	0,9466	0,9488	0,8779	0,8187	0,9409	0,7907	0,8496	0,7164	0,8023	0,8545
Luxembourg	0,7099	0,7411	0,6789	0,4616	0,7535	0,7401	0,8629	0,7005	0,5868	0,8259	0,9457	0,8587	0,9029	0,7213	0,8887
Netherlands	0,6303	0,6731	0,6770	0,6695	0,7221	0,8129	0,7963	0,8032	0,8206	0,8412	0,7900	0,8531	0,8493	0,8270	0,8495
Portugal	0,7789	0,8307	0,8158	0,8391	0,8568	0,9306	0,9216	0,9060	0,9368	0,9394	0,8198	0,8924	0,9054	0,8969	0,9130
United Kingdom	0,5406	0,5129	0,5312	0,4919	0,4431	0,6679	0,6099	0,6867	0,6029	0,5588	0,8151	0,8385	0,7846	0,8081	0,7878
Sweden	0,7885	0,7896	0,8098	0,7931	0,7579	0,9327	0,9189	0,9182	0,9041	0,8979	0,8533	0,8620	0,8541	0,8374	0,7997
Total	0,6931	0,7228	0,6986	0,6921	0,7175	0,8114	0,8262	0,8180	0,8104	0,8236	0,8495	0,8676	0,8478	0,8397	0,8556

Opposite are Germany, the United Kingdom and Ireland, which show lower levels of efficiency: scoring between 0.47 and 0.57. This lower average level of efficiency can be explained by the large number of companies and the existing high dispersion, and also can indicate that those countries in which the market is more fragmented find it more difficult to reach the highest level or efficiency.

In most cases in which the variation of global efficiency increases, it can be observed that this tendency is attached to a similar behaviour in the evolution of pure technical efficiency. This fact indicates that, during the period of study, insurance companies in these countries have improved their resource management to a greater extent than the aspects related to their scale.

DEA allows knowing how the inefficient firms can improve its efficiency level indicating which input should be reduced. Table 4 presents an overview of the observed average reduction for each one of the inputs and the countries analysed. On average, insurers should reduce a 62% of their debt capital and around a 56% of their operating expenses.

The reduction in debt capital would entail a change in the financial policies of the insurance companies, which, in turn, would probably increase their capital. On the other hand, the operating expenses variable includes employee salaries, commissions and other intermediation costs. As it would directly affect their business strategy, a reduction in those would entail changes in the marketing and/or the expansion policies of the different companies.

Table 4: Average reduction in inputs for the 2007 – 2011 periods

	Equity capital	Debt capital	Operating expenses
Germany	-73.05%	-74.41%	-77.07%
Austria	-38.33%	-45.40%	-37.98%
Belgium	-47.24%	-50.66%	-67.61%
Denmark	-48.64%	-45.34%	-46.77%
Spain	-31.38%	-44.29%	-35.49%
Finland	-36.92%	-63.18%	-39.37%
France	-40.89%	-51.38%	-42.58%
Ireland	-90.45%	-83.00%	-92.35%
Italy	-60.02%	-64.85%	-51.22%
Luxembourg	-65.75%	-73.44%	-73.16%
Netherlands	-50.85%	-63.90%	-56.17%
Portugal	-50.07%	-77.78%	-53.21%
United Kingdom	-61.31%	-65.42%	-59.45%
Sweden	-45.72%	-69.40%	-47.03%
Average	-52.90%	-62.32%	-55.68%

4.2. Efficiency and financial health

In this second phase of the study, a To bit model with panel data is applied in order to verify the hypothesis that the most efficient European insurers are those that have a better financial health. The analysis of the relationship between efficiency and financial health of insurance companies constitutes an innovative approach to prior studies on the insurance sector, and it is thus one of the main contributions of this paper. Apart from the financial ratios, other variables have been added such as size, lines of business and country. Table 5 presents the expected relation between the explanatory variables and efficiency, the type of variable and its main descriptors.

Table 5: Descriptive ratios

VARIABLE	Relation to efficiency	Type of variable	Average	Median	Standard Deviation
		DEPENDENT VARIABLE			
Efficiency		Continuous	0,614	0,6062	0,313
		INDEPENDENT VARIABLES			
Country	+/-				
Germany		Dichotomous	0,335	0	0,4721
Austria		Dichotomous	0,0542	0	0,2266
Belgium		Dichotomous	0,0519	0	0,2219
Denmark		Dichotomous	0,0448	0	0,2069
Spain		Dichotomous	0,0259	0	0,159
Finland		Dichotomous	0,0306	0	0,1725
France		Dichotomous	0,0967	0	0,2957
Ireland		Dichotomous	0,0491	0	0,2161
Italy		Dichotomous	0,0236	0	0,1518
Luxembourg		Dichotomous	0,0212	0	0,1442
Netherlands		Dichotomous	0,0401	0	0,1963
Portugal		Dichotomous	0,0189	0	0,1361
United Kingdom		Dichotomous	0,177	0	0,3817
Sweden		Dichotomous	0,0307	0	0,1725
Lines of business	+/-				
Life		Dichotomous	0,3233	0	0,4678
Non-life		Dichotomous	0,6224	1	0,4849
Mixed		Dichotomous	0,0543	0	0,2266
Size	+/-				
Ln Assets		Continuous	13,7464	13,8023	2,0642
Profitability	+				
ROA		Continuous	0,0270	0,0173	0,0723
ROE		Continuous	0,1296	0,1169	0,3100
Guarantee	+	Continuous	21,4116	9,5719	183,5489
Retention	+	Continuous	0,8049	0,9019	0,2233
Combined	-	Continuous	1,0302	0,8534	1,6766
Growth	+	Continuous	0,0825	0,0293	0,5668
Provisions	+	Continuous	0,6234	0,6569	0,2400

The initial econometric model proposed for study is:

$$\begin{aligned} Efficiency_{it} = {} & \beta_0 + \beta_1 Germany_{it} + \beta_2 Austria_{it} + \beta_3 Denmark_{it} + \beta_4 Spain_{it} \\ & + \beta_5 Finland_{it} + \beta_6 France_{it} + \beta_7 Ireland_{it} + \beta_8 Italy_{it} \\ & + \beta_9 Luxembourg_{it} + \beta_{10} Netherlands_{it} + \beta_{11} Portugal_{it} \\ & + \beta_{12} UnitedKingdom_{it} + \beta_{13} Sweden_{it} + \beta_{14} Life_{it} + \beta_{15} NonLife_{it} \\ & + \beta_{16} LnAssets_{it} + \beta_{17} ROA_{it} + \beta_{18} ROE_{it} + \beta_{19} Guarantee_{it} \\ & + \beta_{20} Retention_{it} + \beta_{21} Combined_{it} + \beta_{22} Growth_{it} + \beta_{23} Provisions_{it} + \varepsilon_{it} \end{aligned}$$

Where *i* refer to the insurance company under study, *t* refers to the financial year analysed and ε_{it} represents the random error of the model. The results obtained when applying the Tobit model with a complete panel data are presented in table 6. The estimated coefficient, the statistic value of the model used, the statistic value – if a regression without transforming the Tobit model was applied – and, finally, the confidence interval, were calculated for each variable.

Table 6: To bit regression

VARIABLES	*Estimated Coefficient*	*Statistic*	*Statistic "t"*	*Confidence Interval*	
Country (1)					
Germany	-0,32592	**-8,25****	-7,34	-0,40335	-0,24850
Austria	0,07064	1,76	0,79	-0,00823	0,14952
Denmark	-0,14732	**-2,92****	-1,71	-0,24637	-0,04828
Spain	0,07667	1,53	1,52	-0,02125	0,17459
Finland	-0,12271	**-2,41***	-1,83	-0,22253	-0,02290
France	-0,03783	-0,80	-1,19	-0,13035	0,05468
Ireland	-0,09973	**-2,16***	-1,21	-0,19014	-0,00931
Italy	-0,08718	-1,96	-1,58	-0,17443	0,00006
Luxembourg	-0,12384	**-2,47***	-1,66	-0,22191	-0,02577
Netherlands	-0,14530	**-3,32****	-2,25	-0,23108	-0,05952
Portugal	0,05376	1,09	1,43	-0,04323	0,15077
United Kingdom	-0,17119	**-4,20****	-4,30	-0,25109	-0,09129
Sweden	0,08965	1,93	1,07	-0,00155	0,18087
Lines of business (2)					
Life	0,13765	**5,15****	2,24	0,08524	0,19006
Non-life	0,03026	1,19	0,52	-0,01969	0,08022
Size					
Ln Assets	-0,01606	**-4,77****	-1,73	-0,02267	-0,00946
Profitability					
ROA	0,14857	**2,96****	3,05	0,05008	0,24707
ROE	0,01778	1,56	1,03	-0,00454	0,04012
Guarantee	0,00013	**9,62****	8,99	0,00010	0,00016
Retention	0,33426	**11,34****	9,41	0,27648	0,39204
Combined	-0,01001	**-5,20****	-2,79	-0,01379	-0,00624
Growth	0,01342	**2,41***	2,33	0,00248	0,02436
Provisions	0,55088	**14,46****	11,58	0,47621	0,62554
Constant	0,30083	**5,06****	2,62	0,18432	0,41733

Model applied: ***TOBIT***

χ^2 (p-value) = 1642.94 (0.000)
Log likelihood= 784.81047
Number of groups = 424
N= 1695

Observations per group: minimum 3, maximum 4, average 4

Sigma μ **37, 21**** rho **53,89****

** P (Statistic) < 0.01; * P (Statistic) < 0.05 (1) Benchmark country: Belgium; (2) Benchmark line of business: Mixed

It can be noticed how the values of the statistic of the Tobit model with panel date are higher than the 't' statistics obtained from the linear regression with panel data, which implies that the chosen model explains better the dependent variable.

Results prove that the probability of Wald test statistic is zero, which states that the model is significant. *Rho* is also noteworthy since it indicates the existence of individual effects and this verifies the suitability of a model that takes into account individual heterogeneity.

The results indicate that financial health is positive related to efficiency as all financial ratios, except ROE, are significant with the expected sign. The size of the insurance company, measured on the basis of the natural logarithm of the assets, turned out to be significant with a negative sign. Results indicate that the size of the insurer determines and explains the efficiency scores: the bigger the size, the less efficient the firm will be.

In order to study how dichotomous variables – country and lines of business – influence efficiency, it is necessary to carry out an additional Likelihood Ratio Test (LR test). This fact forces the consideration of two Tobit models: one in which all variables are included and another that doesn't include the dichotomous ones.

The Tobit model that contains all variables incorporates 14 covariables for the country variable and 3 for the lines of business; by doing so, the model improves, although it loses part of its freedom range. Besides, the results show that neither all countries nor all lines of business are significant. The LR Test estimates whether the improvement in the adjustments of the model compensates the loss of freedom. The formula for the test statistic is: $\lambda = -2(L_B - L_A)$ where L is the natural logarithm of the likelihood of models A and B, respectively. The statistic follows a chi-square distribution under the hypothesis that variables do not improve the adjustment of the model (Greene, 1998). The studied variables, as well as the value of the chi-square and the significance level of the test appear in Table 7 below.

Table 7: LR Test

	Countries	***Lines of business***
L_B	692,377	776,115
L_A	784,810	784,810
Chi² (□)	184,867	17,391
d.f.	13	2
Criticalvalue Chi2 at 1%	27,69	9,21
Significance	**0.000**	**0.000**

In the light of the results, the hypothesis can be rejected, so both country and lines of activity variables explain the efficiency gained by insurance companies. In brief, the variables which explain the efficiency of European insurance companies over the 2007 – 2011 periods are positively determined by the returns of assets (or ROA), the guarantee ratio, the retention percentage, the premiums growth and the provisions percentage; and negatively by the size of the company and the combined ratio. The country variable affects efficiency in conjunction with the lines of business. These results allow verifying the initial hypothesis that the insurance companies with a better financial health (higher ROE, guarantee, retention, growth, provisions and lower combined ratio) are more efficient.

5. Conclusions

The purpose of the current study is to analyse the efficiency in the European insurance sector, as well as to analyse which the explanatory factors of such level of efficiency are. The analysis of the efficiency has been realised by applying an input oriented Data Envelopment Analysis (DEA); whereas the study of the explanatory factors of this efficiency has been carried out applying a Tobit model in which the efficiency scores obtained were related to the main economic-financial ratios. Three input variables and three output variables have been selected for the efficiency analysis of a total amount of 424 firms from 14 countries over the time period elapsed between the years 2007 and 2011: on the one hand, net operating expenses, equity and debt capital variables were selected as inputs; on the other hand, net premiums, technical provisions and assets investment variables were chosen as outputs.

Findings show that levels of efficiency differ from one country to another. Despite that all countries present an average efficiency above the 50%, the fact that a different number of companies has been taken into account in each country, might be the reason why the percentage of efficient companies is higher in those countries in which a lower number of firms are considered.

This is the case of countries such as Spain and Portugal, which, in spite of being affected by a strong economic crisis, present a higher level of efficiency than countries such as Germany or the United Kingdom, which are the ones with the lowest efficiency levels among the analysed countries. This result, however, might also be explained by the fact that it is more difficult for all firms to reach high levels of efficiency in countries in which the market is more fragmented. The DEA analysis also indicates which input should be reduced so that inefficient companies become efficient. The results show that out of the three input variables considered for the analysis, that which should be largely reduced is debt capital. Therefore, it would be advisable to contemplate the possibility of implementing a change in the financial structure of the insurance companies. This change would imply that insurers employ their own sources of finance to the detriment of external sources.

The second part of the study is focused on analysing the financial health of the insurance sector in Europe. To do so, the general economic-financial ratios (returns and guarantee) of the insurance sector have been calculated, as well as the specific ones (premiums growth, retention percentage, and combined and technical provisions ratios). To conclude this study, a Tobit model with panel data was applied in order to examine the relation between the efficiency and the financial health of the insurance companies throughout the period analysed. In general terms, it can be inferred that insurance companies with better financial health are more liable to be highly efficient.

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