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## Using data envelopment analysis to measure, relative efficiency of public and private life insurance companies in India

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### Abstract

In this study Data envelopment analysis used to measure the relative efficiency of public and private life insurance companies in India by year wise and group wise. This study used two inputs commission and operating expenses and one output namely investment income. This study used 01 public insurance company and 13 private insurance companies covering a period of 5 years from 2011-12 to 2015-16. The focus of this study is to maximise the output in minimum input. The result of this study show that in group wise analysis of company the mean of scale efficiency of private companies is 0.8151 in year 2011-12 to 0.9615 in year 2015-16. LIC is operating on increasing return to scale and taking the more advantage of pure technical efficiency and scale efficiency and selected public and private life insurance companies at an output oriented overall performance average technical efficiency is 62.424%, pure technical efficiency is 75.49285714% and scale efficiency is 85.57833.

**Keywords:** Data envelopment analysis, efficiency, scale efficiency, technical efficiency, Pure technical efficiency, public and private life insurance companies in India

### Introduction

Life Insurance is the key to good financial planning it gives you safeguards your money and ensures its growth, thus providing you with complete financial well being. In Life Insurance it is an agreement between the policy owner and the insurer. If insurer agrees to pay a sum of money upon the insurance like insured individual's or individuals' death or other event, such as terminal illness, critical illness or maturity of the policy. Data Envelopment Analysis (DEA) is a linear programming based model which evaluates the relative efficiency of decision making units (DMUs), with multiple inputs and outputs.

DEA methodology was developed by Charnes, Cooper and Rhodes (1978) <sup>[1]</sup> (CCR), efficiency is the ratio of a weighted sum of outputs to a weighted sum of inputs, where the weights structure is calculated by means of mathematical programming and constant returns to scale (CRS) are assumed. In 1984, Banker, Charnes and Cooper developed a model (BCC) with variable returns to scale (VRS). To analyze the performance of the public and private life insurance companies in India, this study measures the efficiency of life insurance companies in India for the year 2011-2016 by using Data Envelopment Analysis. The measuring efficiency of insurance companies in India, this study use the output input data which use 14 life insurance companies. This study utilizes two inputs namely, operating expenses and commission and one output, namely investment income.

### Review of Literature

A new definition of efficiency with data for multi-input and multi-output was developed by Charnes, Cooper and Rhodes (1978) <sup>[6]</sup> provided a non-linear programming problem. The initial studies on the efficiency of U.S. life insurers, the study was focused on scale economies. From this study result found that larger firms generally were found to exhibit decreasing returns to scale. Examine the relationship among mergers and acquisitions, efficiency, and economies of scale in the US life insurance industry for the period 1988 to 1995 used Data Envelopment Analysis.

Result was found that acquired firms achieve greater efficiency gains than firms that have not been involved in mergers or acquisitions.

Davutyan, Klumpes (2008) used Data Envelopment Analysis for studied Scale Efficiency, Technical efficiency and Pure Technical Efficiency. For that study they used inputs namely labor, business service, equity capital and used outputs namely premiums and invested asset. The result was found that the efficiency score was very low in seven European countries. In non life insurers Switzerland was the best and Spain was the worst. In life insurance France was the best and Netherlands was the worst.

Hussels, Ward (2006) used data envelopment analysis to analyzed the cost efficiency and technical efficiency of 47 life insurers of U.K. and 31 life insurers of Germany over the period 1991 to 2002. The result concluded that the cost and technical efficiency of U.K. was greater than Germany. There was limited evidence of improvement in post deregulation efficiency and limited influence of deregulation on efficiency. Zijiang Yang (2006) [3] introduced a new two-stage DEA model to evaluated systematic efficiency for the Canadian Life and health insurance industry. Result was concluded that the Canadian L&H insurance industry operated fairly efficiently during the examined period. 1998).

**Data Sources and Methodology**

For this study data have been collected from secondary source i.e. year wise annual report of Regularity and Development Authority of India (IRDA) of 14 public and private life insurance companies in India for the period 2011-12 to 2015-16. For this study companies included, Aviva Life Insurance Co. Ltd. (Aviva), Bajaj Allianz Life Insurance Co. Ltd. (Bajaj), IDBI Fedral Co. Ltd. (IDBI), Birla Sun Life Insurance Co. Ltd. (Birla), HDFC Standard Life Insurance Co. Ltd. (HDFC), ICICI Prudential Life Insurance Co. Ltd. (ICICI), Bharati Axa Co. Ltd., Kotak Mahindra Life Insurance Co. Ltd. (Kotak), Life Insurance Corporation of India (LIC), Max Life Insurance Co. Ltd. (Max Life), Met Life India Insurance Co. Ltd. (Metlife), Reliance Life Insurance Co. Ltd. (Reliance), SBI Life Insurance Co. Ltd. (SBI Life), Tata Aig Life Insurance Co. Ltd. (Tata Aig).

In this study two inputs and one output are used to find out efficiency of public and private life insurance companies in India. Two inputs are operating expenses and commission and outputs is investment income.

Data Envelopment Analysis (DEA) is a linear programming based model which evaluates the relative efficiency of decision making units (DMUs), with multiple inputs and outputs. In DEA methodology, formerly developed by Charnes, Cooper and Rhodes (1978) [6] (CCR), efficiency is defined as a weighted sum of outputs to a weighted sum of inputs, where the weights structure is calculated by means of mathematical programming and constant returns to scale (CRS) are assumed. In 1984, Banker, Charnes and Cooper developed a model (BCC) with variable returns to scale (VRS).

**Returns to Scale:** In production theory the change in output levels due to changes in input levels is termed as returns to scale. Returns to scale can be constant or variable. Constant returns to scale (CRS) implies that an increase in input levels by a certain proportion results in an increase in output levels by the same proportion. Variable returns to scale (VRS) implies that an increase in the input levels need not necessarily result in a proportional increase in output levels

i.e., the output levels can increase (increasing returns to scale) or the output levels can decrease (decreasing returns to scale) by a different proportion than the input increment

Data envelopment was developed for performance measurement. The DEA methodology helps to identify inefficient DMUs as well as the sources and amounts of inefficiency of inputs and/or outputs.

$$Efficiency = \frac{Total\_Output}{Total\_Input}$$

This study has used output oriented DEA model.

**Results**

**Analysis based on Technical Efficiency, Pure Technical Efficiency and Scale Efficiency:** The analysis of public and private life insurance companies in India year wise and group wise has done by using Scale efficiency, Technical efficiency and pure technical efficiency.

**Year wise analysis:** Table 1 shows that the year wise efficiencies of public and private life insurance companies in India over the period 2011-12 to 2015-16. This has been done to find out the year wise efficiencies of various companies under consideration i.e. the effort has been made to find out the year in which companies have more efficiency. From this result life insurance corporation of India which is from public sector is efficient for all the period except year 2014-15 and from private sector, SBI life insurance, ICICI prudential, Aviva, Birla Sunlife, Tata TIA and Bajaj Allianz are some time efficient. Most of the selected insurance companies are found to be efficient in the year 2013-14, 2014-15, 2015-16.

**Table 1:** Year wise Performance of Analysis of Te, PTE, SE.

**Table 1.1**

2011-12			
DMUS	TE	PTE	SE
LIC	1	1	1
Aviva	0.56	0.696	0.804597701
Bajaj Allianz	0.688	0.702	0.98005698
Biral Sunlife	0.459	0.476	0.964285714
HDFC Standard	0.482	0.507	0.950690335
ICICI Prudential	1	1	1
Kotak Mahindra	0.711	0.925	0.768648649
Met life	0.564	0.733	0.769440655
Reliance	0.603	0.633	0.952606635
Bharati Axa	0.384	1	0.384
SBI Life	0.758	0.818	0.926650367
Idbi Fedral	0.243	1	0.243
Tata AIA	0.571	0.632	0.903481013
Max Life	0.206	0.217	0.949308756

**Table 1.3**

2012-13			
DMUS	TE	PTE	SE
LIC	1	1	1
Aviva	0.602	0.962	0.625779626
Bajaj Allianz	1	1	1
Biral Sunlife	1	1	1
HDFC Standard	0.601	0.604	0.995033113
ICICI Prudential	0.988	0.994	0.993963783
Kotak Mahindra	0.626	0.628	0.996815287
Met life	0.523	0.524	0.998091603
Reliance	0.335	0.339	0.98820059
Bharati Axa	0.165	1	0.165
SBI Life	0.965	0.965	1
Idbi Fedral	0.38	1	0.38
Tata AIA	1	1	1
Max Life	0.291	0.294	0.989795918

**Table 1.4**

2014-15			
DMUS	TE	PTE	SE
LIC	0.967	1	0.967
Aviva	0.597	1	0.597
Bajaj Allianz	1	1	1
Birala Sunlife	0.793	0.796	0.996231156
HDFC Standard	0.62	0.623	0.995184591
ICICI Prudential	1	1	1
Kotak Mahindra	0.493	0.506	0.9743083
Met life	0.37	0.375	0.986666667
Reliance	0.342	0.387	0.88372093
Bharati Axa	0.222	1	0.222
SBI Life	1	1	1
Idbi Fedral	0.331	1	0.331
Tata AIA	0.988	1	0.988
Max Life	0.398	0.399	0.997493734

**Table 1.5**

2015-16			
DMUS	TE	PTE	SE
LIC	1	1	1
Aviva	0.73	1	0.73
Bajaj Allianz	1	1	1
Birala Sunlife	0.764	0.791	0.965865992
HDFC Standard	0.71	0.761	0.932982917
ICICI Prudential	0.915	1	0.915
Kotak Mahindra	0.366	0.383	0.955613577
Met life	0.384	0.386	0.994818653
Reliance	0.306	0.334	0.916167665
Bharati Axa	0.194	0.214	0.906542056
SBI Life	0.797	0.813	0.980319803
Idbi Fedral	0.299	1	0.299
Tata AIA	1	1	1
Max Life	0.33	0.365	0.904109589

**Group Wise analysis**

Below table 2 shows that the group wise analysis to find out the Mean of TE, Mean of PTE, Mean of Scale Efficiency. Mean of TE of public group insurance company is found to be efficient except the year 2014-15. Table 2 shows that mean of technical efficiency is increasing 0.55 in year 2011-12 which

increase to 0.67 in year 2015-16 except year 2012-13 and 2014-15 in which result found decrease mean of TE. Mean of PTE of private group is found to be efficient for given period. Where mean of PTE for some year it was increases or for some period it was decreases. The mean of scale efficiency of public and private companies is reverse to each other.

**Table 2:** Group wise Performance of Analysis of TE, PTE, SE.

Years	Groups	Mean TE	Mean PTE	Mean SE
2011-12	Public	1	1	1
	Private	0.556076923	0.718384615	0.815135908
2012-13	Public	1	1	1
	Private	0.544307692	0.697153846	0.825873742
2013-14	Public	1	1	1
	Private	0.652	0.793076923	0.856359994
2014-15	Public	0.967	1	0.967
	Private	0.627230769	0.775846154	0.843969644
2015-16	Public	1	1	1
	private	0.676538462	0.772846154	0.961570789

**Overall Performance:** Table 3 shows that the selected public and private life insurance companies at an output oriented overall performance average technical efficiency is 62.424%,

pure technical efficiency is 75.49285714% and scale efficiency is 85.57833

**Table 3:** Overall Performance of Analysis of TE, PTE, SE.

Years	Company	Technical Efficiency (%)	Pure Technical Efficiency (%)	Scale Efficiency (%)
2011-12	All selected Insurance Companies	58.77857143	73.85	82.8340486
2012-13	All selected Insurance Companies	57.68571429	71.87857143	83.83113319
2013-14	All selected Insurance Companies	67.68571429	80.78571429	86.66199942
2014-15	All selected Insurance Companies	65.15	79.18571429	85.2757527
2015-16	All selected Insurance Companies	62.82142857	71.76428571	89.28871609

### Conclusion

From this study result found that in group wise analysis of company the mean of scale efficiency of private companies is 0.8151 in year 2011-12 to 0.9615 in year 2015-16. LIC is operating on increasing return to scale and taking the more advantage of pure technical efficiency and scale efficiency. We observe that private life insurance companies are behind the public life insurance company. We observe that if private companies are improved in operating expenses and commission then their investment income will go to high and less efficient companies can successfully achieve the optimum performance level. From this result we can say that those inefficient companies which having increasing return to scale then they should expand their business by increasing their input. They have to increase their quality of service, customer's product choice then inefficient companies will be efficient.

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