MEASURING OVERALL TECHNICAL EFFICIENCY USING DATA ENVELOPMENT ANALYSIS: A CASE STUDY OF PUBLIC AND PRIVATE LIFE INSURERS IN INDIA

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ABSTRACT

The efficient performance of the life insurance companies plays an important role in the growth and development of insurance industry and hence ultimately in overall economy of the country. The present study attempts to examine the Technical Efficiency of Indian the Public and Private life insurers on the basis of various parameters. For measuring it, no. of agents, operating expenses, and equity capital were taken as inputs and no. of policies and net premium were taken as outputs in the CCR Model of Data Envelopment Analysis (DEA). The time period of the study was taken for 15 years i.e., from 2004-05 till 2018-19. The Public Sector was represented by LIC of India and the private sector was represented by five companies as they hold around 39% of market share of life insurance industry other than LIC. In total these six players together hold around 83% of total market share (Retail Weighted Received Premium) of life insurance industry.

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Keywords: *Technical Efficiency, DMUs, CCR Model, Data Envelopment Analysis.*

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Introduction

Life is full of uncertainties and exposed to different kinds of risks. Therefore, it is very natural for people to find out the ways to minimize the risks arising due to these uncertainties. One such way of minimizing the risks is to contribute small amount periodically, so that a corpus is built up and if someone suffers a loss, that loss can be indemnified out of this corpus. This way of minimizing the risk through pooling of funds called insurance. Thus, it led to emergence of life insurers. However, over a period of time the number of life insurers has emerged. These life insurers certainly differ in their approach of business and hence in the performance. It needs to be noted that the efficient performance of the life insurance companies plays an important role in the growth and development of insurance industry and hence ultimately in overall economy of the country.

Need of the Study

Since 1956 i.e., the establishment of LIC of India, it was the only player in the Insurance sector and was having 100 percent market share. Since there were no competitors, the performance of LIC of India could not be judged and the LIC continued its complacency in its performance. However, the scenario changed in 1999 when the IRDA Act 1999 was passed. The insurance sector was opened to private sector and foreign direct investment was allowed in India in 2000, where a limit was seton foreign direct investment to 26%, which was increased to 49% in 2014. Since 2001, the LIC of India i.e., the largest life-insurance company in India has seen its market share shrinking and going to private insurance companies like SBI life Insurance Company, HDFC Life, ICICI and Prudential Life Insurance.Thus, there is a strong need to study the performance efficiency of private and public sector insurance companies especially after the entry of private players in insurance sector. In today's times the ability to stand competition, enhance profitability, customer satisfaction in terms of claims settlement, product awareness, service quality and maximum number of lives covered have become the significant indicators of performance efficiency of life insurance companies. Therefore, in this regard, it was felt necessary *"To study and compare the Technical Efficiency of Life Insurance Companies in public and private sectors so that the snags in the performance can be identified and suggestions can be made to improve their performances"*

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Review of Literature

(Grace & Timme, 1992) suggested that *"the magnitude of scale economies and cost complementarities may vary with the scale and mix of outputs".* (Fecher, Kessler, Perelman, & Pestieau, 1993) used the Data Envelopment Analysis (DEA) and concluded that "*there was strong correlation between non-parametric and parametric results and the wide dispersion in the rates of inefficiency across the insurance companies."* (Delhausse, Fecher, Perelman, & Pestieau,1995) also studied technical efficiency of non-life insurer in Belgium and France by using Data Envelopment Analysis (DEA) and Stochastic Frontier Approach (SFA) method and found "*that the technical efficiency of France was better than that of Belgium."*(Cummis, Tennyson, & Weiss, 1999) used the Data Envelopment Analysis and found that *"the firms which have been acquired achieve higher efficiency benefits as compared to the firms that have not gone through mergers or acquisitions."*(Mahlberg, 1999) used DEA to find out Technical efficiency of life insurance companies of Australia (36) and Germany (118) for the period 1992-1996. "*It was found that technical efficiency of life insurance companies of Australia was higher than the life insurance companies in Germany."*

(Boonyasai, Grace, & Skipper 2002) examined technical efficiency of 110 Life insurance companies of 4 Asian countries namely Korea, Philippines, Taiwan and Thailand and found that *"the productivity of Korea and Philippines was more than Taiwan and Thailand and the technical efficiency of all life insurance company has significantly increased."*

Thus, the present study attempts to examine the Technical Efficiency of Indian the Public and Private life insurers on the basis of various parameters. For measuring it, no. of agents, operating expenses, and equity capital were taken as inputs and no. of policies and net premium were taken as outputs in the CCR Model of Data Envelopment Analysis (DEA). The time period of the study was taken for 15 years i.e., from 2004-05 till 2018-19. The Public Sector was represented by LIC of India and the private sector was represented by five companies as they hold around 39% of market share of life insurance industry other than LIC. In total these six players together hold around 83% of total market share (Retail Weighted Received Premium) of life insurance industry.

Objectives of the Study

The present study tried to examine the performance efficiency of public and private life insurers in India. To be more specific the following are the objectives of the study:

- To compare the Technical Efficiency of Public and Private Sector Companies in India.
- To analyze the difference between Technical Efficiency of Public and Private Sector Companies in India.

Research Methodology

The study is related to measure the performance of public and private sector life insurance companies in India. Since the study is based on secondary data and the analysis is descriptive in nature, the data was collected from the annual reports, fact books, manuals of the insurance and websites of IRDA, Life Insurance Corporation of India and private life insurance companies. The said research is the part of larger study done to evaluate the performance of public and private sector insurance companies in terms of their Operational Performance and Technical Efficiency. For this purpose, the study required computation of Overall Technical Efficiency (OTE) of life insurance companies in India during the period 2005-06 to 2018-19 which was computed with the help of Data Envelopment Analysis (DEA) using CCR output oriented model. For all these computations DEA-Solver LV 8.0 version was used. The inputs used for the computation of Technical Efficiency were no. of agents, operating expenses, and equity capital whereas the outputs were no. of policies, and net premium.

Sample Units of the Study

Till March 2020, as per IRDAI, there were 23 private sector life insurance companies operating in India along with public sector giant LIC. However, the researcher has selected the Life Insurance Corporation of India and top five private sector life insurance companies for the study as these six players together hold around 83% of total market share (these top five private sector life insurance companies hold around 39% of market share other than LIC), and their results would be enough for a meaningful study (Anish, 2019).

Thus, the Public Sector and top five private sector life insurance companies selected for the study are as below:

Public Sector Company

- LIC w.e.f 1st September 1956

Private Sector Companies

- HDFC Standard Life Insurance Company Limited, w.e.f 23rd October 2000.
- Max New York Life Insurance Company Limited, w.e.f. 15th[rd] November 2000.
- ICICI Prudential Life Insurance Company Limited, w.e.f. 24th November 2000.
- SBI Life Insurance Company Limited, w.e.f. 30th March 2001.
- Bajaj Alliance Life Insurance Company Limited, w.e.f. 3rd August 2001.

Data Envelopment Analysis

CRR Model: The first basic DEA model was developed by Charnes, Cooper and Rhodes (1978) which was based on the assumption of constant return to scale and is known as CRR model as an abbreviation of their names. According to this model efficient DMUs are located

Table 1: Overall Technical Efficiency from 2005-06 to 2018-19 of Life Insurers

Year/ Insurer	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
LIC	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ICICI Prudential Life	0.4914	0.2912	0.3462	0.4379	0.4852	0.5933	0.626	0.5333	0.7708	0.8465	0.8643	0.7473	0.904	0.9808
Max Life	0.3134	0.517	0.5454	0.3893	0.4475	0.8234	1	1	0.8031	0.8411	0.8107	0.6859	0.781	0.918
HDFC Standard Life	0.4687	0.3115	1	0.2288	0.3039	0.4094	1	0.8141	1	1	0.7889	1	1	1
Bajaj Allianz Life	0.4283	0.276	0.309	0.4419	0.506	0.4568	0.3793	0.3446	0.4353	0.4995	0.453	0.5975	0.5487	0.4599
SBI Life	1	0.9967	1	0.8929	1	1	0.9501	0.7264	0.9759	1	0.9243	1	1	1

Compiled from Annual Reports of IRDA (IRDA, 2019)

On the *efficient frontier*, and are used to compare with other DMUs. The CCR model, actually computes overall technical efficiency which is composed of both pure technical efficiency and scale efficiency, whereas, the BCC model decomposes the overall technical efficiency obtained from CCR model into the pure technical efficiency and scale efficiency as mentioned earlier.

Compilation of Overall Technical Efficiency from 2005-06 to 2018-19 of Life Insurers

Table 1 and the Figure 1, both show that LIC has maintained its technical efficiency throughout the study period. In fact, LIC has left the other life insurers a way behind by consistently having technical efficiency score of 1 during the study period of fourteen years. It is the only company which is having the highest efficiency score from 2005-2006 to 2018-19. The main reason for it is that it is the oldest company with huge Asset base and enjoys the trust of people being a public sector company. Among private life insurers best efficient company that has emerged is the SBI life which has achieved efficiency score of 1 eight times during the study period of fourteen years. After SBI, the next efficient private sector company is the HDFC Life. HDFC life has scored efficiency score of 1 on seven occasions during the study period. Max life got efficiency score of 1 only two times in the study period of fourteen years. ICICI didn't get technical efficiency score of 1 in any of the years of study period but the trend shows that it is catching up in the later years and may become technically efficient in the future. Lastly Bajaj Allianz not only carried the efficiency score of less than 1 in all the occasions but also its efficiency score remained less than the ICICI's score even in later years and hence was the most inefficient DMU among all the DMUs.
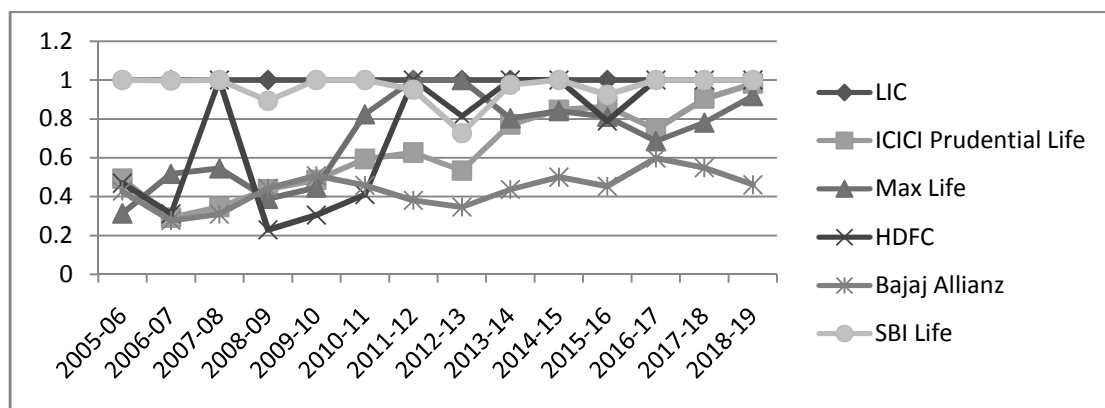

Figure 1: Trend of Overall Technical Efficiency from 2005-06 to 2018-19 of life Insurers

The trend of fluctuation in the overall technical efficiency scores of DMUs is depicted in table 2. In other words, the table can help in understanding the change in the directions of overall technical efficiency and ultimately the performance of the DMUs.

Table 2: Table Indicating Change in Direction of Overall Technical Efficiency Score

DMUs	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	Performance
LIC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	Consistent
ICICI	-	+	+	+	+	+	-	+	+	+	-	+	+	Improved
MAX LIFE	+	+	-	+	+	+	NC	-	+	-	-	+	+	Improved
HDFC	-	+	-	+	+	+	-	+	NC	-	+	NC	NC	Improved
BAJAJ ALLIANZ	-	+	+	+	-	-	-	+	+		+	-	-	Deteriorated
SBILIFE	-	+	-	+	NC	-	-	+	+	-	+	NC	NC	Improved

In the table 2, three symbols have been used i.e., +, - and N.C. The symbol + denotes improvement in the overall technical efficiency score, - indicates reduction and NC denotes no change. The company having more + symbols would be termed as 'Improved' performer, and more with - symbols as 'Deteriorate' performer. The DMU having equal + and – symbols or NC would be considered as the consistent performer. The term No Change is used where the company has reached at the technical efficiency score of one and maintained it in the next successive year. Since, the LIC has consistently maintained efficiency score of 1 throughout the years it would be considered as the consistent performer. In total, most of the DMUs are observed to be overall technically efficient and only one DMU is found to be as deteriorating Performer. To elaborate HDFC, Max Life, ICICI and SBI life have more + symbols, so they would be considered as improved performers. However, the Bajaj Allianz has more – symbols so it would be considered as a deteriorated performer.

Table 3: Range of OTE Scores of Life Insurers during the Study Period

OTE Ranks	Name of the Life Insurance Company	No. of Times the OTE Score lied in the Range During the Study Period			
		OTE Score =1	0.75>OTE Score <1	0.50>OTE Score <0.75	OTE Score <0.50
1	LIC	14	NIL	NIL	NIL
2	SBI Life	8	5	1	NIL
3	HDFC Life	7	2	NIL	5
4	MAX Life	2	6	3	3
5	ICICI Prudential	NIL	5	4	5
6	Bajaj Allianz	NIL	NIL	3	11

It can be seen from the table 3 that LIC achieved OTE score of 1 in all the 14 years and occupied first rank among the life insurers in overall technical efficiency of life insurers over the entire study period. Among private life insurers, best efficient company that has emerged is the SBI life which has achieved OTE score of 1 eight times, five times between 1 and 0.75 and once between 0.75 and 0.50 during the study period of fourteen years and thus stood at second rank. After SBI, the next efficient private sector company is the HDFC Life which got OTE score of 1 on seven occasions, two times between 1 and 0.75 and five times less than 0.50 and thus is placed at third rank. Max life got the OTE score of 1 only two times, between 1 and 0.75 six times, and three times each between 0.75 and less than 0.50 during the study period, putting it at fourth position. ICICI didn't get the OTE score of 1 in any of the years of study period but the trend shows that it is catching up in the later years as it got five times the score between 1 and 0.75, four times between 0.75 and 0.50 and five times less than 0.50 which put it at fifth place. Lastly Bajaj Allianz not only carried the efficiency score of less than 1 in all the occasions but also its efficiency score remained less than 0.50 on 11 occasions and hence was the most inefficient DMU among all the DMUs. Now, the researcher intends to find out whether there is a significant difference in the overall technical efficiency of the life insurance companies. As a result, the following hypothesis is framed.

H$_O$:   There is no significant difference in overall technical efficiency of the life insurance companies in India.

H$_A$:   There is a significant difference in overall technical efficiency of the life insurance companies in India

However, to test this hypothesis Kruskal Wallis Test would be applied as it is a non-parametric test. It is non-parametric equivalent of ANOVA and since Data Envelopment Analysis is a non-parametric technique, ANOVA is not suitable for testing the hypothesis on the data generated by DEA.

Table 4: Test Statistics[a,b]

	Overall Technical Efficiency
Chi-Square	45.970
df	5
Asymp. Sig.	0.000
a. Kruskal Wallis Test	

Table 4 shows the test statistics of Kruskal Wallis test of overall technical efficiency scores of all the life insurers. As the p-value is 0.000 i.e., less than 0.05 it, can be concluded that there is statistically significant difference between the overall technical efficiency of the life insurers. Hence the null hypothesis is rejected.

Limitation of the Research Study

The research work is undertaken to objectively compare the performances of public and private sector life companies. However, there are certain limitations of the study which are as follows:

- The study is based on the analysis of the top five private life insurance companies only.
- Since the study is based on the secondary data, it relies on the availability and accuracy.

Conclusion

The table 1 shows that LIC has maintained its technical efficiency throughout the study period. In fact, LIC has left the other life insurers a way behind by consistently having technical efficiency score of 1 during the study period of fourteen years. It is the only company which is having the highest efficiency score from 2005-2006 to 2018-19. The main reason for it is that it is the oldest company with huge Asset base and seems to enjoy the trust of people being a public sector company(Leena, 2020).

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