Zagreb International Review of Economics & Business, Vol. 15, No. 2, pp. 1-14, 2012

ISSN 1331-5609; UDC: 33+65

The Efficiency Analysis of Non-life Insurance Companies Active in Turkey

Semra Turkan*

Esra Polat*

Suleyman Gunay*

Abstract: This paper evaluates the technical efficiencies of non-life insurance companies, which are active in Turkey in 2007, using Data Envelopment Analysis (DEA). DEA, which is a non-parametric method, facilitates to examine different input-output components. DEA is a management evaluation tool that assists in identifying the most efficient and inefficient decision making units (DMUs) in the best practice frontier. In this study, as inputs of 23 non-life insurance companies, the number of agents, the number of brokers, fixed assets, shareholders' equity and as outputs the investment incomes, premiums received are used. Empirical results of BCC and CCR models, which are DEA models, show that the most efficient insurance company is RAY.

Keywords: Banker-Charnes-Cooper(BCC), Charnes-Cooper-Rhodes(CCR), Data Envelopment Analysis (DEA), Efficiency, Insurance.

JEL Classifiation: G22

Introduction

Insurance is fundamental for protecting individuals against the hazards of life. One of the important functions of insurance companies is to create funds for investments, which are crucial for economic growth, in an economy. Hence, the role of insurance industry is critical in developing economies. However, the number of studies analyzing the performance of the insurance companies in developing economies is very limited. Hao and Chou (2005) analyze the cost efficiency of life insurance companies in Taiwan. Tone and Sahoo (2005) analyze the cost efficiency in the In-

* Semra Turkan, Esra Polat, Suleyman Gunay are at Hacettepe University, Faculty of Science, Department of Statistics, Ankara, Turkey.

dian life insurance industry. Barros and Obijiaku (2007) evaluate the performance of Nigerian insurance companies, from 2001 to 2005, combining operational and financial variables by using Data Envelopment Analysis (DEA), also analyzing the situations of these companies in relation to the frontier of best practices. Yao et al. (2007) only estimate the efficiency of insurance industry in China without considering other aspects of insurance companies that may be just as important or even more so. Wei (2009) introduces a modified measure of risk-adjusted efficiency by using a multistage DEA to estimate the real efficiency level for the 284 insurance companies in China from 1999 to 2006. Dutta and Sengupta (2011) calculating the efficiency scores of the major life insurance companies in India over the period of five financial years from 2004 to 2008 (Barros and Obijiaku, 2007; Kasman and Turgutlu, 2009; Wei, 2009; Dutta and Sengupta, 2011).

The literature on the performance of the Turkish insurance companies has been also limited. Ciftci (2004) investigates the technical efficiency of life and non-life insurance companies in Turkey over the 1998 to 2002 period using DEA. Kilickaplan and Basturk (2004), address the technical efficiency issue in the non-life insurance companies in 2002 using DEA. Kilickaplan ve Karpat (2004) evaluate the total, technical and scale efficiencies of Turkish life insurance companies in the 1998 to 2002 period by using Tobit model. Sezen et al. (2005), also analyze the technical efficiency of the non-life insurance companies in the 1998–2003 period. Kasman and Turgutlu (2007) investigate the technical efficiency of a sample of Turkish life insurance companies, using the DEA, chance-constrained DEA (CCDEA) and stochastic frontier analysis (SFA) for the period 1999-2005. Kasman and Turgutlu (2009) examine the cost efficiency and scale economies of insurance companies in the Turkish insurance industry over a 15-year period, 1990–2004 (Kilickaplan and Karpat, 2004; Kasman and Turgutlu, 2007; 2009).

The primary aim of this study is to examine the technical efficiency performance of non-life insurance companies in Turkey in 2007 by using two base DEA models CCR and BCC and finding the most efficient ones. Additionally, finding how much the inputs of the inefficient insurance companies should be decreased and how much the outputs of them should be increased for making them efficient as the others.

The Concept of Efficiency and Data Envelopment Analysis

Efficiency is commonly defined as inputs/outputs and it is aimed to maximize the outputs from a given set of inputs. In the case of the insurance industry we would like to maximize our profit, or similarly we would like to minimize our costs (Harton, 2010). Modern efficiency measurement was started by Farrell (1957), who proposed that the efficiency of a firm consists of two components: technical efficiency (TE) and allocative efficiency. TE reflects the ability of a firm to obtain maximal output(s) from a given set of input(s) or to use minimal input(s) to obtain a fixed level of output(s). Allocative efficiency reflects the ability of a firm to use the input(s) in optimal proportions, given their respective prices. These two measures are then combining to provide economic efficiency. The objective of TE can be achieved by many combinations of inputs that are a feasible set of efficient input mixes (Dutta and Sengupta, 2011).

Farrell (1957) first advanced the concept of deterministic non-parametric frontier to measure the relative technical efficiency employing the envelope curve. Measured units lying on the production frontier are efficient for their combinations of inputs and outputs, whereas others that are not lying on the production frontier are inefficient. Farrell defined that TE multiplied by allocative efficiency is overall one. Afterwards Charnes, Cooper and Farrell (1978) developed DEA model which was extended from signal input and output to multiple inputs and outputs. DEA is a nonparametric linear programming technique, which constructs a linear frontier and measures the relative efficiency of a set of similar units, usually referred to as decision making units (DMUs). Its concept is that the best practice for firms lying on the production frontier, which results in having an efficiency value of one. In contrast, the firms being below the production frontier have a less value than one and they are said to be less efficient (Chen and Lin, 2007; Kumar and Gulati, 2008).

Since DEA is a mathematical programme for measuring performance efficiency of organizations popularly named as DMUs, the DMU can be of any kind such as manufacturing units, a number of schools, banks, hospitals, police stations, firms etc. DEA measures the performance efficiency of these kinds of DMUs, which share a common characteristic that they share non-profit organization where the measurement is difficult. Although DEA was initially used to assess the relative efficiency of not-for-profit organizations such as schools and hospitals, gradually its application has been extended to cover for-profit organizations such as banks as well. Over the years, DEA has emerged as a very significant technique to measure the relative efficiency of banks (Kumar and Gulati, 2008; Mantri, 2008). Evaluation of efficiency and productivity using DEA has become a popular method by many scholars around the world. However the banking industry has been the most frequently evaluated and measured sector compared to the insurance industry (Abidin and Cabanda, 2011). DEA assumes the performance of the DMU using the concepts of efficiency or productivity, which is measured as the ratio of total outputs to total inputs. The efficiencies estimated are relative to the best performing DMU is given a score of 100 % and the performance of the other DMUs vary between 0-100 % (Mantri, 2008). The number of DMUs to be compared depends on the objectives of the DEA study and the number of homogenous units required to be compared in the application. Nevertheless there are various opinions regarding the number of DMUs. Norman and Stoker (1991) argued that the number of DMUs should be at least 20. According to Boussofiane (1991), in terms of the reliability of the study there should be at least (m+n+1) number of DMUs, where m is the number of inputs and n is the number of outputs (Bakirtas et al., 2010).

A measure of technical efficiency under the assumption of constant returns-to-scale (CRS) is known as a measure overall technical efficiency (OTE). The OTE measure helps to determine inefficiency due to the input/output configuration as well as the size of operations. In DEA, OTE measure has been decomposed into two mutually exclusive and non-additive components: pure technical efficiency (PTE) and scale efficiency (SE). This decomposition allows an insight into the source of inefficiencies. The PTE measure is obtained by estimating the efficient frontier under the assumption of variable returns-to-scale. It is a measure of technical efficiency without scale efficiency and purely reflects the managerial performance to organize the inputs in the production process. Thus, PTE measure has been used as an index to capture managerial performance. The ratio of OTE to PTE provides SE measure. The measure of SE provides the ability of the management to choose the optimum size of resources (Kumar and Gulati, 2008).

Data Envelopment Analysis Models and Super Efficiency Approach

There are many different variations of DEA, but the two most basic approaches in DEA as constant returns to scale and variable returns to scale. The model built on constant return to scale assumption is called CCR (Charnes, Cooper, Rhodes), while the model based on variable return to scale assumption is called BCC (Banker, Charnes, Cooper). According to Charnes et al. (1978) there is an important relation between the scales and the efficiencies of the enterprises studied under constant return to scale assumption. As per CCR approach, in situations in which all inputs can be controlled, the input-oriented models and output-oriented models give the same relative efficiency values. However, according to Banker et al. (1984) an increase in inputs leads to a disproportionate increase in outputs. Therefore, as per BCC approach, while input-oriented models enable determination of how much the inputs of the inefficient DMUs should be decreased in order to be able to obtain a certain output level; output-oriented models enable the determination of how much the outputs should be increased so that inefficient DMUs become efficient with a given input combination (Bakirtas et al., 2010; Harton, 2010). Allowing variable returns to scale effectively means when defining efficiency of a given insurance company it is only compared to other insurance company of a similar size. Assuming scale advantage exists, this is equivalent to compensating smaller organizations for their reduced efficiency. Assuming that economies of scale exist, within a BCC model a small organization will appear efficient, but within a CCR model the small organization will appear inefficient (Harton, 2010).

CCR model

The CCR model can be classified into input-oriented model, which minimizes the input levels given output levels and output-oriented model, which maximizes the output levels given input levels. Under the assumption of constant returns to scale which indicates input levels rise proportionally to output levels, the overall TE value will equal using input-oriented model or output-oriented model (Chen and Lin, 2007). CCR applies to the situation, in which all DMUs operate under the most suitable scale. However, DMUs may not operate under optimum scale due to full competition conditions not being present, finance problems and other reasons (Bakirtas et al., 2010)

Input-oriented CCR model

To evaluate the efficiency of the kth DMU, we have to minimize the input levels given output levels. In other words, we analyze the "maximization" of output levels given input levels for DMU_k using the following method. The original fractional programming is as in Eq. (1) (Ciftci, 2004; Chen and Lin, 2007; Abidin and Cabanda, 2011).

$$\begin{aligned}
&\max h_k = \sum_{r=1}^{s} u_r y_{rk} \Big/ \sum_{i=1}^{m} v_i x_{ik} \\
&\textit{subject to} \sum_{r=1}^{s} u_r y_{rj} \Big/ \sum_{i=1}^{m} v_i x_{ij} \le 1 \quad j = 1,\cdots,n \\
&v_i \ge 0;\ i = 1,\cdots,m \\
&u_r \ge 0;\ r = 1,\cdots,s
\end{aligned} \tag{1}$$

In Eq. (1) h_k is the estimate of relative efficiency for the kth DMU_k, u_r is the rth weighted level of inputs for the kth DMU, v_i is the ith weighted level of inputs for the jth DMU, x_{ij} is the ith level of inputs for the jth DMU, y_{ij} is the rth level of outputs for the jth DMU (Chen and Lin, 2007). As it is difficult to find solutions using the fractional programming and is likely to calculate infinite solutions, the fractional programming is transformed into the linear programming and solutions are found using the duality which is in favor of reducing the number of constraints. The linear programming is as in Eq. (2) and the duality in linear programming is as in Eq. (3) (Ciftci, 2004; Chen and Lin, 2007; Abidin and Cabanda, 2011).

$$\begin{aligned}
&\max h_k = \sum_{r=1}^{s} u_r y_{rk} \\
&\textit{subject to} \sum_{i=1}^{m} v_i x_{ik} = 1, \\
&\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0; \quad j = 1,\cdots,n \\
&v_i \ge 0;\ i = 1,\cdots,m \\
&u_r \ge 0;\ r = 1,\cdots,s
\end{aligned} \tag{2}$$

$$
\begin{aligned}
&\min w_k = q_k \\
&\textit{subject to} \sum_{j=1}^{n} y_{rj}\lambda_j \geq y_{rk};\ r = 1,\cdots,s \\
&\sum_{j=1}^{n} x_{ij}\lambda_j \leq q_k x_{ik};\ i = 1,\cdots,m \\
&\lambda_j \textit{ is the weight } \lambda_j \geq 0; \quad j = 1,\cdots,n \\
&-\infty \leq q_k \leq +\infty
\end{aligned}
\tag{3}
$$

The development of output-oriented model is the same as for input-oriented one. To evaluate the efficiency of the kth DMU, we have to maximize the output levels given input levels using the same method mentioned above in input-oriented model. In the case of evaluation of efficiency, no matter which model is chosen. The value of q_k which is equal to one indicates that DMU_k is relatively efficient, whereas the value of q_k which is less than one indicates that DMU_k is relatively inefficient (Chen and Lin, 2007).

BCC model

Banker, Charnes and Cooper (1984) presented the BCC model which applies to the cases of variable returns to scale. The efficiency values obtained from the solution of BCC model is named as TE. In this way determination of TE value also enables the measurement of SE value. By evaluating the current input combination optimally, the success rate for the generation of the biggest possible outcome is defined as TE, the success in producing on optimum scale is defined as SE. BCC model measures PTE and calculates SE using OTE in CCR model divided by PTE. Hence, we further know inefficiency mainly stems from pure technical inefficiency or scale inefficiency. As the CCR model, the BCC model also can be classified into input-oriented model and output-oriented model (Chen and Lin, 2007; Bakirtas et al., 2010).

Input-oriented BCC model

The original fractional programming is as in Eq. (4) and the linear programming is as in Eq. (5) (Ciftci, 2004; Chen and Lin, 2007).

$$
\begin{aligned}
&\max z_k = \sum_{r=1}^{s} u_r y_{rk} - u_0 \Big/ \sum_{i=1}^{m} v_i x_{ik} \\
&\textit{subject to} \sum_{r=1}^{s} u_r y_{rj} - u_0 \Big/ \sum_{i=1}^{m} v_i x_{ij} \leq 1,\ j = 1,\cdots,n
\end{aligned}
\tag{4}
$$

$$u_r \geq 0;\ r = 1, \cdots, s$$
$$v_i \geq 0;\ i = 1, \cdots, m$$
$$u_0 \in (-\infty, +\infty)$$

$$\begin{aligned}
&Max\, z_k = \sum_{r=1}^{s} u_r y_{rk} - u_0 \\
&subject\ to \sum_{i=1}^{m} v_i x_{ik} = 1, \\
&\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} - u_0 \leq 0,\ j = 1, \cdots, n \\
&u_r \geq 0;\ r = 1, \cdots, s \\
&v_i \geq 0;\ i = 1, \cdots, m
\end{aligned} \tag{5}$$

The duality in linear programming is as follows (Ciftci, 2004; Chen and Lin, 2007):

$$\begin{aligned}
&\min w_k = q_k \\
&subject\ to \sum_{j=1}^{n} y_{rj} \lambda_j \geq y_{rk},\ r = 1, \cdots, s \\
&\sum_{j=1}^{n} x_{ij} \lambda_j \leq q_k x_{ik},\ i = 1, \cdots, m \\
&\sum_{j=1}^{n} \lambda_j = 1 \\
&\lambda_j\ is\ the\ weight\ \lambda_j \geq 0; \quad j = 1, \cdots, n \\
&-\infty \leq q_k \leq +\infty
\end{aligned} \tag{6}$$

The concept of output-oriented model is the same as for input-oriented one. To evaluate efficiency of the kth DMU, we have to maximize the output levels given input levels using the same method mentioned above in input-oriented model (Chen and Lin, 2007).

Super efficiency approach

The super-efficiency model gives efficiency scores by eliminating the data on the DMU to be evaluated from the solution set. For the input model this can result in values which give the DMU the status of being "super efficient". These values are then used to rank the DMUs and thereby eliminate some (but not all) of the ties that occur for efficient DMUs (Yen and Othman, 2011).

Assume there are m inputs, s outputs and n DMUs. Andersen and Petersen (1993) excluded DMU_j from the decision-making reference collection and the super-efficiency score of DMU_j is estimated as follows (Chen et al., 2010).

super-BCC Model:

$$\begin{aligned} &\min_{E_j,\lambda_1,\lambda_2,\cdots,\lambda_n} \quad E_j \\ &\textit{subject to} \quad E_j X_j - \sum_{\substack{k=1 \\ k\neq j}}^{n} z_k X_k \geq 0 \\ &\qquad -Y_j + \sum_{\substack{k=1 \\ k\neq j}}^{n} z_k Y_k \geq 0 \\ &\qquad \sum_{\substack{k=1 \\ k\neq j}}^{n} z_k = 1 \\ &\qquad z_k \geq 0, k = 1,\cdots,n \\ &\qquad E_j \textit{ is free} \end{aligned} \tag{7}$$

In Eq.(7), E_j is the super-efficiency score of DMU_j estimated by the Andersen and Petersen (AP) model; X_j is the input vector of DMU_j; Y_j is the output vector of DMU_j; z_k is the intensity of DMU_k. This model's feature is to exclude the DMU out of the reference set. If the DMU is inefficient, then the reference set does not change in this model. On the other hand, the frontier will change if the DMU is efficient and the score of efficiency is larger than 1. This says that the AP model does not change an inefficient DMU's score, but an efficient DMU's score in this model is larger than 1. Therefore, this model seems to solve for the efficiency with a value of the rankings, but follow-up scholars find that this model can't be estimated (infeasible). In practice, they are still unable to model all efficient DMUs and do the right value rankings (Chen et al., 2010).

Application and Results of Analysis

In this study, the performances of non-life insurance companies operating in Turkey in 2007 are examined using DEA. The input-oriented CCR and BCC models are obtained for each insurance company. By using an input orientation, one can determine whether an insurance company can produce the same level of input with less ouput. In addition, super efficiency model is estimated to find the degree of efficiency of insurance companies.

The first step in DEA is determination of the DMUs. In this study, DMUs are non-life insurance companies. The data were collected from insurance and pension annual report 2007 of the Republic of Turkey Prime Ministry Undersecretariat of Treasury Insurance Supervisory Board. The second step of DEA is determination of inputs and outputs. In this study, the number of agents, the number of brokers, fixed assets, shareholders' equity are considered as input variables and investment incomes, premiums as output variables. Determination of inputs and outputs based on the conclusion of review previous studies on insurance companies. The data set used in this study is presented as in Table 1.

Table 1. Insurance Companies, Inputs and Outputs

	Input 1	**Input 2**	**Input 3**	**Input 4**	**Output 1**	**Output 2**
Insurance Company	**Number of Agents**	**Number of Brokers**	**Fixed Assets**	**Shareholders' Equity**	**Investment Incomes**	**Premiums**
AIG	309	28	1849842	23260911.01	3238697.48	154397637.2
AKSİGORTA	1401	33	49736439	2638533699	120606335.1	792710644.6
ANADOLU	1453	54	20423428	644088129.1	127879695.6	1192587098
ANKARA	487	33	2729739	52972876.69	9090090.03	192121733.8
AVIVA	622	44	1206411	69484574.81	22554504.58	223215268.3
AXA OYAK	1452	33	32600134	352910426.8	115685481.4	1129744758
BAŞAK GROUPAMA	1332	43	16419247	90060082.94	40860200.85	467986891.1
BİRLİK	357	11	167307	10387875	1742464	113616205
ERGOİSVİÇRE	1381	44	12688202	141682313.7	26252188.39	636646722
EUREKO	119	38	2306771	94995703.18	9692422.83	415466359.4
FİBA	603	36	4408759	9411580.41	3631319.61	289331062.3
GENERALİ	258	27	65797154	196984011	20575772.05	74543116.65
GÜNEŞ	1143	48	17090344	68644764.17	10668780.95	637523807.8
GÜVEN	2601	15	5328586	20245171.02	4118918.37	222893121.5
HDI	601	22	4085995	10188097.51	3903096.94	157754632.4
HÜR	542	6	1418499	51178905.09	9468866.61	42047858.31
IŞIK	362	9	31852007	255121836.8	59135211.02	105492692.5
KOC ALLIANZ	1224	48	11864804	45252527.61	8785354.05	860806488
LIBERTY	373	16	17326104	49079914.8	9014028.07	151718242.4
RAY	492	34	-1503922	25546917.71	3358135.69	270988567.3
TEB	142	34	1209190	19911303.5	2721301	154835614.2
T. GENEL	302	38	30715845	253598078.9	34433888.57	321761159.4
YAPI KREDİ	711	24	719326	25558045.86	5034278.84	628142638.6

Techinical efficiency scores related to insurance companies in Table 1 are obtained from input-oriented CCR and BCC models. The results of CCR and BCC models are illustrated in Table 2 and Table 3, respectively.

Table 2. The results of CCR

CCR Model		
DMUs	**Efficiency**	**Referans sets**
AIG	0.5578	6 (0.02) 10 (0.02) 23 (0.20)
AKSİGORTA	0.5251	3 (0.02) 6 (0.66) 17 (0.70)
ANADOLU	**1.0000**	**2**
ANKARA	0.5764	5 (0.17) 6 (0.04) 10 (0.01) 23 (0.17)
AVIVA	**1.0000**	**4**
AXA OYAK	**1.0000**	**8**
BAŞAK GROUPAMA	**1.0000**	**4**
BİRLİK	0.7065	5 (0.04) 20 (0.03) 23 (0.16)
ERGOİSVİÇRE	0.5796	5 (0.00) 6 (0.20) 23 (0.66)
EUREKO	**1.0000**	**6**
FİBA	**1.0000**	**2**
GENERALİ	0.4932	10 (0.10) 17 (0.33)
GÜNEŞ	0.6317	6 (0.05) 10 (0.02) 23 (0.91)
GÜVEN	0.6706	6 (0.00) 7 (0.06) 23 (0.31)
HDI	0.9075	7 (0.05) 11 (0.46)
HÜR	0.9753	3 (0.06) 5 (0.05)
IŞIK	**1.0000**	**3**
KOC ALLIANZ	0.8453	7 (0.05) 11 (0.08) 23 (1.30)
LIBERTY	0.5593	6 (0.06) 7 (0.03) 23 (0.11)
RAY	**1.0000**	**1**
TEB	0.9204	6 (0.01) 10 (0.13) 23 (0.15)
T. GENEL	0.7750	10 (0.65) 17 (0.48)
YAPI KREDİ	**1.0000**	**9**
Mean	**0.8141**	

Table 3. The results of BCC

BCC Model		
DMU	**Efficiency**	**Referans sets**
AIG	0.8340	6 (0.01) 8 (0.46) 10 (0.02) 21 (0.50) 23 (0.01)
AKSİGORTA	0.7175	3 (0.40) 6 (0.60)
ANADOLU	**1.0000**	**2**
ANKARA	0.7162	3 (0.00) 5 (0.10) 6 (0.04) 8 (0.50) 10 (0.04) 21 (0.31)
AVIVA	**1.0000**	**1**
AXA OYAK	**1.0000**	**8**
BAŞAK GROUPAMA	**1.0000**	**0**
BİRLİK	**1.0000**	**6**
ERGOİSVİÇRE	0.5920	6 (0.20) 8 (0.12) 21 (0.06) 23 (0.62)
EUREKO	**1.0000**	**5**
FİBA	**1.0000**	**0**
GENERALİ	0.6845	8 (0.09) 17 (0.32) 21 (0.60)
GÜNEŞ	0.6320	6 (0.05) 10 (0.02) 21 (0.02) 23 (0.90)
GÜVEN	0.9135	6 (0.02) 8 (0.80) 16 (0.00) 23 (0.18)
HDI	**1.0000**	**0**
HÜR	**1.0000**	**1**
IŞIK	**1.0000**	**3**
KOC ALLIANZ	**1.0000**	**0**
LIBERTY	0.9065	6 (0.01) 8 (0.76) 10 (0.09) 17 (0.09) 21 (0.05)
RAY	**1.0000**	**0**
TEB	**1.0000**	**6**
T. GENEL	0.7960	6 (0.04) 10 (0.55) 17 (0.40)
YAPI KREDİ	**1.0000**	**4**
Mean	**0.9040**	

As seen from Table 2 and 3, as the results of input-oriented CCR and BCC models, the insurance companies of which efficiency score is 1 are considered as efficient. The efficiency score less than 1 shows that insurance company is inefficient. According to CCR model, nine of the insurance companies are efficient and the mean of efficiency is 0.81 that means the inputs should be reduced at level 19 %. According to BCC model, fifteen of insurance companies are efficient and the mean of efficiency is 0.90 that means the inputs should be reduced at level 10 %.

It is assumed that inefficient DMUs can be achieved at the same level of efficient insurance companies in DEA. For this purpose, it should be computed how much input quantities reduced and how much output amounts increased to improve the efficiency of inefficient DMUs as to efficient DMUs. For example, in Table 2 AIG is not efficient. Hence, some changes should be made using intensity values of efficient DMUs in reference sets related to AIG. As seen from Table 2, AXA OYAK, EUREKO and YAPI KREDİ are reference insurance companies for AIG and the intensity values of these are 0.02, 0.02 and 0.2 respectively. Accordingly, the input values and output values, which are required as to AIG be effective, are computed from Table 1 and Table 2 as below:

Number Agents: 0.02 (1452) + 0.02 (119) +0.2 (711) = 174
Number of Brokers: 0.02 (33) + 0.02 (38) +0.2 (24) = 6
Fixed Assets: 0.02 (32600134) + 0.02 (2306771) +0.2 (719326) = 842003.3
Shareholders'Equity: 0.02 (352910426.8) + 0.02 (94995703.18) +0.2 (25558045.86) = 14069732
Investment Incomes: 0.02 (115685481.4) + 0.02 (9692422.83) +0.2 (5034278.84) = 3514414
Premiums: 0.02 (1129744758) + 0.02 (415466359.4) +0.2 (628142638.6) = 156532750

Same computations can be made for the other inefficient insurance companies From Table 2 and Table 3.

The efficiency levels of insurance companies are found utilizing the super efficiency model in EMS program. The results of super efficiency model are obtained as in Table 4.

Table 4. The results of Super Efficiency model

CCR Model				**BCC Model**	
	DMUs	Efficiency		DMUs	Efficiency
1	AIG	0.5578	1	AIG	0.8340
2	AKSİGORTA	0.5251	2	AKSİGORTA	0.7175
3	**ANADOLU**	**1.0408**	**3**	**ANADOLU**	**Big value**
4	ANKARA	0.5764	4	ANKARA	0.7162
5	**AVIVA**	**1.5211**	**5**	**AVIVA**	**1.6997**
6	**AXA OYAK**	**1.5242**	**6**	**AXA OYAK**	**1.5943**
7	**BAŞAK GROUPAMA**	**1.3420**	**7**	**BAŞAK GROUPAMA**	**1.3713**
8	BİRLİK	0.7065	**8**	**BİRLİK**	**2.3788**
9	ERGOİSVİÇRE	0.5796	9	ERGOİSVİÇRE	0.5920
10	**EUREKO**	**3.2067**	**10**	**EUREKO**	**3.7378**
11	**FİBA**	**1.4500**	**11**	**FİBA**	**1.5393**
12	GENERALİ	0.4932	12	GENERALİ	0.6845
13	GÜNEŞ	0.6317	13	GÜNEŞ	0.6320
14	GÜVEN	0.6706	14	GÜVEN	0.9135
15	HDI	0.9075	**15**	**HDI**	**1.1836**
16	HÜR	0.9753	**16**	**HÜR**	**2.0126**
17	**IŞIK**	**1.3787**	**17**	**IŞIK**	**1.6081**
18	KOC ALLIANZ	0.8453	**18**	**KOC ALLIANZ**	**3.9202**
19	LIBERTY	0.5593	19	LIBERTY	0.9065
20	**RAY**	**Big value**	20	**RAY**	**Big value**
21	TEB	0.9204	**21**	**TEB**	**1.9031**
22	T. GENEL	0.7750	22	T. GENEL	0.7960
23	**YAPI KREDİ**	**2.4317**	**23**	**YAPI KREDİ**	**9.1631**

As seen from table 4, the most efficient insurance company is RAY, the second efficient company is EUREKO and the third efficient company is YAPI KREDİ according to CCR, while the most efficient companies are RAY and ANADOLU, the second efficient company is YAPI KREDİ and the third efficient company is KOC ALLIANZ. The most efficient insurance company is RAY according to both CCR and BCC models.

Concluding Remarks

Parallel to global insurance market, there are two main insurance groups, life and non-life according to Turkish Insurance Regulation. In this study, the technical efficiencies of 23 non-life insurance companies in 2007, which are active in Turkey, are examined. For this purpose, we benefited from Data Envelopment Analysis which facilitates to examine different input-output components and which is a non-parametric method. As inputs; the number of agents, the number of brokers, fixed assets, shareholders' equity and as outputs; the investment incomes, premiums received are used. Empirical results show that according to CCR model the most efficient insurance companies are RAY, EUREKO and YAPI KREDI, respectively. However according to BCC model, RAY and ANADOLU insurance companies come first, the second one YAPI KREDI and the third one is KOC ALLIANZ. As a consequence of this study, in 2007 in Turkey the most efficient insurance company is RAY according to both CCR and BCC models.

REFERENCES

Abidin, Z. and Cabanda, E. (2011), Efficiency of Non-Life Insurance in Indonesia, *Journal of Economics, Business and Accountancy Ventura,* 14 (3), pp. 197-202.

Bakirtas, İ., Kecek, G. and Ozturk, D. (2010), Efficiency Evaluation of Turkish Individual Pension System by Data Envelopment Analysis, *Journal of Money, Investment and Banking,* 18, pp. 29-39.

Barros, C. P. and Obijiaku, E. L. (2007), Technical Efficiency of Nigerian Insurance Companies, *Working papers*, *Technical University of Lisbon, School of Economics and Management, Department of Economics, ISSN 0874-4548*, pp. 1-32.

Chen, Y. and Lin, C. (2007), Empirical study on the efficiency analysis of Australian banks, *Banks and Bank Systems*, (2) 4, pp. 38-49.

Chen Y. C., Chiu Y. H. and Huang C. W. (2010), Measuring super-efficiency of financial and nonfinancial holding companies in Taiwan: An application of DEA models, *African Journal of Business Management*, 4 (13), pp. 3122-3133.

Ciftci, H. (2004), Türk Sigorta Sektörünün Sorunları; DEA Analizi ile Türk Sigorta Şirketlerinin Etkinlik Düzeylerinin Belirlenmesi, *Çukurova Üniversitesi, SBE Dergisi*, (3) 1, pp. 121-149.

Dutta, A. and Sengupta, P. P. (2011), Efficiency Measurement of Indian Life Insurance Industry in Post-Reforms Era, *Global Business Review*, 12 (3), pp. 415–430.

Harton, K. (2010), Scale Advantage - Using Data Envelopment Analysis to Detect Economies of Scale in the Insurance Industry, *Proceedings of the 45th Annual Conference of the ORSNZ, November,* pp. 160-169.

Kasman, A. and Turgutlu, E. (2007), A Comparison of Chance-constrained DEA and Stochastic Frontier Analysis: An Application to the Turkish Life Insurance Industry, *8. Türkiye Ekonometri ve İstatistik Kongresi 24-25 Mayıs 2007 – İnönü Üniversitesi Malatya*, http://web.inonu.edu.tr/~eisemp8/bildiri-pdf/kasman-turgutlu.pdf.

Kasman, A. and Turgutlu, E. (2009), Cost efficiency and scale economies in the Turkish insurance industry, *Applied Economics*, 41, pp. 3151–3159.

Kilickaplan, S. and Karpat, G. (2004), Türkiye Hayat Sigortası Sektöründe Etkinliğin İncelenmesi, *DEU İİBF Dergisi*, (19) 1, s. 1-14.

Kumar, S. and Gulati, R. (2008), An Examination of Technical, Pure Technical, and Scale Efficiencies in Indian Public Sector Banks using Data Envelopment Analysis, *Eurasian Journal of Business and Economics*, (1) 2, pp. 33-69.

Mantri, J. K. (2008), Research methodology on data envelopment analysis (DEA), Universal-Publishers Boca Raton, Florida.USA, http://www.bookpump.com/upb/pdf-b/9429500b.pdf.

Yen, F. L. and Othman, M. (2011), Data Envelopment Analysis to Measure Efficiency of Hotels in Malaysia, SEGi Review ISSN 1985-5672, (4):1, pp. 25-36.

Wei, H. (2009), Risk-adjusted Efficiency of the Insurance Industry in China: 1999-2006, *International Conference on Management Science & Engineering (16th)*, September 14-16, Moscow, Russia.