An Evaluation of Investment Performance of Private Life Insurance Industry in India

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Abstract

Data Envelopment Analysis (DEA) model is used to provide valuable information on investment efficiency of private life insurance industry in India. This study utilizes two inputs (shareholders’ investments and policyholders’ investments) and two outputs (net returns on investments to the shareholders and net returns on investments to the policyholders). This study focuses upon 20 private life insurance companies operating in India over a period of 4 years from 2010-11 to 2013-14. Since this study attempts to maximize output, an output oriented DEA model is used. The study finds that investment efficiency of private life insurance industry has improved on Banker, Charnes and Cooper (BCC) model and Charnes, Cooper and Rhodes (CCR) model. The study further highlights that during all years under study, 15% to 40% life insurance companies have been found on the CRS frontier and 40% to 60% life insurance companies have been found on the VRS frontier. With regard to scale efficiency issues, 15% to 40% companies have been operated at their most productive scale over the study period.

Keywords: Data envelopment analysis; Technical efficiency; Pure technical efficiency; Scale efficiency

Introduction

Insurance industry plays crucial part in economic and social development of India through its role as intermediary between investors and industry. Two insurance categories are identified based on the type of risk underwritten: life and general (non-life). The insurance companies provide a source of long-term funds to the government and various industries in the financial markets. The industry has ₹ 20972.75 billion assets under management which represents 36.52% of GDP and 52 companies competed aggressively at the end of 2014. Over the last decade Indian insurance industry has experienced exceptional changes and confronted more difficulties. As an aftermath of deregulation and globalization foreign companies entered in Indian market place. The competitive pressures force many insurance companies to change corporate strategies in order to reduce operating costs while keeping up or improving the quality of their services. Investment activity is a crucial issue of the insurance sector because the ultimate performance of the sector relies upon the return of its investment. Investment returns made by insurance companies constitute a major portion in operating performance and enhance their standing in competitive market place. Investment gains are reflecting financial wellbeing of insurance companies and facilitate designing of pricing and dividend policies. Strong investment returns facilitate insurance companies to offset their underwriting losses and allow them to report overall profitability. As the marketplace continues to evolve at a rapid pace, it is imperative to find a tool to help managers in identifying the companies that are best positioned to thrive in a changing environment. Along these lines, assessing performance in the insurance industry remains an important objective and has always been the subject of considerable interest. This research proposed a DEA model which estimate investment performance of Indian private life insurance industry. The paper successfully provides a comprehensive evaluation for insurance companies. The rest of the paper is organized as follows. Section 2 gives a brief review of investment performance. Section 3 provides the models and methodology utilized in this paper. Section 4 gives the DEA results and further discussion. Finally, our conclusions are presented in Section 5.

Insurance industry performance evaluation

Some work has been done on investment performance evaluation of insurance industry. The most widely acknowledged technique used by insurance companies to benchmark their performance has been the ratio analysis. The well-known ratios used to evaluate investment performance of insurance companies are the ratio of investment income to investment assets or the ratio of investment income to net premiums [1]. Both of the ratios are widely used by industry experts, since investments generate a significant proportion of income for the insurance industry. Ratio analysis provides relatively insignificant amount of information when considering the effects of economies of scale, identification of benchmarking policies and estimation of investment performance measures of firms. As a result, there is an incentive to use more successful strategies in evaluating the investment performance of insurers. Bhawa and Kaur [2] determined technical efficiency, pure technical efficiency and scale efficiency of general companies using DEA over the years from 2002-2003 to 2009-10. For this purpose claim incurred was taken as output and investment income as well as net income were taken as input. Their study declared some improvement in overall efficiency of general insurance companies over the period of study. Hsiao (n.d) determined capital investment efficiency and efficiency changes using DEA and malmquist productivity index over the years from 1998 to 2008. The researcher had also made some hypotheses to test if there is a statistically significant difference among the DEA model and TFI of CAMEL-S model for life insurers. The result of study suggested that insurers should revise their investment strategies to improve company’s overall financial performance.

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Hsiao and Su [3] employed DEA and malmquist productivity index to measure relative efficiency and investment performance of 24 life insurers in Taiwan from 1998 to 2002. The main findings disclosed that efficiency and investment performance are the main determinants of business performance. Wu et al. [4] developed a new problem-oriented DEA model to simultaneously assess the production and investment performance of insurers, differing from classical DEA models appropriate for independent performance evaluation. The results showed that Canadian L and H insurance companies operated very efficiently for the examined 3-year period (1996-1998). Yang (2006) constructed a two-stage DEA model to provide valuable managerial insights while assessing the dual impacts of operating and business strategies for the Canadian life and health (L and H) insurance industry. The results of study showed that the Canadian L and H insurance industry operated efficiently during the period examined (the year 1998). Adam [5] examined the relationship between investment earning of life insurance firms in New Zealand and their organizational characteristics using a pooled weighted least squares regression model over the period 1988-1993. The empirical result of study indicated that investment earnings are positively associated with size, leverage, underwriting risk and stock companies. Adams and Buckle [6] examined the determinants of corporate (i.e. underwriting and investment related) financial performance in the Bermuda insurance market using panel data for 1993-1997. The study found that highly leveraged, lowly liquid companies, reinsurers and companies with higher underwriting risk have better operational performance. Binay [7] measured the risk-adjusted equity investment performance of all institutional investors in the United States during 1981-2002. The results indicated that institutional investors have been successful in managing their assets to purchase a portfolio of assets [13]. They invest these assets to maximize rate of return on capital and value ownership claims. Thus, the objective of this approach is to measure the ability of an insurer to maximize profits. The study has two inputs which are shareholders’ investments and policyholders’ investments, and two outputs which are Investment income to the shareholders and Investment income to the policyholders. The diagram for the investment model is provided in Figure 1.

Mathematical solution

The study adopts both types of envelopment surfaces, BCC and CCR in order to examine scale efficiency issues as given in equation 1 and equation 2. This method provides a convenient way to categorize efficiency as technical efficiency, pure technical efficiency and scale efficiency [14].

Pure Technical Efficiency (PTE): In PTE, efficiency is measure relative to variable return to scale (VRS) frontier. It takes into account the variation of efficiency with respect to the scale of operation.

Scale Efficiency (SE): Scale efficiency perceives that economy of scale cannot be achieved at all scales of production and there is one most productive scale size, where the scale efficiency is at 100 per cent [15]. The scale efficiency is measured by dividing technical efficiency with the PTE.

Technical efficiency (TE): TE can be viewed as the product of PTE and SE. It mirrors the ability of a firm to obtain the maximum output from a given set of input or the efficiency with which inputs are transformed into output or just the output/input ratio. Output orientation (the LP is oriented to maximize outputs) was selected for the investment model, since the management wants to maximize the investment gains [16].

The mathematical solution to implement the conceptual model is given in equation 1 and equation 2. Assume there are data on K inputs and M outputs on each of N firms or DMUs. For ith DMU these are represent by vector of $x_i$ and $y_i$. Respectively. The $K \times N$ input matrix, $X$, and the $M \times N$ output matrix, $Y$, represent data of all N DMUs. $x$ is a vector of constant.

Equation 1 represents output oriented CCR DEA model and Equation 2 represents output oriented BCC DEA model.

\[
\text{max}_{\lambda, \Phi} \Phi \lambda Y \geq \Phi y_i \\
\lambda x \leq x_i \\
\lambda \geq 0
\]

Performing a DEA analysis requires the solution of n linear programming problems of the above form, one for each DMU [17]. In the study, there are data on twenty life insurance companies for 4 years; hence there are twenty linear programming problems for CRS DEA to be solved in a particular year. The CRS linear programming can be

**Models and Methodology**

This paper develops a comprehensive DEA model to measure investment efficiency for the Indian life insurance industry. In the investment approach, insurers are viewed as financial intermediaries whose functions are to issue contingent claims to policyholders and

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**Figure 1: Investment Model.**

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The empirical results of the study are primarily based on financial data of private life insurance companies. Audited and accounting data for 2010-11 to 2013-14 (denominated in Rs.) were obtained for 20 major private life insurers from IRDA annual reports and annual reports of respective companies [20]. Some firms eliminated from the sample because of data problems such as companies come into existence after study period or non availability of data. The firms remaining in the sample account for about 90% of premium volume in the private life insurance market in each year of the sample period [21]. The data is from annual balance sheets, policyholders account and shareholders’ investment account of following companies:

1. Aegon Religare Life Insurance Company Ltd.
2. Aviva Life Insurance Company Ltd.
3. Bajaj Allianz Life Insurance Company Ltd.
4. Bharti AXA Life Insurance Company Ltd.
5. Birla Sunlife Insurance Company Ltd.
6. DLF Pramerica Life Insurance Company Ltd.
7. Future Generali Life Insurance Company Ltd.
8. HDFC Standard Life Insurance Company Ltd.
9. ICICI Prudential Life Insurance Company Ltd.
10. IDBI Federal Life Insurance Company Ltd.

### Table 1: Table from past Literature

<table>
<thead>
<tr>
<th>Authors</th>
<th>Countries</th>
<th>No. of DMUs</th>
<th>Sample period</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahmad [12]</td>
<td>India</td>
<td>10</td>
<td>2001-2009</td>
<td>Share capital including the reserves and surpluses</td>
<td>Shareholders’ investment</td>
</tr>
<tr>
<td>Barros and Obijaku [13]</td>
<td>Nigeria</td>
<td>10</td>
<td>2001-2005</td>
<td>Capital, operative costs, number of employees, total investments</td>
<td>Profits, net premiums, settled claims, outstanding claims, investment income</td>
</tr>
<tr>
<td>Bawa and Kaur [2]</td>
<td>India</td>
<td>2003-2010</td>
<td>Investment</td>
<td>Investment income to the policyholders, investment income to the shareholders</td>
<td></td>
</tr>
<tr>
<td>Cummins et al. [16]</td>
<td>Italy</td>
<td>94</td>
<td>1985-1993</td>
<td>Labor (acquisition, admin.), fixed capital expense, equity capital</td>
<td>Life: sum of life insurance benefits, changes in reserves, invested assets. Non-life: Losses incurred, invested assets</td>
</tr>
<tr>
<td>Hao and Chou [19]</td>
<td>Taiwan</td>
<td>26</td>
<td>1977-1999</td>
<td>Labor, physical capital, claim</td>
<td>Premiums, investment</td>
</tr>
<tr>
<td>Klumpes [22]</td>
<td>UK</td>
<td>40</td>
<td>1994-1999</td>
<td>Labor (home office, agent), business services, financial capital</td>
<td>Claims, real invested assets</td>
</tr>
<tr>
<td>Mahlberg and Url [23]</td>
<td>Austria</td>
<td>70</td>
<td>1992-1999</td>
<td>Expenditures on labor, material, energy, depreciation, marketing, commissions (1 input); capital management cost (1 input)</td>
<td>Claims, net change in provisions, allocated investment returns, bonuses and returned premia</td>
</tr>
<tr>
<td>Noulas et al. [24]</td>
<td>Greece</td>
<td>16</td>
<td>1991-1996</td>
<td>Salaries and expenses (1 input) and payment to insurers and expenses incurred in the production of services (1 input)</td>
<td>Premium income, revenue from investment activities</td>
</tr>
<tr>
<td>Diacon et al. [17]</td>
<td>15 European countries</td>
<td>454</td>
<td>1996-1999</td>
<td>Total operating expenses, total capital, total technical reserves, total borrowings from creditors</td>
<td>Net earned premiums (general, long-term), total investment income</td>
</tr>
<tr>
<td>Yao et al. [27]</td>
<td>China</td>
<td>22</td>
<td>1999-2004</td>
<td>Labor, capital, payment and benefits</td>
<td>Premiums, investment income</td>
</tr>
</tbody>
</table>

Note that the linear programming problem given in equation 2 must be solved N times, once for each DMU in the sample for a particular year. In the study, there are data on twenty life insurance companies for 4 years; hence there are twenty linear programming problems for VRS DEA to be solved in a particular year [19].

**Data**

Easily modified to account for VRS by adding the convexity constraint: 

N1'λ = 1 to equation 1 to provide:

\[
\begin{align*}
\max_{\lambda_i} \Phi \\
Y \geq \Phi Y_i \\
X \leq x_i \\
N1'\lambda = 1 \\
\lambda \geq 0
\end{align*}
\]

**Table 1**: Table from past Literature
Efficiency Score at Constant Return to Scale i.e. Overall Technical Efficiency

Table 2: Efficiency Score at Constant Return to Scale i.e. Overall Technical Efficiency

<table>
<thead>
<tr>
<th>DMUs</th>
<th>2010-11</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aegon Life</td>
<td>0.920</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>0.98</td>
</tr>
<tr>
<td>Aviva Life</td>
<td>0.699</td>
<td>0.937</td>
<td>0.925</td>
<td>0.868</td>
<td>0.85</td>
</tr>
<tr>
<td>Bajaj Life</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1</td>
</tr>
<tr>
<td>Bharti Life</td>
<td>1.000</td>
<td>0.872</td>
<td>1.000</td>
<td>1.000</td>
<td>0.96</td>
</tr>
<tr>
<td>Birla Life</td>
<td>0.772</td>
<td>0.947</td>
<td>0.920</td>
<td>0.879</td>
<td>0.87</td>
</tr>
<tr>
<td>DLF Life</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1</td>
</tr>
<tr>
<td>Future Life</td>
<td>1.000</td>
<td>0.902</td>
<td>0.874</td>
<td>1.000</td>
<td>0.94</td>
</tr>
<tr>
<td>HDFC Life</td>
<td>1.000</td>
<td>0.946</td>
<td>1.000</td>
<td>1.000</td>
<td>0.98</td>
</tr>
<tr>
<td>ICICI Life</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1</td>
</tr>
<tr>
<td>IDBI Life</td>
<td>0.645</td>
<td>0.939</td>
<td>1.000</td>
<td>0.959</td>
<td>0.88</td>
</tr>
<tr>
<td>IndiaFirst Life</td>
<td>1.000</td>
<td>1.000</td>
<td>0.857</td>
<td>0.725</td>
<td>0.89</td>
</tr>
<tr>
<td>Exide Life</td>
<td>1.064</td>
<td>0.974</td>
<td>1.000</td>
<td>0.744</td>
<td>0.84</td>
</tr>
<tr>
<td>Kotek Life</td>
<td>0.878</td>
<td>0.905</td>
<td>1.000</td>
<td>0.822</td>
<td>0.90</td>
</tr>
<tr>
<td>Max Life</td>
<td>1.000</td>
<td>1.000</td>
<td>0.936</td>
<td>0.880</td>
<td>0.95</td>
</tr>
<tr>
<td>Met Life</td>
<td>1.000</td>
<td>1.000</td>
<td>0.977</td>
<td>0.887</td>
<td>0.96</td>
</tr>
<tr>
<td>Reliance Life</td>
<td>1.000</td>
<td>0.681</td>
<td>1.000</td>
<td>1.000</td>
<td>0.92</td>
</tr>
<tr>
<td>SBI Life</td>
<td>0.483</td>
<td>0.918</td>
<td>1.000</td>
<td>1.000</td>
<td>0.85</td>
</tr>
<tr>
<td>Sriman Life</td>
<td>0.747</td>
<td>0.855</td>
<td>1.000</td>
<td>1.000</td>
<td>0.90</td>
</tr>
<tr>
<td>Star Life</td>
<td>1.000</td>
<td>1.000</td>
<td>0.923</td>
<td>1.000</td>
<td>0.98</td>
</tr>
<tr>
<td>TATA Life</td>
<td>0.773</td>
<td>0.834</td>
<td>0.988</td>
<td>1.000</td>
<td>0.89</td>
</tr>
<tr>
<td>Mean</td>
<td>0.879</td>
<td>0.935</td>
<td>0.970</td>
<td>0.938</td>
<td></td>
</tr>
</tbody>
</table>

Source: Computed through DEAP version 2.1

Table 3: Efficiency Score at Variable Return to Scale i.e. Pure Technical Efficiency

EXIDE Life, MAX Life and TATA Life have not shown efficiency score of 1 in any years from 2010 to 2014. DLF Life scored highest rank in overall technical efficiency with mean efficiency score estimated to be 1 and SBI Life has scored lowest rank in overall technical efficiency with mean efficiency stood at 0.75. Investment efficiency of private life insurance industry has shown an increasing trend from 2010-11 to 2013-14. Average efficiency has increased from 0.857 in 2010-11 to 0.908 in 2013-14. Notably, in the year 2012-13 insurance industry found to be highly efficient as mean efficiency stood at 0.948. The study further highlighted that least number of companies found to be efficient on constant return to scale during 2011-12 which is mainly due to the decline in income from investment. This decline in income from investments was a reflection of the condition prevailing in stock market and a decline in the unit linked business for life insurance industry (Table 3).

Table 3 evinces technical efficiency (pure technical efficiency) of private life insurers calculated at variable return to scale. Table reveals that during all years under study, 8 (40%) to 12 (60%) life insurance companies have been found on the frontier. DLF Life has efficient maximum number of times in twelve years; while Aviva Life, BIRLA Life, IDBI Life,
and 7 (35%) insurers exhibited decreasing return to scale. However it is important to note that during all years under study, 15% to 40% companies have been found on the CRS frontier and 40% to 60% life insurance companies have been found on the VRS frontier [25]. With regard to scale efficiency issues, 15% to 40% companies have been operated at their most productive scale over the study period. The study also reveals that investment efficiency of private life insurance industry has improved on both BCC and CCR model [26].

The deepening of insurance market makes a positive contribution to the economic growth. Insurance companies earn their profits through underwriting of premium from various policies and investing in various securities as prescribed by the regulatory body [23]. Investment activity is an essential issue of insurance sector because the ultimate performance of the sector depends on the return of its investment whether it is life or general insurance. Thus, an attempt has been made to estimate investment efficiency of 20 private life insurers over the period from 2011-14 using DEA [24]. The study finds that during all years under study, 15% to 40% life insurance companies have been found on the CRS frontier and 40% to 60% life insurance companies have been found on the VRS frontier [25]. With regard to scale efficiency issues, 15% to 40% companies have been operated at their most productive scale over the study period. The study also reveals that investment efficiency of private life insurance industry has improved on both BCC and CCR model [26]. The study further highlighted that least number of companies found to be efficient during 2011-12 which is mainly due to the decline in income from investment [27]. This decline in income from investments was a reflection of the condition prevailing in stock market and a decline in the unit linked business for life insurance industry.

Conclusions

Table 4 depicts the scale efficiency of life insurers which is the ratio of CRS efficiency score to VRS efficiency score. This table represents that during all the years under study 3 (15%) to 8 (40%) companies have been operated at their most productive scale. DLF Life has scored highest rank in scale efficiency as average efficiency score stood at 1 while MAX Life has scored lowest rank as average efficiency score is estimated to be 0.85. Efficiency of private life insurance industry has improved from 2002-03 to 2013-14 as average efficiency increased from 0.970 in 2010-11 to 0.968 in 2013-14. Notably, in the year 2012-13 insurance industry found to be highly scale efficient as mean efficiency stood at 0.976. The study further highlighted that least number of companies found to be scale efficient during 2011-12 which is mainly due to the decline in income from investment. This decline in income from investments was a reflection of the condition prevailing in stock market and a decline in the unit linked business for life insurance industry.

Table 5 shows that during all the years under study 3 (15%) to 8 (40%) insurers have marked increasing return to scale which reveals increase in output has been more than proportionate increase in input. In the year 2011-12 and 2012-13 most of insurers have marked decreasing return to scale. Decreasing return to scale reveals that increase in output has been less than proportionate increase in input. However it is important to note that in year 2013-14, 7 (35%) insurers exhibited constant return to scale and 7 (35%) insurers exhibited decreasing return to scale.

Conclusion

The deepening of insurance market makes a positive contribution to the economic growth. Insurance companies earn their profits through underwriting of premium from various policies and investing in various securities as prescribed by the regulatory body [23]. Investment activity is an essential issue of insurance sector because the ultimate performance of the sector depends on the return of its investment whether it is life or general insurance. Thus, an attempt has been made to estimate investment efficiency of 20 private life insurers over the period from 2011-14 using DEA [24]. The study finds that during all years under study, 15% to 40% life insurance companies have been found on the CRS frontier and 40% to 60% life insurance companies have been found on the VRS frontier [25]. With regard to scale efficiency issues, 15% to 40% companies have been operated at their most productive scale over the study period. The study also reveals that investment efficiency of private life insurance industry has improved on both BCC and CCR model [26]. The study further highlighted that least number of companies found to be efficient during 2011-12 which is mainly due to the decline in income from investment [27]. This decline in income from investments was a reflection of the condition prevailing in stock market and a decline in the unit linked business for life insurance industry.

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<tr>
<th>DMUs</th>
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<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aegon Life</td>
<td>0.993</td>
<td>1.000</td>
<td>1.000</td>
<td>0.847</td>
<td>0.96</td>
</tr>
<tr>
<td>Aviva Life</td>
<td>0.999</td>
<td>0.863</td>
<td>0.955</td>
<td>0.990</td>
<td>0.95</td>
</tr>
<tr>
<td>Bajaj Life</td>
<td>1.000</td>
<td>0.819</td>
<td>0.988</td>
<td>1.000</td>
<td>1.00</td>
</tr>
<tr>
<td>Bharti Life</td>
<td>0.963</td>
<td>0.992</td>
<td>1.000</td>
<td>1.000</td>
<td>0.98</td>
</tr>
<tr>
<td>Birl Life</td>
<td>0.997</td>
<td>0.854</td>
<td>0.966</td>
<td>0.963</td>
<td>0.94</td>
</tr>
<tr>
<td>DLF Life</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.000</td>
<td>1.00</td>
</tr>
<tr>
<td>Future Life</td>
<td>0.975</td>
<td>0.800</td>
<td>0.976</td>
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</tr>
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<td>0.847</td>
<td>1.000</td>
<td>1.000</td>
<td>0.95</td>
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<td>ICICI Life</td>
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<td>0.641</td>
<td>0.972</td>
<td>0.869</td>
<td>0.87</td>
</tr>
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<td>IDBI Life</td>
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<td>0.949</td>
<td>0.941</td>
<td>0.946</td>
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<td>0.881</td>
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<td>0.95</td>
</tr>
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<td>0.933</td>
<td>0.964</td>
<td>0.994</td>
<td>0.96</td>
</tr>
<tr>
<td>Koteck Life</td>
<td>0.990</td>
<td>0.849</td>
<td>1.000</td>
<td>0.994</td>
<td>0.95</td>
</tr>
<tr>
<td>Max Life</td>
<td>0.817</td>
<td>0.737</td>
<td>0.874</td>
<td>0.981</td>
<td>0.85</td>
</tr>
<tr>
<td>Met Life</td>
<td>1.000</td>
<td>0.877</td>
<td>0.964</td>
<td>0.961</td>
<td>0.95</td>
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<td>Reliance Life</td>
<td>1.000</td>
<td>0.855</td>
<td>1.000</td>
<td>1.000</td>
<td>0.96</td>
</tr>
<tr>
<td>SBI Life</td>
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<td>0.779</td>
<td>1.000</td>
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<td>0.960</td>
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<td>0.97</td>
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<tr>
<td>Star Life</td>
<td>1.000</td>
<td>1.000</td>
<td>0.966</td>
<td>1.000</td>
<td>0.99</td>
</tr>
<tr>
<td>TATA Life</td>
<td>0.989</td>
<td>0.877</td>
<td>0.998</td>
<td>0.940</td>
<td>0.95</td>
</tr>
<tr>
<td>Mean</td>
<td>0.970</td>
<td>0.87</td>
<td>0.976</td>
<td>0.968</td>
<td></td>
</tr>
</tbody>
</table>

Source: Computed through DEAP version 2.1

Table 4: Scale Efficiency Scores

Table 5: Economies of Scale of the Insurance Companies.