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The Efficiency of Jordan Insurance Companies and its Determinants using DEA, Slacks, and Logit models

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Abstract

This study aims to evaluate the technical efficiency in the Jordan insurance market, and examine the internal and external determinants that appear to affect the technical efficiency of the insurance companies. The study used panel data for 22 insurance companies operating inside Jordan over the period 2000-2016. Data Envelopment Analysis used to evaluate the technical Efficiency Scores, Slacks based and Logit models to examine the efficiency determinants. The study found that there is a slight development of technical efficiency for the Jordanian insurance companies during the study period. In addition, there is a substantial efficiency difference between insurance companies each year, and there is a variation at the level of efficiency for each company in each year. The results also showed that owners' equity are among the most important internal determinants of companies' efficiency, and there is a significant correlation between type, size, and return on assets of the insurer and its efficiency. This study provides insurance management with relevant indicators that would guide them to make efficient use of the resource base. The period of study also covers the period following the adoption of the Insurance Law and the issuance of most of the legislation related to the work of insurance companies.

Key words: Insurance, efficiency, DEA, Logit model, Jordan.

1. Introduction

The efficiency has become an issue that has begun to take an interest in the insurance sector as efficiency helps to identify efficient and inefficient companies in the market, in order to improve competition and profitability and raise the trust of the policyholders. The efficiency of the insurer refers to insurer ability to produce a given set of outputs via the use of inputs (Diacon et al., 2002).

In recent years, efficiency measurement has captured a great deal of attention. And the insurance sector, in particular, has seen extreme growth in the number of studies applying frontier efficiency methods. Frontier methodologies measure firm performance relative to best practice frontier comprised of the leading firm in the industry. Data envelopment analysis (DEA) is the most frequently applied method of frontier efficiency analysis in the insurance. DEA measure the relative performance of companies through comparing a set of inputs and outputs and developing benchmarks related to industry best practices, based on the idea that the widespread application of these can lead to improving performance throughout the whole industry (Barros et al., 2005).

The Insurance sector in Jordan consists of (24) insurance companies, whereof one is licensed as a life company, (9) are licensed as non-life companies, (14) are licensed as composite companies. Jordan insurance market is small by international standard. In 2016, Gross written premiums in Jordan reached JOD (582.9) million, and the gross Claims paid reached JOD (438.9) million. In the same year, the sector earned JOD (35.1) million in net profits before tax, the return on assets was (3.8%), and the return on equity was (10.2%)

The importance of the insurance sector in Jordan increased during the period (2000-2016), where gross written premiums increased at an annual rate of (12%), insurance premiums per capita increased by (187%), which increased from JOD (21) to JOD (59) at that period. In addition, the ratio of gross premiums to the gross domestic product (insurance penetration ratio) increased from (1.7%) in 2000 to (2.1%) in 2016.

The purposes of this study is to partially fill the gap in existing literature by evaluating the technical efficiency for the Jordan insurance companies using DEA method, and examine the internal (managerial inefficiency) and external (characteristic of external environment) determinants that appear to affect the technical efficiency of the insurance companies using slacks-based and Logit models.

The importance of the study stems from the importance of efficiency in the work of the insurance companies and their impact on their performance and results. The issue of efficiency in the insurance companies is of fundamental importance for the current time due to the challenges faced the insurance sector in Jordan represented by the low return on assets and weak contribution to GDP, In addition to the low per capita insurance. This study provides insurance management with a relevant indicator that would guide them to make efficient use of the resource base. The period of study also covers the period following the adoption of the Insurance Law and the issuance of most of the legislation related to the work of insurance companies.

2. Literature review and empirical Studies

In microeconomic theory, the production function is defined in term of the maximum output that can be produced from a specific input, given the existing technology to the firm involved (Battese, 1992). The term economic efficiency means that resources are used in such a way to generate maximum possible output with a given input. In insurance, efficiency refers to the ability of an insurance company to produce a specific set of outputs (such as premium or investment profits) from the use of a specific set of input, such as capital and labor. The insurance company is technically efficient if cannot reduce its resources usage without some corresponding reduction in output, given the current state of production technology in the industry (Diacon, 2001).

Economic efficiency consists of technical efficiency and Allocative efficiency (Farrell, 1957), where technical efficiency means the ability of an organization or (Decision making unit-DMUs) to obtain the maximum amount of production using available inputs, and the measure of technical efficiency is usually defined as the maximum reduction of all inputs allowing continual production of the same output as before. Allocative efficiency refers to the capacity of the production unit to mix optimal proportions of inputs and outputs appropriate to their current market price. Thus, economic efficiency refers to the combination of both technical efficiency and allocative efficiency. Therefore, the company cannot be 100% economically efficient unless it is 100% technically and allocative efficient (Jarraaya and Bouri, 2012).

There are two approaches to calculating the efficiency indicators; the first is the Input Oriented approach, which minimizes the inputs used in the production to the lowest possible level while the level of production remains constant. The other approach is the Output Oriented approach, which increases the production level to the highest possible level while the input level remains constant. The two approaches can specify to the production function under the assumption of constant (CRS) or variable return to scale (VRS) (Eling and Luhnen, 2011)

Efficiency estimated by comparing firms to the "best practice" efficient frontier formed by the most efficient firms in the industry (Farrell, 1957). The literature distinguishes two main approaches to estimating these frontiers; parametric and non-parametric approach. The most widely non-parametric or mathematical approach used is Data Envelopment Analysis (DEA) which introduced by Charnes et al. (1978). DEA is a non-parametric approach that employs linear programming technique to construct an efficient frontier that envelope all the combination between inputs and outputs of firms in the sample. The efficient combination of input and output is in the frontier, while the inefficient combination will be less than that.

The objective of this model is to estimate the production frontier of DMUs that use the same input in the production. The relative efficiency of each unit measured for the purpose of making a comparison and efficiency score is usually standardized between 0 and 1, with the most (least) efficient firm receiving the value of 1 (0). The difference between a company's assigned value and the value of 1 can be interpreted as the company's improvement potential in terms of efficiency (Cooper et al., 2007: Diacon et al, 2002).
The efficiency of any economic entities is obtained through the maximum of the weighted ratio of outputs to the weighted ratio of inputs, provided that the ratio of similar entities are less or equal to one (Charnes et al., 1978).

The model is generally as follows:

$$Max\ \theta = \frac{\sum_{r=1}^{s} U_r Y_{ro}}{\sum_{i=1}^{m} V_i X_{io}}$$

Subject to:

$$\frac{\sum_{r=1}^{s} U_r Y_{rj}}{\sum_{i=1}^{m} V_i X_{ij}} \leq 1$$

Where:

J=1,…,n.

$$U_r, V_i \geq 0 \qquad U_r, V_{rj} \geq 0$$

r = 1,….,s.;   i= 1,..,m

$$Y_{rj}, X_{ij} > 0$$

Where:
s: Number of output.
U_r: Weight of Output r.
Y_{ro}: Amount of r produced by DMUs.
m: Number of Input.
V_i: Weight of Input i.
X_{io}: Amount of Input I used by DMUs.

There are two types of DEA, namely the constant return to scale and variable return to scale. The first model introduced by (Charnes et al., 1978) and called (DEA-CCR). This model is appropriate when the entities operate at their optimal scale of production. The production possibilities curve can be determined under this assumption and the technical efficiency scores known as the overall technical efficiency.

The second model developed by Banker et al. (1984) and called (DEA-BCC). Many factors do not make the entities operate at its optimal level such as incomplete competition and some restrictions on financing and so on. Therefore, the DEA-CCR model may give inaccurate ratios of the technical efficiency of the entities. In this model, technical efficiency is decomposed to pure technical efficiency and scale efficiency.

Measurement of efficiency for insurance sector got significant consideration in recent years, where the empirical researches observed various matters concerning the efficiency of the insurance business. In a study prepared by (Fecher et al., 1993), which included 84 life and 243 non-life insurance companies in France during the period 1984-1989. By using both parametric and non-parametric approach, the authors observe that there a great variation in the relative efficiency levels between companies, and there is a correlation between the size, ownership, distribution, reinsurance, and claims ratio of the company and its efficiency.

In order to analyze the technical efficiency of 94 insurance companies operating in Italian insurance market for the period (1985-1993) using the DEA model, (Cummins et al, 1996) found that the result indicated that the level of efficiency during the study period remained constant despite the low productivity in the same period.

Cummines et al., (1999) study of the US market, which focuses on the life insurance companies during the period (1988-1933), found that the efficiency of insurance companies is relatively low when compared to other companies in other financial sectors in addition to the existing of significant differences in efficiency among those companies.

Diacon (2001) reviewed the efficiency of non-life insurance companies in the UK and compared their counterparts in the European Union. The study included 431 companies in six European countries. The results showed that the efficiency of insurance companies operating in the UK is medium and has the ability to be one of the most efficient companies in the EU. In study of Diacon et al. (2002), which included 450 life insurance companies in 15 European countries, with the aim of identifying the best companies for reference and measuring the performance of other companies, they found significant differences in the level of efficiency between countries. In addition, there was a decrease in the average level of technical efficiency during the study period. Also by using Tobit regression they found that mutual companies have higher levels of efficiency than stock companies, the most efficient insurer are those that specialized in particular market sectors, and solvency ratios are associated with higher level of technical efficiency.

Hardwick et al., (2004) evaluated 50 life insurance companies in various organizational forms to verify the relationship between corporate governance and efficiency and found that the efficiency of companies increases as a number of board of directors increases.

Borges et al. (2008) use the DEA model to evaluate the performance of Greek life insurance companies during the period 1994-2003. They found that large and equated life insurance companies as we as those involved in merger and acquisition exhibit higher efficiency.

In Jordan, Ajlouni and Tobaishat, (2010) study 22 Insurance companies listed in Amman stock exchange By Using DEA during the period (2000-2016), they showed an improvement in the efficiency of companies during the study period, and the efficiency of life and nonlife are nearly closed.

3. Data and methodology

The study used panel data for 22 out of 24 insurance companies operating inside Jordan covering the period (2000-2016). Two companies excluded from the study due to unavailability of data covering the entire study period. The data collected from the annual financial statements of the insurance companies.

In insurance, there are three main inputs: business, capital and business services, and there are three main approaches for measuring the output of the insurance industry: Asset or Intermediation Approach and User-Cost Approach and value-added approach**.**

The value-added approach emphasizes the importance of outputs if they contribute significant added value based on operating cost allocations. This approach the most used approach for studying insurance company efficiency's (Cummins and Weiss, 2000). This approach assumes that insurers offer three main services through risk pooling and risk bearing, real financial services related to insured losses and intermediation by collecting funds and invest them.

DEA results are sensitive to the variables that used (inputs and outputs), the choice of method and variables have an important impact on the measurement and analysis of efficiency. As (Diacon, 2001: Yang, 2006: Alhassan et al, 2015) the following variables will be used in efficiency measurement by DEA:

Inputs: total operating expenses, Debt and Owner's equity, and total technical Provisions.

Outputs: Net Earned premiums and investments Income.

Details of the input and output variables are given in the following box.

Variable	**Description**
Total Operating Expenses	Includes administrative, general expenses and commission paid as at the end of the year.
Debt and Owner's equity	Including the paid-up capital of the company in addition to the retained earnings after the issuance of both statutory and voluntary reserves and premium on paid-up capital, as well as the value of the change in the investment valuation reserve as at the beginning of the year. Plus borrowing from banks.
Total Technical Provisions	Includes The provision for Unearned premiums, Outstanding Claim Provision, and the Mathematical reserve at the end of the year
Net Earned premiums	premiums written by the Company after excluding reinsurers 'share plus the value of the change in the unearned premium provision after excluding the reinsurer's share (for non-life insurance business) or the value of the change in the mathematical reserve after deducting reinsurers' share (for life insurance).
Investments Income	Including the profits from financial investments in addition to the interest on deposits in banks and interest earned on bonds owned by the company.

Because of the many constraints that prevent companies from operating at their optimal scale of production, the DEA model with a variable return to scale (DEA-BCC) used to evaluate the level of efficiency for insurance companies in Jordan. As follows:

$$Min_{\theta,\lambda}\theta$$

Subject to:

$$-Y_j + Y\lambda \geq 0$$

$$\theta X_j - X\lambda \geq 0$$

$$Z'\lambda = 1$$

$$\lambda \geq 0$$

Where:

$[X]i.j$ is the input matrix, $[Y]r.j$ is the output matrix, λ is the vector of the variables weights, Z is scale Constraint, θ represents the technical efficiency of the Decision Making Units (DMUs), where $0 \leq \theta \leq 1$.

4. Data analysis and Findings

DEA Analysis Result

Table (1) summaries the average Technical efficiency per year for the insurance companies in Jordan during the period 2000-2016. The result of DEA analysis shows in general, that during the period of study there is a slight development of technical efficiency for the Jordanian insurance companies, where it was (89.0%) in 2000 and reached (92.5%) in 2016. The year 2012 witnessed the highest level of efficiency reached by the insurance companies (94.0%), while the lowest level of the efficiency of these companies was in 2001 as it was (80.1%).

Table 1: Average Technical efficiency per year for the insurance companies in Jordan during the period 2000-2016

Year	Average Efficiency	Year	Average Efficiency
2000	89.0%	2008	92.6%
		2009	91.7%
2001	80.1%	2010	85.5%
2002	89.8%	2011	91.6%
2003	85.2%	2012	94.0%
2004	82.5%	2013	90.5%
2005	92.7%	2014	91.2%
2006	92.9%	2015	92.5%
2007	92.8%	2016	92.5%

Table (2) shows that (DMU-1) achieved the highest level of efficiency by (100%) and it was the Bench Mark for the other companies, Twelve companies had average efficiency greater than (90%) during the study period, while five companies With an average efficiency of (80%-90%), four companies efficiency was lower than (80%) and the lowest company in terms of efficiency was (DMU-22) at (72.5%).

Companies that are more efficient than (90%) are considered to perform well in comparison with their inputs in the production process, These companies are characterized either by higher output such as (DMU-1) or lower use of production inputs compared to other companies as they depend on certain types of insurance such as motor compulsory insurance, which does not require high expenses to achieve premiums. and These companies can reduce their use of inputs to reach full technical efficiency.

The second group of companies, which ranged between 80% and 90%, could achieve the same outputs using less input. The third and fourth groups, which ranged between 70% and 80%, had large inputs and could achieve the same Outputs by significantly reducing their inputs

Table 2: Average Technical efficiency per company for the insurance companies in Jordan during the period 2000-2016

DMU	Efficiency Score	DMU	Efficiency Score
DMU-1	100.0%	DMU-12	91.1%
DMU-2	99.7%	DMU-13	89.2%
DMU-3	99.5%	DMU-14	88.0%
DMU-4	98.4%	DMU-15	87.4%
DMU-5	97.4%	DMU-16	86.0%
DMU-6	96.8%	DMU-17	85.7%
DMU-7	95.5%	DMU-18	83.7%
DMU-8	94.7%	DMU-19	78.5%
DMU-9	93.5%	DMU-20	77.3%
DMU-10	93.4%	DMU-21	77.0%
DMU-11	92.2%	DMU-22	72.5%

Appendix (1) illustrates that there is a substantial efficiency difference among insurance companies in each year, for example in 2000, (9) companies achieved the level of efficiency (100%), while the other companies fell from this level. In addition, the lowest level of efficiency in that year was (60.9%).

In addition, there is a variation at the level of each company each year, which affect the average efficiency during the study period. For example, the fluctuation in the efficiency of (DMU-120, which was in 2000 (68.5%) and increased to (97.9%) in 2002, then reach (72.2%) in 2004, and increased to achieve the full technical efficiency during the years 2005-2008, then decreased in 2009 to (80.8%) and fluctuated during the years (2010-2016) and reached (91.1%) at the end of 2016.

These results are similar to those of Ajlouni and Tobaishat (2010) in terms of the technical efficiency of the insurance companies. However, there is difference in the efficiency scores of the companies between the two studies because they calculate the efficiency scores under the assumption of a constant return to scale, contrary to our study, which uses the assumption of a variable return to scale.

5. Determinants of Efficiency

Slacks based model

The inefficiency is either from using inputs incorrectly, or these inputs cannot achieve the required level of output. Therefore, if companies reduce their use of inputs to achieve the same level of output, it will be possible to upgrade their efficiency to achieve full technical efficiency.

For inefficiencies firm, the input target will be less than actual input. The difference between actual input and target input is input slack, and it can be expressed as a percentage:

$$\text{Input Slack percentage} = \frac{\text{Actual Input} - \text{Input Target}}{\text{Actual Input}} \times 100$$

Appendix (2) show the percentage of input that must be reduced in order to achieve the full efficiency for each company. By reviewing the ratio for each company, it is clear that the owner's equity and Debt are the most important determinant of firm efficiency, followed by technical reserves. Operating expenses were the least important determinants of efficiency. It is possible to reach the current level of output by reducing the owner's equity and Debt by (6.33%), its technical reserves by (0.85%) and operating expenses by (0.27%). Thus, the companies achieve the full technical efficiency.

Logit Model

To examine how external factor affects the efficiency level for the insurance companies, this study uses the Logit model to analyze the size and direction of the relative effect of the independent variable in their impact on the efficiency. One of the main advantages of Logit regression does not require a linear relationship between dependent and independent variables, and it can handle various types of relationships because it applies a non-linear log transformation to the predicted odds ratio. Those external variables are not decision variables that would otherwise figure in the firm's choice of the nature or level of inputs and or/outputs as that already been included in the DEA analysis.

The suggested model can formed as follows:

$$\theta_{it} = \alpha \quad + \beta_1 Size_{it} + \beta_2 \, Rein_{it} \; + \beta_3 ROA_{it} + \beta_4 Type_{it} + \mathcal{E}_i$$

Where:

α : represents the constant, i: insurance company, t: time period (in years), θ: Technical efficiency, Size: natural logarithm of Assets, Rein: reinsurance ratio, ROA: return on assets, Type: type of insurance company, (β 's) : Model parameters, and (Ɛ): the random error.

The dependent variable (efficiency) converted to a binary outcome:(0,1) expressing that the company is Efficient or not, where the variable takes the value (1) by probability (P) if the company is technically efficient, and the value (0) with probability of (1-P) if company is not technically efficient.

(Size): Size of the insurer (i) in time (t). Large insurers expected to benefit from economies of scale and scope in the form of lower per unit cost of production derived from the large scale of production. In other hands, the inability of the larger firm to monitor and control activities of large-scale operation results in diseconomies of scale, a negative relationship. Size of the insurer measured by natural Logarithm of Company Assets.

(Rein): Reinsurance of the insurer (i) in time (t). Reinsurance is a way of transferring the risk from the insurer to the reinsurer, in order to protect the insurer from unexpected financial losses that may expose to it. This variable measured by dividing the total amount transferred to the reinsurers to the total premiums written by the insurer

(ROA): Return on Asset of the insurer (i) in time (t). Profitability of insurer proxy by ROA to investigate if there a relationship with technical efficiency.

(TYPE) is a Dummy variable equal to 1 for composite (life and nonlife) insurer and zero for life or non-life insurer, aiming to capture the role of business line diversification on efficiency.

Table (3) shows the results of the Logit models that investigate the probability of the company is efficient currency employing the explanatory variables mentioned above.

Table 3: Regression Result

Variable	Coefficient
Size	0.270659*** (0.146413)
Rein	-0.08912 (0.816565)
Type	-1.273139* (0.270336)
ROA	2.467615** (1.163194)
C	-3.700586 (2.381742)
Log likelihood	-242.3529
LR statistic	33.72552
Cox-Snell r	0.086229
Nagelkerke r	0.114976

- Standard errors in brackets.
- *1%, **5% and ***10% significant levels.

Based on the Maximum Likelihood estimation, the result indicated that the type of insurance has a significant impact on the efficiency of the company. The coefficient is negative which mean that the proportion of insurer being efficient decreased by (1.273) times in case if the Insurer licensed as a composite (life and non-life).

This result can be explained as while the insurer being just life or non-life insurer will enhance the efficiency throw concentration the efforts and resources on the specific line of business in a way that increases the insurance efficiency. This finding consistent with the number of previous studies such as the study of (Barros et al., 2009) (Diacon, 2001), and contrary to what came in the study of (Wasseja and Mwenda, 2015).

The result support that the size of the insurer play a role in achieving the full technical efficiency, where the coefficient is positive and statically significant at 10%. Large insurer seems to have improved flexibility to arrange the best combination of inputs and outputs and benefits from the economies of scale. This finding support (Diacon et al., 2002) (Barros et al., 2005) (Afza and Kausar, 2010) (Yao et al, 2007).

Return on the assets variable highlight the role of profitability in enhancing the chance that insurer being efficient, where the result indicates that ROA increases the chance of being efficient by (2.46) times. The result consistent with the finding of (Gramanova and Strunz, 2017) (Diacon, 2001).

However, reinsurance is had no statically significant impact on the insurer efficiency, which means that reinsurance does not matter to efficiency.

The Log Likelihood ratio for the model, which is testing the weather the coefficients are simultaneously significantly different from zero, confirm the general statistical significance of the model at the 1% level of significance. Pseudo R square values are also calculated (Cox & Snell and Nagelkerke pseudo R squares). This value is an indicator of the percentage of the variance in the dependent variable that explained by the model, the results considered acceptable Since Econometric estimation based on cross-section data usually show low R2, particularly logistic regression (Gujarati, 2003).

6. Conclusions and recommendations

This study aimed to evaluate the insurance companies in Jordan during the period 2000-2016 by measuring the technical efficiency of these companies and its determinants. The study uses panel data for (22) insurance companies operating in Jordan, where the technical efficiency and factor that appears to affect its efficiency were estimated by utilizing Data Envelopment Analysis (DEA), slacks-based and logit models.

The study finds that there is a slight development of technical efficiency for the Jordanian insurance companies during the study period. In addition, there is a substantial efficiency difference among insurance companies in each year, and there is a variation at the level of efficiency for each company each year.

The results also showed that owners' equity is among the most important internal determinants of companies' efficiency, followed by technical provisions and operating expenses. The external determinants identified by the logit model and support that there is a significant correlation between type, size, and return on assets of the insurer and its efficiency.

Based on the results the study recommends improving the technical efficiency of low-efficiency companies by reducing the level of inputs used, reallocating the resources used to maximize efficiency. The results showed that it is possible to reach the same current level of output by reducing on average the owner's equity and debt by (6.33%), technical provisions by (1.82) and operating expenses by (0.85%).

Insurance companies also should focus on specific types of insurance (life or nonlife) and should increase their size throw merger with each other's, and regulator must take action to encourage such mergers.

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Appendix 1: Technical efficiency of insurance company in Jordan for the period 2000-2016

DMU	2000	2001	2002	2003	2004	2005	2006	2007	2008
DMU-1	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
DMU-2	100.0%	100.0%	100.0%	99.5%	95.1%	100.0%	100.0%	100.0%	100.0%
DMU-3	100.0%	92.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
DMU-4	100.0%	91.6%	84.3%	100.0%	100.0%	100.0%	100.0%	100.0%	98.4%
DMU-5	90.2%	96.6%	100.0%	85.0%	89.9%	100.0%	100.0%	100.0%	100.0%
DMU-6	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	96.8%	100.0%	100.0%
DMU-7	100.0%	79.0%	90.2%	53.8%	100.0%	100.0%	100.0%	100.0%	100.0%
DMU-8	76.1%	57.7%	100.0%	95.5%	100.0%	100.0%	100.0%	100.0%	100.0%
DMU-9	85.6%	100.0%	93.5%	100.0%	98.4%	95.7%	96.4%	100.0%	91.3%
DMU-10	91.5%	91.7%	100.0%	100.0%	87.5%	94.4%	88.1%	100.0%	100.0%
DMU-11	100.0%	79.5%	74.3%	82.4%	67.1%	100.0%	100.0%	94.5%	98.4%
DMU-12	68.5%	88.6%	97.7%	77.8%	72.2%	100.0%	100.0%	100.0%	100.0%
DMU-13	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	69.1%	75.8%
DMU-14	80.0%	50.3%	100.0%	77.4%	61.5%	82.6%	100.0%	100.0%	100.0%
DMU-15	90.5%	100.0%	99.5%	100.0%	100.0%	100.0%	56.9%	87.4%	100.0%
DMU-16	60.9%	34.8%	71.7%	55.5%	67.3%	82.3%	88.7%	100.0%	100.0%
DMU-17	85.4%	85.0%	100.0%	100.0%	71.2%	100.0%	56.4%	100.0%	68.8%
DMU-18	74.4%	82.6%	100.0%	62.5%	58.4%	92.8%	100.0%	82.1%	100.0%
DMU-19	84.8%	50.5%	73.7%	44.0%	51.2%	78.2%	98.3%	75.5%	76.5%
DMU-20	100.0%	71.3%	69.0%	59.0%	57.0%	64.4%	100.0%	61.3%	71.6%
DMU-21	72.4%	52.8%	69.7%	82.9%	85.5%	75.0%	100.0%	100.0%	100.0%
DMU-22	96.8%	63.1%	52.5%	100.0%	52.2%	73.0%	66.2%	65.3%	67.1%
Average	89%	80%	90%	85%	82%	93%	93%	93%	93%

DMU	2009	2010	2011	2012	2013	2014	2015	2016	Average
DMU-1	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
DMU-2	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.7%
DMU-3	100.0%	99.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.5%
DMU-4	100.0%	100.0%	98.7%	100.0%	100.0%	100.0%	100.0%	100.0%	98.4%
DMU-5	100.0%	100.0%	100.0%	100.0%	97.0%	97.0%	100.0%	100.0%	97.4%
DMU-6	86.7%	82.6%	97.9%	100.0%	81.5%	100.0%	100.0%	100.0%	96.8%
DMU-7	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	95.5%
DMU-8	95.9%	94.4%	89.8%	100.0%	100.0%	100.0%	100.0%	100.0%	94.7%
DMU-9	97.5%	100.0%	93.5%	71.8%	79.9%	91.4%	97.5%	97.5%	93.5%
DMU-10	100.0%	100.0%	100.0%	100.0%	96.6%	82.9%	77.4%	77.4%	93.4%
DMU-11	78.9%	100.0%	100.0%	100.0%	100.0%	98.5%	100.0%	100.0%	92.6%
DMU-12	80.0%	91.0%	96.3%	98.9%	98.1%	97.3%	91.1%	91.1%	91.1%

DMU-13	89.2%	72.5%	87.9%	81.5%	92.7%	93.6%	77.4%	77.4%	89.2%
DMU-14	100.0%	87.4%	79.3%	100.0%	88.3%	89.0%	100.0%	100.0%	88.0%
DMU-15	57.2%	71.5%	100.0%	100.0%	87.0%	64.7%	85.4%	85.4%	87.4%
DMU-16	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	86.0%
DMU-17	100.0%	61.2%	62.0%	81.5%	100.0%	84.8%	100.0%	100.0%	85.7%
DMU-18	89.7%	83.0%	100.0%	91.7%	68.9%	77.0%	79.4%	79.4%	83.7%
DMU-19	100.0%	67.5%	97.2%	100.0%	93.1%	96.0%	73.9%	73.9%	78.5%
DMU-20	94.5%	50.1%	100.0%	97.7%	75.0%	82.3%	80.3%	80.3%	77.3%
DMU-21	59.7%	51.8%	55.0%	63.5%	62.6%	77.5%	100.0%	100.0%	77.0%
DMU-22	85.1%	75.4%	59.6%	80.6%	73.8%	80.6%	70.9%	70.9%	72.5%
Average	92%	86%	92%	94%	91%	91%	92%	92%	90%

Appendix 2: Input Slacks

DMU	Variable Return to Scale		
	(Technical Reserves)	(Operating Expenses)	(Owner's Equity+Debt)
DMU-1	0.00%	0.00%	0.00%
DMU-2	-5.00%	0.00%	-1.42%
DMU-3	-0.98%	0.00%	-4.88%
DMU-4	0.00%	-0.16%	0.00%
DMU-5	-0.43%	0.00%	-3.99%
DMU-6	0.00%	0.00%	-5.84%
DMU-7	-0.24%	0.00%	0.00%
DMU-8	-0.53%	-0.25%	-16.32%
DMU-9	-7.48%	-0.05%	-3.16%
DMU-10	-3.07%	0.00%	-6.35%
DMU-11	-0.70%	-0.56%	0.00%
DMU-12	-1.69%	-0.05%	-8.39%
DMU-13	-3.76%	0.00%	-16.96%
DMU-14	-0.07%	-0.86%	-2.86%
DMU-15	-2.88%	0.00%	-19.90%
DMU-16	-0.29%	-0.03%	-1.73%
DMU-17	-2.71%	-0.01%	-21.07%
DMU-18	0.00%	-14.49%	-11.03%
DMU-19	-3.25%	-0.40%	-5.43%
DMU-20	-1.94%	-1.06%	-2.16%
DMU-21	-3.66%	-0.27%	-0.46%
DMU-22	-1.31%	-0.61%	-7.23%
Average	-1.82%	-0.85%	-6.33%