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Carlos Pestana Barros and Echika Lemechi Obijiaku

Technical Efficiency of Nigerian Insurance Companies

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Technical Efficiency of Nigerian Insurance Companies

Carlos Pestana Barros[a] and Echika Lemechi Obijiaku[2]

[a]Instituto Superior de Economia e Gestão, Technical University of Lisbon, Rua Miguel Lupi, 20, 1249-078 Lisbon, Portugal, Email Cbarros@iseg.utl.pt
[2] University of Lagos, Akoka. Lagos, Nigeria.letigerus2002@yahoo.com

Abstract:

This paper uses data envelopment analysis (DEA) to evaluate the performance of Nigerian insurance companies, from 2001 to 2005, combining operational and financial variables. The paper also analyses the situations of these companies in relation to the frontier of best practices. In addition, it tests for the roles played by dimension, bank network and market share in the efficiency of the Nigerian insurance companies. The implications of this research for managerial purposes are then drawn.

Keywords: Nigerian insurance companies, Data Envelopment Analysis, Efficiency

1. Introduction

The efficiency of Nigerian insurance companies is of interest in contemporary economics, in view of the increasing risks related to environmental and globalisation issues in the world today (Mutenga and Staikouras, 2007). Efficiency has been the focus of much research in insurance in the recent past (Fecher, Kessler, Perelman and Pestieu, 1993; Gardner and Grace, 1993; Fukuyama, 1997; Cummins and Zi, 1998). Moreover, the increased market competition brought about by deregulation and liberalisation at national level has equally placed insurance companies in a competitive environment. As a result, Nigerian insurance companies are now under pressure to upgrade their efficiency relative to their competitors. Benchmarking analysis is one of the ways to drive insurance companies towards the frontier of best practices (Mahlberg and Url, 2003).

In this paper, we analyse the technical efficiency of a representative sample of Nigerian insurance companies with the aid of four well-known DEA models: (i) the DEA-CCR model (Charnes, Cooper and Rhodes, 1978); (ii) the DEA-BCC model (Banker, Charnes and Cooper, 1984); (iii) the Cross-Efficiency DEA model (Sexton et al., 1986 and Doyle and Green, 1994); and (iv) the Super-Efficiency DEA model (Andersen and Petersen, 1993). Previous research on insurance efficiency has been conducted by several authors using DEA, such as Barros, Borges and Barroso (2005), Cummins, Rubio Misas and Zi (2005), Mahlberg and Url (2003), Diacon, Starkey and O'Brien (2002), Cummins, Weiss and Zi (1999) and Cummins and Zi (1998), among others.

DEA is a linear programming technique that enables management to benchmark the best-practice decision-making unit (DMU), i.e., by calculating the scores denoting their efficiency with a linear programming procedure (Brocket et al., 2004). Furthermore, DEA provides estimates of the potential improvement that can be made by the *inefficient Decision Making Unit* (DMU_i). Throughout this paper, we shall assume some knowledge of DEA on the reader's part. Readers who are not familiar with the technique are referred to Fare et al. (1994), Charnes et al. (1995), Coelli, Rao and Battese (1998), Cooper et al. (2000), Thanassoulis (2001) and Zhu (2002).

This paper expands upon previous research into insurance company efficiency by analysing the efficiency of Nigerian insurance companies in two stages with a DEA model in the first stage. The Data Envelopment Analysis (DEA) model is used to calculate both technical and scale efficiency. In the second stage, the Mann-Whitney U-test is used to test some hypotheses (Brocket and Gollany, 1996). To the authors' knowledge, this is one of the first articles to examine the relative efficiency of African insurance companies. From an academic perspective, the particular contribution of this paper lies in the use of alternative DEA models, whereas previously published papers have mainly restricted the analysis to one model.

The paper is organised as follows: in section 2, we describe the institutional setting; in section 3, we survey the literature on the topic; in section 4, we present the theoretical framework; in section 5, the data and results are presented; in section 6, the managerial implications of the study are considered; and, in section 7, we draw our conclusions.

2. Institutional Setting

The Nigerian insurance market is one of the most developed among the African countries, together with that of South Africa. The market during the period analysed consisted of 103 companies and 350 insurance brokers. Most of the insurance companies have a close link with bank groups, for example, Wapic Insurance PLC, which is affiliated to the Intercontinental Bank in Nigeria. Others have major shareholders who may also occupy a seat on the board of directors. The industry has under-performed its role in the financial sub-sector of the economy when compared with its counterparts in other parts of the world. The total Nigerian insurance share of the world market is only 0.01%, compared to South Africa with 0.86% (U.S. Commercial Service, 2006). Several factors account for the under-performance of the insurance industry, such as: low capitalisation, high receivables and poor public perception of the importance of insurance for business.

The structure of operations of the life branch is not significantly different, to judge by the steady growth of intermediaries and their control of over 70% of the total business generated in the Nigerian insurance market. Intermediaries who continue to accept risks on companies' behalf are largely free to determine the very essence of the insurance business. Not only are the consequences of this structure costly for operators, but additionally, the risk element in operators' business portfolios is high, the attendant cost of business generation is high, market and customer knowledge is poor, resulting from lack of direct interfacing with the market and companies continue to grapple with the costs associated with developing products which have no bearing on the needs of the market. This market formation, combined with inadequate knowledge on the part of the

companies' sales personnel of their own insurance products and the general weak understanding of operators of the market's needs, continues to restrain the industry from having a meaningful impact on the market's perception.

The general perception of the industry today, regardless of recent efforts to present and promote a positive image, is that its standards are too low and that it is not progressive. The result of the industry's weak enterprise skills is the stifling of growth, since companies are unable to adapt rapidly to the changing business climate and take optimal advantage of the opportunities created by recent changes in legislation.

Endeavouring to eradicate or reduce some of the deficiencies, the government announced in September 2005 new capital requirements for insurance companies in Nigeria, to come into force by February 2007. The minimum share capital for life business is set at Naira 2 billion, (nb. the naira is the Nigerian national currency. Its US dollar value stood at 1 USD = 130.62 NGN on 31 December of 2002), non-life is N.3 billion, reinsurance is N.10 billion and composite company, i.e., those active both in life and non-life insurance simultaneously, N. 5 billion. The recapitalisation process will lead to the consolidation of the insurance industry. This will invariably increase the financial stability and capacity of life insurance companies within the industry. It will also raise the entry barrier and create some players of much larger dimension than has been the case until now. The consolidation should bring about the emergence of solid, professional institutions that can operate effectively both in the local market and internationally. Several earlier recapitalisation exercises have been attempted, for example, the reforms introduced in the Insurance Act of 1997, followed by the Insurance Act of 2003, with the aim of increasing the capital base of the companies in the Nigerian insurance market.

These previous reforms in turn have given rise to mergers and acquisitions in the market. The number of life insurance companies has decreased due to the 2005 recapitalisation exercise.

This papers analyses the efficiency of a sample of 10 Nigerian insurance companies, all of which are composed of both life and non-life branches, and some of which are quoted on the Nigerian stock exchange. The companies in the sample are displayed, together with some characteristics, in Table 1 below.

INSERT TABLE 1

3. Literature Survey

Contemporary research in insurance efficiency employs frontier models. Two scientific methods employed to analyse efficiency quantitatively are the econometric frontier analysis and the data envelopment analysis (DEA). Both have their advantages and drawbacks. Unlike the econometric stochastic frontier approach, the DEA permits the use of multiple inputs and outputs and does not impose any functional form on the data; neither does it make distributional assumptions for the inefficiency term. Both methods assume that the production function of the fully-efficient decision unit is known. In practice, this is not the case and the efficient isoquant must be estimated from the sample data. In these conditions, the frontier is relative to the sample considered in the analysis. Table 2 provides a detailed description of previous research.

INSERT TABLE 2 Around here

Some remarks are in order. First, we note that ten papers out of thirteen make use of DEA, while the remaining three use econometric frontiers. Second, too many of the papers replicate previous research with little improvement in methodology. Third, some papers focus on international comparisons, which is important in the context of globalisation. Next, we note that we have not yet seen papers that apply more up-to-date techniques, such as Fourrier frontiers (Altunbas et al., 2001) and input distance functions (Coelli and Perelman, 1999, 2000). Moreover, it is note-worthy that we have not found any papers using non-traditional DEA models such as the Cone-Ratio DEA model of Charnes et al. (1990), or the Assurance Region DEA model of Thompson et al. (1986, 1990).

4. Methodology

Following Farrell (1957), Charnes, Cooper and Rhodes (1978) first introduced the term DEA (Data Envelopment Analysis) to describe a mathematical programming approach to the construction of production frontiers and the efficiency measurement of the constructed frontiers. The latter authors proposed a model that had an input orientation and assumed constant returns-to-scale (CRS).

The DEA-CCR and DEA-BCC models are strong in identifying the inefficient units, but are weak in discriminating between the efficient units (Seiford and Zhu, 1999). These two models often rate too many units as efficient. To overcome this deficiency, we

use the Cross-Efficiency DEA model (Sexton et al., 1986; and Doyle and Green, 1994) and the Super-Efficiency DEA model (Andersen and Petersen, 1993).

5.0 Data and Results

Frontier models require the identification of inputs (resources) and outputs (transformation of resources). Several criteria can be used in their selection. The first of these, an empirical criterion, is availability. Secondly, the literature survey is a means of ensuring the validity of the research and thus represents another criterion to be taken into account. The last criterion for measurement selection is the professional opinion of relevant individuals. In this paper, we abide by all three of the above-mentioned criteria.

To estimate the cost frontier, we used balanced panel data on Nigerian insurers in the years from 2001 to 2005 (10 companies × 5 years = 50 observations). The data was obtained from the insurance companies' balance sheets, presented in each of the annual reports for the years under analysis. The 10 companies studied in the present paper are leading companies in the market, representing around 40% of the Nigerian insurance market. The data was obtained in the insurance companies financial accounts, available either in the stock exchange for the quoted companies or in the companies' websites. Supplementary information was obtained from insurance bodies' websites, such as NAICOM {National Insurance Commission} and NIA {Nigerian Insurance Association}

We measured the insurance production according to a generalised Cobb-Douglas production function. Determination of inputs and outputs was based on the conclusions of the review article by Cummins and Weiss (2000) and on the available data. Outputs are variables that measure the results of the production, such as (i) the profit and loss

account; (ii) net premiums; (iii) settled claims; (iv) outstanding claims; (v) investment income. Four indicators measure inputs: (i) total capital; (ii) total operative costs; (iii) total number of employees; and (iv) total investments. All the monetary variables are in Naira (000s) and were deflated by the GDP deflator and denoted at constant 2002 prices. On 31st December 2001, the foreign exchange rate between the US dollar and the naira was: 1 USD = 123.54 NGN. On 31st December 2005, it was 1 USD = 130.5 NGN. The rate to the dollar on 5th September 2007 was 127.3808 NGN.

The combination of indicators measured ensured the DEA convention that the minimum number of DMUs is greater than three times the number of inputs plus output (120≥3(4+3)] (Raab and Lichty, 2002).

By using an output orientation, one can determine whether an insurance company can produce the same level of output with less input. The characteristics of the variables are depicted in Table 3:

INSERT TABLE 3 around here

5.1 DEA Results

The DEA index can be calculated in several ways. In this study, we estimated an output-oriented, technically-efficient (TE) DEA index, assuming that the insurers aim to maximise the profits resulting from their activity.

In this context, inputs are exogenous and the outputs endogenous, due to the competitive environment in which the units compete (Kumbhakar, 1987).

The variable returns-to-scale (VRS) hypothesis was chosen, disentangling technical efficiency into two different components: pure technical efficiency and scale

efficiency (Fare et al, 1994). The VRS scores measure pure technical efficiency only. However, the constant returns-to-scale (CRS) index is composed of a non-additive combination of pure technical and scale efficiencies. A ratio of overall efficiency scores to pure technical efficiency scores provides a measurement of scale efficiency.

The relative efficiency of Nigerian insurance companies is presented below in Table 4, with the companies being ranked according to the BCC model, using GAMS software (Brooks et al., 1992).

[Insert Table 4 about here]

A number of points emerge from the compiled index. Firstly, there are too many companies on the efficient frontier, which can be verified by the value one in the CCR and BCC scores.

Secondly, best-practice calculations indicate that almost all the insurers operated at a high level of pure technical efficiency in the period.

Thirdly, all technically efficient CRS insurance companies are also technically efficient in VRS, signifying that the dominant source of efficiency is scale.

Fourthly, on the basis of the BCC results, which measure pure technical efficiency accountable to management skills, all are efficient in the period. The rationale for interpreting BCC as management skills is based on the contrast between the CCR and BCC models. The CCR model identifies the overall inefficiency, whereas BCC differentiates between technical efficiency and scale efficiency (Gollani and Roll, 1989). Based on this differentiation, the ratio between CCR and BCC enables the estimation of scale efficiency in Table 4 and, assuming efficiency is due to managerial skills and scale

effects, the BCC scores are interpreted as managerial skills. Thus, according to the BCC scores obtained, none of the insurance companies analysed is inefficient.

Fifthly, according to the scale efficiency, all but two of the Nigerian insurance companies are efficient, while two are not. Those companies with DRS (decreasing returns to scale) are too large in dimension. Scale dimension should be decreased if decreasing returns to scale prevail. There are no IRS (increasing returns to scale) Nigerian insurance companies in the sample.

Sixthly, the efficiency scores presented in Table 4 are average values for the period, but when we analyse the insurance companies for all years, the result is the same: all of the companies display pure technical efficiency, but some of them do not display scale efficiency. Therefore, the overall conclusion is that Nigerian insurance companies are well managed as far as pure technical efficiency is concerned, but dimension makes a difference and therefore, some insurance companies have decreasing returns to scale.

Table 5 presents the results of the Cross-Efficiency DEA model and the Super-Efficiency DEA model, which were applied to the Nigerian insurance companies with two objectives: first to cross-validate the DEA-CCR and DEA-BCC models; and second, to restrict the number of DMUs in the frontier of best practices.

[Insert Table 5 about here]

We can observe that the scores from both the Cross-Efficiency and the Super-Efficiency DEA models rank the Nigerian insurance companies unequivocally, and that they maintain the same ranking, thereby overcoming the difficulty that the CCR-DEA and BCC-DEA models have in discriminating between the efficient units. The main

advantage of the results of Table 5 in relation to Table 4 is the unequivocal ranking of the sample of companies.

5.2 Efficiency by Different Types of Nigerian Insurance Companies

Having established the efficiency rankings of the Nigerian insurance companies, we now test some hypotheses related to the rankings obtained. The Mann-Whitney U-test, which tests for differences between the efficiency scores, is adopted. Grosskopf and Valdamanis (1987) and Brockett and Golany (1996) recommend the Mann-Whitney U-test for the non-parametric analysis of DEA results. It is used here because the efficiency scores do not fit within a standard normal distribution. The super-efficient scores are chosen, because these scores discriminate the units analysed adequately.

The following hypotheses are defined:

Hypothesis 1: Larger insurance companies are more efficient than smaller insurance companies.

This is a common hypothesis in insurance analysis, based on economies of scale (Barros, Borges and Barroso, 2005). To test this hypothesis, the insurance companies are classified by the book value of assets and then the sample is divided into two sub-sets on this basis.

Hypothesis 2: The insurance companies integrated into bank networks are more efficient than those not integrated into banks.

This is also a common hypothesis related to the economies of scale of networks (Cummins, Weiss and Zi, 1999). To test the hypothesis, the companies are classified

according to their relationship with banks and then the sample is divided into two sub-sets on the basis of this classification.

Hypothesis 3: The insurance companies with higher market shares are more efficient than insurance companies with lower market share.

The market share distinction is another common hypothesis in insurance analysis (Bernstein, 1999). To test this hypothesis, the insurance companies are classified according to the estimated market share and next, as previously, the sample is divided into two sub-sets.

INSERT TABLE 6 around here

The minus sign of the Z score indicates that large insurance companies tend to have higher efficiency scores than small companies, which validates the first hypothesis. This result is in line with previous research on insurance efficiency (Barros, Borges and Barroso, 2005). The present result is supported by the economies of scale observed in life insurance companies.

Moreover, bank network-managed insurance companies are found to have higher efficiency scores than those that are not managed within a bank network, thus validating the second hypothesis. This result reinforces the assertion that bank network-managed insurance companies are more efficient than their non-bank network counterparts, validating organisational forms in insurance companies (Cummins, Weiss and Zi, 1999).

Finally, the test shows that insurance companies with higher market share tend to be more efficient than those with lower market share, which validates the third hypothesis, confirming that market share is a good proxy for the efficiency scores (Bernstein, 2005).

6. Discussion

We find that the majority of Nigerian insurance companies are managed with pure technical efficiency, displaying similar managerial skills. However, for a small number of technically inefficient insurance companies, there is room to upgrade their efficiency level by means of reference to the frontier of best practices. Moreover, scale effects differentiate the insurance companies, with some of them displaying scale efficiency and others not. Therefore, scale is a major issue in insurance company management.

Moreover, we note that large insurance companies, with a higher book value of assets, tend to have higher efficiency scores than insurers with lower values, an effect that is explained by the economies of scale in this particular activity (Cummins and Zi, 1998). In addition, insurance companies operating within bank networks tend to have higher efficiency scores than those not linked to a bank, an effect that may be explained by the scope economies related to networks. Finally, companies with higher market share are also more efficient. From this result, it emerges that dimension, bank network and market share are all issues that are determinant factors in this activity.

Reason for difference in efficiency may reside in the principal-agent relationship (Jensen and Meckling, 1976). This relates to the difficulty of controlling those empowered as managers to act on behalf of the stockholders. Evidence of principal-agent

problems exists among the insurance companies in the Nigerian case. Since the Nigerian insurance companies operate in a less developed country, they may be unable to achieve efficiency due to principal-agent problems (Barros, Borges and Barroso, 2005) related to the lack of awareness in the market and the absence of legally-empowered supervisory controls.

The general conclusion is that scale is of paramount importance and therefore, the DEA-CCR models should not be the sole means of evaluating the Nigerian insurers' performance.

Different managerial styles may partly explain the behaviour observed. Any attempts to overcome the identified inefficiencies should start with an analysis of the scale of activities and the adoption of a competitive strategy.

How do our results compare with previous research? The efficiency scores established lead us to observe that Nigerian insurance companies are relatively more efficient than other analysed insurance companies (Barros, Borges and Barroso, 2005). One reason for this observation may be found in the use of up-to-date data on the insurance companies analysed, in contrast to previous research. In addition, the relationship between the dimension, bank network, market share and the efficiency is clearly displayed in the paper.

With regard to the limitations of the present research, it is worth mentioning that the measurement of dimension by the book value of assets is of debatable value, but it could alternatively be measured by the number of clients.

Some extensions of this paper can also be envisaged, such as analysing the insurance companies with heterogeneous stochastic frontier models (Orea and

Kumbhakar, 2005), or adopting alternative DEA models such as the Malmquist Index model (Malmquist, 1953).

7. Conclusions

This article has proposed a simple framework for the comparative evaluation of Nigerian insurance companies and the rationalisation of their operational activities. The analysis is based on a DEA model that allows for the incorporation of multiple inputs and outputs in determining relative efficiencies. Benchmarks are provided for improving the operations of insurance companies performing less efficiently. Several interesting and useful managerial insights and implications arising from the study are discussed. The general conclusion is that the Nigerian insurance companies display relatively high managerial skills, despite the previously-mentioned evidence of principal-agent problems and the lack of trained professionals referred to in Section 2, being VRS-efficient for the most part. We have identified some inefficient insurance companies, although these have a margin in which to upgrade their efficiency. Moreover, these companies do not display equivalent scale efficiency, signifying that dimension acts as a restriction on the efficient performance of small insurers. A statistical correlation test between dimension (measured by book values of assets) and the CCR efficiency scores supports a statistically positive correlation between them. On the other hand, a statistical correlation test between the insurance companies integrated into a bank network and the CCR efficiency scores is statistically supported. Finally, a statistical correlation test between higher market share and the CCR efficiency scores is also statistically supported. More research is needed to confirm these results.

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Table 1: Characteristics of the Sample of Nigerian Insurance Companies in the Analysis (2001)

No.	Insurance Companies	Total Capital	Total Operative costs	Total number of employees	Profit &Loss	Quoted (yes=1, no=0)
1	Lasaco Assurance PLC	90000	168418	86	85215	1
2	Unic Insurance PlC	397600	1110841	162	-162268	1
3	Prestige Assurance PLC	109688	52335	72	76894	1
4	Crusader Insurance PLC	108794	270029	140	40956	1
5	Guinea Insurance PLC	120000	39883	63	-19465	1
6	Wapic Insurance PLC	100000	53273	83	29411	1
7	Law Union and Rock	100000	227123	148	32551	1
8	Leadway Assurance Co. LTD	158126	518439	354	78999	0
9	Royal Exchange Assurance	256289	522321	216	153530	1
10	African Alliance Insurance	20000	346824	134	708	0
	Mean	146049.7	330948.6	145.8	31653.1	0.8
	Median	109241.0	248576.0	137.0	36753.5	1
	Standard Deviation	106581.3	326703.4	87.3	83851.5	—

Table 2: Summary of Previous Research.

Papers	Method	Units	Inputs	Outputs
Barros, Barroso and Borges (2005)	DEA-Malmquist	27 Nigerian insurance companies	Wages, capital, total investment income and premiums issued	Claims paid and profits
Karl C. Ennsfellner, Danielle Lewis and Rand I.Anderson (2005)	Bayesian stochastic frontier	Austrian health, life and non life insurance companies, 1994-1999	Health, life and non-life: Net operating expenses, equity capital and technical provisions net of reinsurance.	Health and life: incurred benefits net of reinsurance, changes in reserves net of reinsurance, total invested assets. Non-life: claims incurred net of reinsurance, total invested assets.
Cummins, Rubio Misas and Zi (2005)	DEA Input distance function	Spanish stock and mutual life insurance companies, 1989-1997.	Price of non life output, price of life output, labour input, materials, equity capital, debt capital, price of labor, price of materials, price of equity capital, price of debt capital, total costs, total assets, non-life premiums, life premiums, net income, reserves/total assets, net income/equity income, debt capital/total capital, equity capital/total assets, net income/total assets.	Total output, non-life output, life output
Mahlberg and Url (2003)	DEA-Malmquist index	Austrian Life insurance companies, 1992-1999.	Administration and distribution costs and costs of capital investments	Aggregate value of: expenditure on claims incurred, net change in technical provisions and the amount of returned premiums desegregated on Health insurance, Life insurance, property-liability insurance

Diacon, Starkey and O'Brien (2002)	DEA-CCR and DEA-VRS.	Standard & Poor's Eurothesys data base, 1996-1999	Total operating expenses net of reinsurance commissions, total capital, total technical reserves, total borrowings	General insurance net earned premiums, long term insurance net earned premium, total investment income.
Noulas, Hatzigayios, Lizaridis and Lyroudi (2001)	DEA-CCR model	11 Greek life insurance companies, 1991-1996.	Direct cost (claims) and indirect costs (salaries and other expenditures).	Premium income and Revenue from investments.
Cummins, Weiss and Zi (1999)	DEA Input oriented distance function, DEA-Malmquist index	US insurers 1981-1990	Labour costs, materials , policy holders supplied debt capital and equity capital and real invested assets,	Short tail personal lines, short tail commercial lines, long tail personal tail, long tail commercial tail, return on assets
Cummins and Zi (1998)	Deterministic cost frontier, DEA-CCR, DEA-VRS and DEA-NIRS	US life insurance companies, 1988-1992	Labour, financial capital and materials.	Incurred benefits desegregated into ordinary life insurance, group life insurance and individual annuities, addition to reserves
Fukuyama (1997)	DEA-Malmquist index.	25 Japanese life insurance companies, 1988-1993	Asset value, number of workers and tied agents or sales representatives.	Insurance reserves, loans
Cummins, Turchetti and Weiss (1996)	DEA Input distance function and DEA-Malmquist index	17 Italian life, 58 non-life and 19 mixed life insurance companies, 1985-1993.	Wages, administrative wages, fixed capital, equity capital and other ratios.	Life insurance benefits and changes in reserves, non-life incurred losses in auto property, in auto liability, in other property and in other liability, and invested assets.
Fecher, Kessler, Perelman and Pestieau (1993)	DEA-BCC and Stochastic Cobb-Douglas frontier	84 life and 243 non life French life	Wages, other outlays, distribution ratio, reinsurance ratio and claims ratio.	Gross premiums, desegregated by sectors and the sum of dividends, coupons and

		insurance companies, 1984-1989.		rents.
Cummins and Weiss (1993)	Translog stochastic frontier	From 38 to 134 US life insurance companies, 1980-1988.	Labour, capital and intermediate expenditures.	Discounted long tail incurred losses for unregulated and regulated states; discounted long tail incurred losses for unregulated and regulated states, the sum of loss reserves, loss adjustment expense reserve and unearned premium reserve and the sum of loss adjustment expenses.
Gardner and Grace (1993)	Deterministic Cobb-Douglas frontier.	561 US life insurance companies, 1985-1990.	Labour, physical capital and miscellaneous items.	Ordinary life insurance premiums, group life insurance premiums, ordinary annuity, group annuity, group accident and health premiums.

Table 3: Characteristics of the Variables for the period 2001-2005

	Minimum	Maximum	Mean	Std. Deviation
Outputs				
Profit and loss account	-235251	641491	118578.4	142925.1
Net premiums	42567	3956300	751884.3	738914.7
Settled claims	16373	1549300	312317.1	304730.1
Outstanding claims	4699	791738	150008.9	180518.9
Investment income	5880	766884	181312.5	175372.8
Inputs				
Total capital at constant price 2002=100	20000	975409	272935.9	196886.7
Total operative costs at constant price 2002=100	39883	3906300	783432.3	728314.6
Total number of employees	55	354	144.7	81.3
Total investments at constant price 2002=100	7956	6730400	1240657	1580822

Table 4: CCR-DEA Model and BCC-DEA Model, Technical Efficiency Scores for Nigerian Insurance Companies, average values for the period 2001-2005

No.	Insurance companies	Technical efficiency, Constant Returns-to-Scale CCR model	Technical efficiency, Variable Returns-to-Scale BCC model	Scale efficiency	Position of the company on the frontier
1	Lasaco Assurance PLC	1.000	1.000	1.000	—
2	Unic Insurance PlC	1.000	1.000	1.000	—
3	Prestige Assurance PLC	1.000	1.000	1.000	—
4	Crusader Insurance PLC	0.692	1.000	0.692	drs
5	Guinea Insurance PLC	1.000	1.000	1.000	—
6	Wapic Insurance PLC	1.000	1.000	1.000	—
7	Law Union and Rock	1.000	1.000	1.000	—
8	Leadway Assurance Co. LTD	1.000	1.000	1.000	—
9	Royal Exchange Assurance	0.770	1.000	0.770	drs
10	African Alliance Insurance	1.000	1.000	1.000	—
	Mean	0.946	1.000	0.946	
	Median	1.000	1.000	1.000	
	Standard Deviation	0.115	0.000	0.115	

Table 5: Cross-Efficiency DEA Model and Super-Efficiency DEA Model, Technical Efficiency Scores for Nigerian Insurance Companies, average values for the period 2001-2005

No.	Insurance companies	Technical efficiency, cross-efficiency scores	Technical Efficiency, super-efficiency scores
1	Lasaco Assurance PLC	1.161	1.982
2	Unic Insurance PlC	1.036	1.172
3	Prestige Assurance PLC	1.759	1.763
4	Crusader Insurance PLC	0.729	0.835
5	Guinea Insurance PLC	1.135	1.139
6	Wapic Insurance PLC	1.082	1.117
7	Law Union and Rock	1.053	1.192
8	Leadway Assurance Co. LTD	1.032	1.125
9	Royal Exchange Assurance	0.638	1.052
10	African Alliance Insurance	1.028	1.152
	Mean	1.065	1.253
	Median	1.045	1.146
	Standard Deviation	0.297	0.346

Table 6: Mann-Whitney Test of Differences in Efficiency

Reference	Mann-Whitney U-Test	Mann-Whitney Z-Test	Asymptotic significance (two-tailed)
Large insurance companies vs. small insurance companies	196.00	-1.325	0.025*
Bank network-managed insurance companies vs. not bank network-managed insurance companies	152.00	-1.54	0.023*
Insurance companies with higher market share vs. insurance companies with lower market share	178.00	-1.43	0.047*

* Indicates significance at a 5% level.