

Exploring operational efficiency of Indian life insurance sector in the post-reforms era: A data Envelopment Analysis (DEA) approach

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Abstract

The current study evaluates the Overall Technical Efficiency (OTE) of all the companies in Indian life insurance sector following the reforms introduced in the sector by the Government of India following the recommendations proposed by the Malhotra Committee. The OTE of each Indian life insurance companies in each year during the study period (2001-02 to 2020-21) has been computed using an input oriented non-allocative envelopment model developed by Charnes, Cooper and Rhodes (CCR) (1978) taking into consideration 'Operating Expenses' and 'Commission Expenses' as input variables and 'Investment Income', 'Net Premium Earned' and 'Benefits Paid' as output variables. While by the end of 2022, the total number of life insurance companies in the sector have become 24, from 2001, they have entered the industry in different intervals. Hence the number of Decision-Making Units (DMUs) in each year during the study period varied during the study period. The data with respect to these input and output variables are collected from the 2014 and 2021 issue of the Handbook on Insurance Statistics issued by the Insurance Regulatory and Development Authority of India (IRDAI). The data collected has been deflated using Gross Domestic Product (GDP) deflator to nullify the effect of inflation and analysed using an excel based mathematical tool, DEA Frontier. It is observed that in an average the entire industry for the overall study period has an operational efficiency of 61% with a volatility of 18.6%. The Life Insurance Corporation of India (LIC), the only public sector company in the industry has reported efficiency in each year during the study period. Out of all the private life insurers, SBI Life, ICICI Prudential Life, IndiaFirst Life, HDFC Life, Canara HSBC OBC Life are marginally inefficient companies and they have projected operational efficiency in quite a few years during the study period. Aegon Life was most volatile in terms of their operational performance. Worst performing private companies in terms of their operational performances are Exide Life, Future Generali Life, PNB MetLife, Bharti AXA Life and Edelweiss Tokio Life.

Keywords: CCR, DEA, DMU, Efficiency, IRDAI, Life Insurance, OTE

Acknowledgement

The scholar namely Dr. Mitrendu Narayan Roy is the awardee of Indian Council of Social Science Research (ICSSR) Minor Research Project (MRP). This research paper is largely an outcome of the MRP sponsored by the ICSSR. However, the responsibility for the facts stated, opinions expressed, and the conclusions drawn is entirely that of the author. The author expresses his sincere gratitude to the ICSSR, for providing an opportunity in conducting the research work.

Introduction

1. Background of the study

Life insurance companies function as crucial financial intermediaries by pooling household savings via premium collection, providing financial security to nominees, and channelizing funds under IRDAI guidelines into productive corporate investments that drive capital formation and GDP growth (Saha, 2021) ^[18]. Historically evolving from ancient Babylonian practices and European "Benevolent Societies" to modern structures like Lloyd's in 1688 and Edmund Halley's 1693 mortality table, Indian life insurance began its journey with the Oriental Life Insurance Company in 1818, eventually leading to the nationalization of 237 companies and 73 provident societies to form the state-controlled LIC in 1956 (Kane *et al.*, 1997) ^[11]. This 44-year monopoly shifted following the 1994 Malhotra Committee

recommendations, which advocated for private player entry, a 26% Foreign Direct Investment (FDI) cap, and a dedicated regulatory body (Malhotra, 1994) ^[14] for the sector. Implemented through the IRDA Act of 1999 ^[15], these reforms fostered market competition, product innovation, and cost reduction, eventually expanding the sector to 24 companies (with LIC as the sole public entity) and raising the FDI cap to 49% to further promote efficient resource utilization for economic growth (Sinha, 2007a) ^[21]. The study utilizes DEA to evaluate the post-liberalization efficiency of Indian life insurers to see how efficiently these life insurance companies have been moving the wheels of economic expansion and growth.

2. Objectives of the study

The study is an attempt to analyse the relative efficiencies of all the companies that have ever worked in the Indian life insurance space in the post-reforms era and propose suggestions for their improvements in the future.

Materials and methods

1. Conceptual framework

With a view to evaluating the efficiency of all the life insurance companies (Table 1) during the period 2001-02 to 2020-21 (20 years), the paper considers DEA which is a non-parametric technique used for analyzing the efficiency of different units operating under a uniform environment

known as DMUs (Ramanathan, 2003 ^[16]). Charnes *et al.* (1981) ^[3] explains that the efficiency ratio cannot exceed unity, and the efficient units form an envelope over the inefficient units. The DMUs lie on or below this envelope. Farrell (1957) ^[7] used DEA as a measure to estimate the productivity of a unit, especially in a situation where production was carried out with multiple inputs and outputs. He presented an activity-based approach to deal with the issue of multiple input(s) and output(s) by combining them in different proportions. While Farrell was more focused on productivity, it was increasingly clear that the metric was more apt to measure efficiency of a unit (Cooper *et al.* 2006 ^[5]). The concept of technical efficiency was developed by Koopmans (1951 ^[13], p. 79) to describe the productive efficiency of a unit. Primarily DEA models can be classified under two groups – (a) non-allocative model; and (b) allocative model based on their selection and treatment of input(s) and output(s). The non-allocative DEA models can be of two orientations – (a) input orientation, and (b) output orientation (Charnes *et al.*, 1981) ^[3]. The goal of input-oriented efficiency is to minimize input(s) while maintaining the current level of output(s). It seeks to change input(s) for a given output level. In situations where the objective is to minimise the controllable input(s), it is feasible to use input-oriented DEA. There are many non-allocative models present in the existing literature. However, in the present study, CCR model is discussed in details. The CCR is the earliest form of a DEA model. It was initially introduced by Charnes *et al.* (1978) ^[4] as an extension to Farrell's work of fractional optimization problem. They converted the fractional programming problem to a linear programming problem, which was later termed as DEA. The CCR Model assumes that the production function follows Constant Returns to Scale (CRS). In this model, objective function is to maximize the output (or minimize the input)

of a DMU with reference to the efficient unit(s). In an input oriented CCR model (CCR-I), input and output matrices are X and Y respectively, while u_r and v_j are the optimal weight-vector (where $i = 1$ to m , and $r = 1$ to s). In order to maximise the objective function, the fractional form of the optimization problem can be stated as:

$$\begin{aligned} \max_{v,u} \quad & \frac{u_r y_{r0}}{v_i x_{i0}} \\ \text{subject to} \quad & \frac{u_r y_{rj}}{v_i x_{ij}} \leq 1; \quad (j = 1, \dots, n); (i = 1, \dots, m); (r = 1, \dots, s) \\ & v_m, u_s \geq 0 \end{aligned}$$

The dual of the above equation is expressed with a real variable θ and a non-negative vector $\lambda = (\lambda_1, \dots, \lambda_n)^T$ is also known as the *envelopment form* of the CCR model, which is shown as follows:

$$\begin{aligned} \min_{\theta, \lambda} \quad & \theta \\ \text{subject to} \quad & \theta x_0 - X\lambda \geq 0 \\ & Y\lambda - y_0 \geq 0 \\ & \lambda \geq 0 \end{aligned}$$

Cooper *et al.* (2006) ^[5] defined CCR efficiency (also known as OTE) as follows. A DMU is CCR efficient if $\theta = 1$ and there exists at least one optimal v or u with $v > 0$ and $u > 0$, otherwise the DMU is CCR-inefficient. It means that the objective function θ has a bounded solution which has a range $\{0, 1\}$. If $\theta = 1$, then the DMU is said to be 'CCR-Efficient', and if the score is less than 1, the DMU is said to be 'CCR-Inefficient'.

Table 1: Life Insurance Companies

Sl.	Ownership	Name of Company	Short Name
1.	Public	Life Insurance Corporation of India	LIC
2.	Private	Aditya Birla Sunlife Insurance Company Ltd.	Aditya Birla Sunlife
3.	Private	Aegon Life Insurance Company Ltd.	Aegon Life
4.	Private	Ageas Federal Life Insurance Company Ltd.	Ageas Federal
5.	Private	Bajaj Allianz Life Insurance Company Ltd.	Aviva Life
6.	Private	Aviva Life Insurance Company India Ltd	Bajaj Allianz
7.	Private	Bharti AXA Life Insurance Company Ltd.	Bharti AXA
8.	Private	Canara HSBC OBC Life Insurance Company Ltd.	Canara HSBC OBC
9.	Private	Edelweiss Tokio Life Insurance Company Ltd.	Edelweiss Tokio
10.	Private	Exide Life Insurance Company Ltd.	Exide Life
11.	Private	Future Generali India Life Insurance Company Ltd.	Future Generali
12.	Private	HDFC Life Insurance Company Ltd.	HDFC Life
13.	Private	ICICI Prudential Life Insurance Company Ltd.	ICICI Prudential
14.	Private	IndiaFirst Life Insurance Company Ltd.	IndiaFirst
15.	Private	Kotak Mahindra Life Insurance Ltd.	Kotak Mahindra Life
16.	Private	MaxLife Insurance Company Ltd.	Max Life
17.	Private	PNB MetLife India Insurance Company Ltd.	PNB MetLife
18.	Private	Pramerica Life Insurance Company Ltd.	Pramerica
19.	Private	Reliance Nippon Life Insurance Company Ltd.	Reliance Nippon Life
20.	Private	Sahara India Life Insurance Company Ltd.	Sahara India Life
21.	Private	SBI Life Insurance Company Ltd.	SBI Life
22.	Private	Shriram Life Insurance Company Ltd.	Shriram
23.	Private	Star Union Dai-Ichi Life Insurance Company Ltd.	Star Union Dai-Ichi
24.	Private	TATA AIA Life Insurance Company Ltd.	TATA AIA

Source: Compiled by Author

2. Selection of Input and Output Variables

With a view to estimate efficiency score under non-allocative models, a few operational and financial variables are selected as inputs and outputs for the current study. The rule of thumb for deciding the number of input(s) and output(s) in comparison to the number of DMUs is mentioned as follows (Banker *et al.*, 1989 ^[1], Pedraja-Chaparro *et al.* 1999, Cooper *et al.* 2006 ^[5]; Zhu, 2014 ^[26]):

$$n \geq \max \{m \times s, 3(m + s)\}$$

Where, 'n' is the number of DMU; 'm' is the number of input(s) and 's' is the number of output(s). Since, Max (n)=24; the efficiency scores have been estimated based on a two-input and three-output model as follows:

Table 2: Input and Output Variables Selected for the Study

Input Variables (m)	Output Variables (s)
(1) Operating Expenses (Sinha and Chatterjee, 2009; Gulati, 2014; Sinha, 2015; Dastur, 2017; Khan, 2018; Rathi, 2021; Zhao <i>et al.</i> , 2021) ^[6, 8, 12, 22, 23, 25]	(1) Investment Income (Dastur, 2017; Siddiqui, 2021; Zhao <i>et al.</i> , 2021; Učkar and Petrović, 2022) ^[6, 20, 24, 25]
(2) Commission Expenses (Sinha and Chatterjee, 2009; Gulati, 2014; Sinha, 2015; Dastur, 2017; Shetty and Basri, 2018; Khan, 2018) ^[6, 8, 19, 22, 23]	(2) Net Premium Earned (Sinha and Chatterjee, 2011; Bhagat, 2017; Khan, 2018; Siddiqui, 2021; Zhao <i>et al.</i> , 2021) ^[2, 12, 20, 25]
	(3) Benefits Paid (Sinha and Chatterjee, 2009 ^[23] ; Sinha and Chatterjee, 2011; Dastur, 2017; Khan, 2018) ^[6, 12]

Source: Compiled by Author.

The input and output variables are selected based on existing literature. The rule of thumb as provided in the following equation is proved as follows:

$$\begin{aligned} \max & \quad \{2 \times 3, 3(2 + 3)\} \\ \max & \quad \{6, 15\} \\ \therefore n & \geq 15 \end{aligned}$$

Eqn. (3.36) confirms that in the current model, actual observations (n=24) is greater than the minimum number of observations required (n=15). Hence, the criteria are fulfilled and the study can be conducted with two inputs and three outputs.

3. Test of Isotonicity

The input(s) and output(s) selected for the purpose of estimating efficiency scores should be significantly positively correlated (Sinha, 2013). In order to fulfil this condition, Test of Isotonicity is conducted which is nothing but calculating the Pearson's correlation coefficient (r) between each pair of input(s) and output(s) [based on the average data of inputs(s) and output(s) of all 24 companies for the entire study period] and testing the significance of individual correlation coefficient using t-test. It is observed that (Table 3) input variables are significantly (statistically significant at 1% level) and positively (r>0.5) correlated with the output variables. Hence, the select variables are fit for conducting DEA under non-allocative model.

Table 3: Test of Isotonicity (overall period)

Pearson Correlation	Operating Expenses	Commission	Investment Income	Premium earned	Benefits Paid
Operating Expenses	1	0.961**	0.983**	0.980**	0.980**
Commission	0.961**	1	0.952**	0.988**	0.942**
Investment Income	0.983**	0.952**	1	0.977**	0.989**
Premium earned	0.980**	0.988**	0.977**	1	0.972**
Benefits Paid	0.980**	0.942**	0.989**	0.972**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Calculated by Author

4. Collection of Data

The data on the select input(s) and output(s) of all 24 life insurance companies for the entire study period (2001-02 to 2020-21) have been collected from Policyholders' Account (Profit & Loss a/c) of the IRDAI Handbook on Insurance Statistics (IRDA, 2014 & IRDA, 2021). The data has been deflated using Gross Domestic Product (GDP) deflator (2011-12) (worldbank.org) to eliminate the effects of inflation.

5. Model Selection and Analytical Tool

With a view to calculating OTE scores with the aforesaid dataset, input-oriented envelopment form of the CCR model has been used. In order to calculate OTE scores, DEA Frontier, a Microsoft (MS) Excel based mathematical software has been used.

Results and Discussions

1. Company-wise Analysis

1.1. The LIC

The LIC has efficiency score (=1) in all the years during the study period (Table 4). The LIC being the market leader has reported significant financial results as compared to its private counterparts which clearly made the LIC an outlier in the life insurance industry and helped the LIC to achieve efficiency status throughout the post-reforms era.

1.2. Aditya Birla Sunlife

Aditya Birla Sunlife has been incorporated in the year 2000-01. It has an average efficiency of 59.8% (OTE=0.598) with a volatility of 17.3% during the study period. The average efficiency of the company is less than the industry average (OTE=0.610) during the study period. However, the efficiency of the company is also less volatile as compared

to the industry as a whole. The company never achieved efficient status ($OTE=1$) during the study period. In the initial years after the incorporation, the efficiency of the company was significantly less. However, it gradually improved till 2009 and reached almost 60% level. During the global financial crisis in the 2009, the efficiency fell significantly coming down to a bit less than 40% only to rise again to almost 70% by the end of 2013. However, major

sell-offs in the life insurance market *also* impacted the company and its efficiency again dropped to some extent. However, major policy revisions by the IRDAI especially with respect to FDI, improved the efficiency of the company to more than 90%. The efficiency of the company is now projecting a declining trend probably because of the economic disruptions in the backdrop of Covid-19 pandemic (Table 4).

Table 4: OTE Scores

	2002	2003 ^[16]	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Mean	SD
LIC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.000
Aditya Birla Sunlife	0.272	0.297	0.507	0.524	0.563	0.583	0.587	0.489	0.377	0.523	0.704	0.649	0.710	0.629	0.670	0.978	0.894	0.728	0.707	0.575	0.598	0.173
Aegon Life	-	-	-	-	-	-	-	0.574	0.257	0.379	0.314	0.441	0.343	0.278	0.510	1.000	1.000	1.000	1.000	1.000	0.623	0.322
Ageas Federal	-	-	-	-	-	-	1.000	0.936	0.322	0.367	0.369	0.381	0.461	0.485	0.506	0.545	0.683	0.658	0.812	0.908	0.602	0.232
Aviva Life	-	0.045	0.194	0.290	0.385	0.425	0.507	0.595	0.481	0.724	1.000	0.735	0.770	0.697	1.000	1.000	1.000	1.000	1.000	1.000	0.676	0.312
Bajaj Allianz	0.135	0.255	0.283	0.503	0.673	0.393	0.407	0.577	0.503	0.635	1.000	1.000	1.000	1.000	0.942	1.000	1.000	0.796	0.732	0.609	0.672	0.287
Bharti AXA	-	-	-	-	-	0.922	0.314	0.416	0.208	0.457	0.594	0.468	0.307	0.270	0.294	0.350	0.475	0.425	0.359	0.381	0.416	0.170
Canara HSBC OBC	-	-	-	-	-	-	-	0.168	0.288	0.448	0.698	0.738	0.948	0.928	0.932	0.973	0.809	0.703	0.638	0.570	0.680	0.256
Edelweiss Tokio	-	-	-	-	-	-	-	-	-	-	0.109	0.100	0.094	0.169	0.232	0.323	0.418	0.409	0.314	0.287	0.246	0.124
Exide Life	0.105	0.108	0.210	0.408	0.397	0.499	0.624	0.594	0.426	0.453	0.501	0.541	0.471	0.421	0.343	0.452	0.549	0.510	0.470	0.503	0.429	0.142
Future Generali	-	-	-	-	-	-	1.000	0.302	0.104	0.186	0.221	0.300	0.373	0.448	0.552	0.445	0.522	0.553	0.528	0.470	0.429	0.219
HDFC Life	0.285	0.424	0.495	0.488	0.834	0.897	0.811	0.598	0.440	0.624	0.654	0.752	0.971	0.922	0.807	0.795	0.803	0.845	0.763	0.756	0.698	0.189
ICICI Prudential	0.484	0.559	0.634	0.775	0.990	1.000	0.961	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.957	1.000	1.000	0.796	0.986	1.000	0.907	0.165
IndiaFirst	-	-	-	-	-	-	-	-	-	-	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.924	0.941	1.000	0.955	0.028
Kotak Mahindra Life	0.123	0.186	0.374	0.658	0.700	0.806	0.637	0.529	0.535	0.763	1.000	0.788	0.660	0.421	0.467	0.519	0.634	0.594	0.662	0.637	0.585	0.205
Max Life	0.180	0.221	0.279	0.302	0.384	0.434	0.424	0.446	0.318	0.374	0.408	0.480	0.610	0.600	0.628	0.530	0.594	0.568	0.577	0.511	0.443	0.135
PNB Metlife	0.052	0.121	0.176	0.214	0.327	0.311	0.268	0.323	0.290	0.809	0.677	0.616	0.563	0.454	0.375	0.511	0.600	0.593	0.639	0.537	0.423	0.206
Pramerica	-	-	-	-	-	-	-	1.000	0.176	0.213	0.152	0.112	0.207	0.489	0.742	0.782	0.586	0.503	0.652	0.666	0.483	0.287
Reliance Nippon Life	0.052	0.093	0.231	0.529	1.000	0.674	0.668	0.403	0.323	0.425	0.551	0.711	0.577	0.571	0.485	0.652	0.724	0.724	0.676	0.701	0.539	0.232
Sahara India Life	-	-	-	0.152	0.474	0.510	0.441	0.497	0.497	0.544	0.452	0.691	0.835	0.771	0.677	0.864	1.000	0.931	0.924	1.000	0.662	0.242
SBI Life	1.000	1.000	1.000	1.000	1.000	1.000	0.876	0.931	0.910	1.000	1.000	1.000	1.000	1.000	0.969	1.000	1.000	1.000	1.000	1.000	0.984	0.036
Shriram	-	-	-	-	0.203	0.417	0.505	0.477	0.374	0.639	0.699	0.595	0.491	0.326	0.347	0.452	0.520	0.495	0.463	0.452	0.466	0.121
Star Union Dai-ichi	-	-	-	-	-	-	-	0.350	0.596	0.777	0.755	0.579	0.470	0.490	0.477	0.668	0.507	0.497	0.542	0.523	0.556	0.119
TATA AIA	0.205	0.285	0.382	0.342	0.433	0.476	0.518	0.523	0.363	0.509	0.871	1.000	1.000	0.978	0.856	0.547	0.464	0.395	0.372	0.353	0.544	0.252
Mean	0.324	0.353	0.444	0.513	0.624	0.647	0.642	0.578	0.469	0.602	0.655	0.653	0.661	0.639	0.657	0.724	0.738	0.694	0.701	0.683	0.610	0.186
S.D.	0.337	0.319	0.282	0.266	0.281	0.250	0.245	0.244	0.266	0.248	0.293	0.272	0.288	0.278	0.256	0.248	0.214	0.207	0.225	0.240	0.197	0.087

Source: Computed by Researcher

1.3. Aegon Life

Aegon Life started its operation from 2008-09. It has an average efficiency of 62.3% ($OTE=0.623$) with a volatility of 32.2% during the study period. The average efficiency of the company was more than the industry average ($OTE=0.610$) for the overall study period. However, the volatility in their efficiency was also higher as compared to industry average. The company had achieved efficient status ($OTE=1$) in the year 2017 and since then it was one of the efficient companies in the industry. Following its incorporation, the company quickly achieved almost 60% efficiency in no time. However, in the aftermath of global financial crisis (2010), it dropped significantly to a level slightly above 20%. It moved through a volatile phase till 2015. During this time, their efficiency ranged within 20% to 60%. However, from 2015, following major Government intervention, the efficiency of the company started to rise and finally it achieved efficient status in 2017^[2] which it enjoyed till the end of the study period (Table 4).

1.4. Ageas Federal

Ageas Federal had been incorporated in the year 2007^[21]-08. It had an average efficiency of 60.2% ($OTE=0.602$) with a volatility of 23.2% during the study period. The average efficiency of the company was slightly less than the industry

average ($OTE=0.610$) during the study period. However, it was more volatile as compared to the industry benchmark. On the very first year of its incorporation, it achieved efficient status ($OTE=1$). However, after that, it never achieved efficient status during the study period. After achieving efficient status on the first year of its incorporation, the company witnessed a sharp fall in its efficiency till 2010. The efficiency of the company started to rise after 2010 following a few positive initiatives by the Government in the aftermath of global financial crisis (Table 4).

1.5. Aviva Life

Aviva Life had been incorporated in the year 2002-03. It had an average efficiency of 67.6% ($OTE=0.676$) with a volatility of 31.2% during the study period. It was higher than the industry average ($OTE=0.610$) for the whole period. However, the efficiency of the company was more volatile as compared to the industry as a whole. The company achieved efficient status ($OTE=1$) for the first time in 2012. However, since 2016, Aviva Life was an efficient company in the industry. The company had projected an increasing trend in its productive efficiency during the study. However, in the aftermath of global financial crisis, the efficiency of the company slumped drastically. However, it quickly recovered riding some

positive Government initiatives reaching optimum efficiency in 2016 where it remained till the end of the study period (Table 4).

1.6. Bajaj Allianz

Bajaj Allianz was incorporated in the year 2001-02. It had an average efficiency of 67.2% ($OTE=0.676$) with a volatility of 28.7% during the study period. It was higher than the industry average ($OTE=0.610$) for the full period. However, the volatility in company's efficiency was more volatile as compared to the industry average. While in 2016, the efficiency of the company dropped slightly, it again had become efficient in 2017 and 2018 ^[2, 12]. Since its incorporation, the company projected an increasing trend in its operating efficiency. Though the operating efficiency of the company dropped during global financial crisis, positive initiatives by the Government, reversed the trend and within two years the company achieved efficient status (Table 4).

1.7. Bharti AXA

Bharti AXA was incorporated in the year 2006-07. It had an average efficiency of 41.6% ($OTE=0.416$) with a volatility of 17% during the study period. It was much less than the industry average ($OTE=0.610$) for the entire period. However, the volatility in company's efficiency was also less as compared to the industry average. During the initial years after its incorporation, the company projected an increasing trend in its operating efficiency. However, it dropped during global financial crisis till 2010. While positive initiatives by the Government reversed the trend for a brief period, it again started to decline from 2013. Following the Government's initiatives to raise the FDI cap, the operating efficiency rose for a brief period starting its fall again from 2020 in the backdrop of Covid-19 pandemic (Table 4).

1.8. Canara HSBC OBC

Canara HSBC OBC was incorporated in the year 2008-09. It had an average productive efficiency of 68% ($OTE=0.68$) with a volatility of 25.6% during the study period. The company performed better than the industry average ($OTE=0.610$). However, the efficiency of the company was also more volatile as compared to the industry average. The operating efficiency of the company projected a continuous growth till 2016 after incorporation with a few minor fluctuations. However, since then the operating efficiency of the company was projecting a declining trend probably due to volatilities in the international market and Covid-19 pandemic (Table 4).

1.9. Edelweiss Tokio

Edelweiss Tokio was incorporated in the year 2011-12. It was the latest company to join the industry till 2021 ^[25]. It had an average efficiency of 24.6% ($OTE=0.246$) with a volatility of 12.4% during the study period. It was much less than the industry average ($OTE=0.610$) for the entire study period. However, the efficiency of the company was also less volatile as compared to the industry average. The operating efficiency of the company was initially rising after its incorporation with a minor bump in 2014 ^[8] probably due to the major sell-offs in the life insurance market.

Subsequently, it gradually improved till 2019 when Covid-19 happened which adversely affected the operating efficiency of the company (Table 4).

1.10. Exide Life

Exide Life was incorporated in the year 2001-02. It had an average efficiency of 42.9% ($OTE=0.429$) with a volatility of 14.2% during the study period. The operating efficiency of the company was less than the industry average ($OTE=0.610$). However, the volatility in the operating efficiency was also comparatively less than industry average (18.6%). The company never achieved efficient status during the entire study period. The operating efficiency of the company was initially rising till 2009 with a minor revision in 2007 ^[21]. However, global financial crisis and its aftermath brought the operating efficiency of the company down to some extent. While positive Government initiatives helped the company to regain their operating efficiency till 2014 ^[8]. From 2015, the operating efficiency again began to fall till 2016. However, increased FDI cap provided an additional impetus to the company's efficiency and it increased to some extent. However, recently, the company was projecting a declining efficiency probably due to Covid-19 pandemic. In most of the years during the study period, the efficiency of the company ranged between 40-60% (Table 4).

1.11. Future Generali

Future Generali was incorporated in the year 2007 ^[21]-08. Surprisingly, it also had an average operating efficiency of 42.9% ($OTE=0.429$) with a volatility of 21.9% during the study period. It was less than the industry average ($OTE=0.610$). However, its volatility was also higher compared to the industry average (18.6%). The company obtained efficient status in its operating sphere quickly after its incorporation. However, it witnessed a continuous fall in its efficiency since then. In the aftermath of global financial crisis, positive Government moves helped the company thrive and its operating efficiency rose to almost 60%. Subsequently, it was fluctuating between 40-60% probably due to a few reformatory measures and changing landscapes in the world economy (Table 4).

1.12. HDFC Life

HDFC Life was incorporated in the year 2000-01. It was one of the first private company to have joined the industry. It had an average operating efficiency of 69.8% ($OTE=0.698$) with a volatility of 21.9% during the study period. The company outperformed the industry ($OTE=0.610$) during the study period in terms of operating efficiency. However, the operating efficiency of the company was more volatile as compared to that of the industry average (18.6%). However, it never achieved operating efficiency during the entire study period. Following its incorporation, the operating efficiency had gone up and reached 90% level. However, global financial crisis and resultant volatility spill-over led to its fall to almost 40% till 2010. While the positive initiatives of the Government helped the company to regain its confidence, it had become operationally efficient by the end of 2014. However, uncertainties looming over the market due to

Government policy with respect to FDI, subsequent Covid-19 pandemic led to fall in the efficiency of the company, but not to a significant level (Table 4).

1.13. ICICI Prudential

ICICI Prudential was incorporated in the year 2000-01. Just like HDFC Life, it was also, one of first private entrant of this industry. It had an average operating efficiency of staggering 90.7% ($OTE=0.907$) with a volatility of 16.5% for the entire study period. It was a marginally inefficient company. The operating efficiency of the company was significantly higher than the industry average ($OTE=0.610$). However, it was less volatile as compared to the industry average. From 2007^[21] to 2015, it consistently maintained efficient status. In 2016, operating efficiency of the company fell below 100%. It again achieved efficient status in 2017 which was maintained in 2018^[2, 12] as well. In 2019 and 2020, the company again failed to achieve operating efficiency. In 2021^[25], the company again gained its efficient status back. Within a few years after its incorporation, the company achieved efficient status and it remained efficient till the end of the study period withstanding major economic headwinds (Table 4).

1.14. IndiaFirst

IndiaFirst was incorporated in the year 2009^[23]-10. It had an average operating efficiency of staggering 98.5% ($OTE=0.985$) with a volatility of 2.8% for the entire study period. It was a marginally inefficient company. The operating efficiency of the company was significantly higher than the industry average ($OTE=0.610$). However, it was less volatile as compared to the industry (18.6%). Barring 2018^[12] and 2019, the company had achieved efficiency in all other years (Table 4).

1.15. Kotak Mahindra Life

Kotak Mahindra Life was incorporated in the year 2001-02. It had an average operating efficiency of 58.5% ($OTE=0.585$) with a volatility of 20.5% for the entire study period. The operating efficiency of the company was lower than the industry average ($OTE=0.610$) and it was more volatile as compared to the industry as well. It never achieved efficient status during the study period barring 2012. After the incorporation, the operating efficiency of the company grew till 2008 reaching almost 80% level. However, global financial crisis dragged the operating efficiency of the company down to less than 60%. Reformatory measures from the Government helped the company to become efficient by the end of 2012. However, major sell-offs in the market, led to its decrease to almost 40% by the end of 2015. Since then, till the end of the study period, its operational efficiency had been rising and by the end of the study period, it was at a bit more than 60% level (Table 4).

1.16. Max Life

Max Life was incorporated in the year 2000-01. It was one of first private entrant of this industry. It had an average operating efficiency of 44.3% ($OTE=0.443$) with a volatility of 13.5% for the entire study period. The operating efficiency of the company was much less than the industry

average ($OTE=0.610$). However, it was less volatile as compared to the industry. The company never achieved efficiency during the entire study period. Starting with an operating efficiency of 20%, within a few years, the company had reached 40% level. However, the growth was halted during global financial crisis. From 2010 to 2016, the company's operating efficiency grew to almost 60% level. But it was reversed in post-2016 era and it had again started a declining trend reaching approximately 50% level (Table 4).

1.17. PNB MetLife

PNB MetLife was incorporated in the year 2001-02. It had an average operating efficiency of staggering 42.3% ($OTE=0.423$) with a volatility of 20.6% for the entire study period. The operating efficiency of the company was significantly lower than the industry average ($OTE=0.610$). However, its volatility was more as compared to the industry average (18.6%). Starting with an operating efficiency of less than 20% (2002), the company reached an operating efficiency level of approximately 30% level by the end of 2006 and remained at that level till 2010. However, after 2010, it suddenly increased to almost 80% level. Then it started to fall and it continued till 2016 probably due to post-crisis sell-offs in the market. While rise in FDI helped the operating efficiency to improve (up to 60%) for a brief period, Covid-19 pandemic again dragged it down (Table 4).

1.18. Pramerica

Pramerica was incorporated in the year 2008-09. It had an average operating efficiency of 48.3% ($OTE=0.483$) with a volatility of 28.7% for the entire study period. The operating efficiency of the company was significantly lower than the industry average ($OTE=0.610$). However, its volatility was comparatively more than the industry average. The company was efficient in the year of incorporation. However, it never achieved such status after that. After achieving efficient status, the operational efficiency of the company dropped to almost 15% till the end of 2013 probably due to the setback of global financial crisis. From 2013 to 2018^[19], there had been a sharp rise in the operational efficiency. Following a sudden drop in the subsequent period, it again started to rise due to people's preference towards life insurance in the backdrop of Covid-19 pandemic (Table 4).

1.19. Reliance Nippon Life

Reliance Nippon Life was incorporated in the year 2001-02. It had an average operating efficiency of 53.9% ($OTE=0.539$) with a volatility of 23.2% for the entire study period. The operating efficiency of the company was lower than the industry average ($OTE=0.610$). However, it had high volatility as compared to the industry benchmark. In 2006, the company achieved efficient status. Following its incorporation, the operational efficiency of the company had continuously risen reaching its maximum in 2006. However, global financial crisis dragged it down to less than 40% level at the end of 2010. However, positive reforms by the Government improved the operational efficiency of the company and the rise continued till 2013 (to almost 70% level). However, major sell-offs in the market led to its fall

again till 2016. While announcements of FDI rise in the sector revived the operational efficiency of the company to some extent, in the backdrop of Covid-19, it again started to fall settling currently at around 65% (Table 4).

1.20. Sahara India Life

Sahara India Life was incorporated in the year 2004-05. It had an average operating efficiency of 66.2% ($OTE=0.662$) with a volatility of 24.2% for the entire study period. The operating efficiency of the company and its volatility was slightly higher than the industry average ($OTE=0.610$). After the incorporation, the operational efficiency of the company rose to almost 50% level by the end of 2006 and remained there till 2012. Then there was a steep increase in its operational efficiency till 2014^[8]. But major sell-offs in the market led to its fall for a brief period. The growth in operational efficiency resumed from 2016 and it continued till 2018^[12]. During the Covid-19 phase, the operational efficiency of the company was almost static (Table 4).

1.21. SBI Life

SBI Life was incorporated in the year 2001-02. It had an average operating efficiency of staggering 98.4% ($OTE=0.984$) with a volatility of 3.6% for the entire study period. It was a marginally inefficient company. The operating efficiency of the company was significantly higher than the industry average ($OTE=0.610$). However, it was less volatile as compared to the industry average. In backdrop of global financial crisis, it lost its efficient status. However, in 2011, it regained its efficient status and maintained it till 2015. Once again in 2016, it lost its efficient status but from 2017 it again resumed its operation as an efficient member of the industry that continued till date (Table 4).

1.22. Shriram Life

Shriram Life was incorporated in the year 2005-06. It had an average operating efficiency of 46.6% ($OTE=0.466$) with a volatility of 12.1% for the entire study period. The operating efficiency of the company and its volatility was significantly lower than the industry average ($OTE=0.610$). Following its incorporation in 2005, the company reported a rising operating efficiency till 2008. However, global financial crisis dragged the operating efficiency down to less than 40% in 2010. Though Government initiatives improved the operating efficiency of the company to reach 70% level, major sell-offs in the industry led to a sharp fall to almost 40% level by the end of 2015. While FDI reforms in 2005 led to a reversal in the trend, it was short lived. In the backdrop of Covid-19, by the end of the study period, the operating efficiency started to fall (Table 4).

1.23. Star Union Dai-Ichi

Star Union Dai-Ichi was incorporated in the year 2008-09. It had an average operating efficiency of 55.6% ($OTE=0.556$) with a volatility of 11.9% for the entire study period. The operating efficiency of the company and its volatility was slightly lower than the industry average ($OTE=0.610$). After its incorporation, the operating efficiency of the company rose till 2011 to the extent of 80%. Then it declined to around 50% level till 2014. From 2014 to 2016, it maintained an almost static operating efficiency. In 2016, it jumped to almost 70% level only to come back to its previous position the year after. By the end of the study

period, the company was maintaining a static operating efficiency at around 50% level (Table 4).

1.24. Tata AIA

TATA AIA was incorporated in the year 2001-02. It had an average operating efficiency of 54.4% ($OTE=0.544$) with a volatility of 25.2% for the entire study period. The operating efficiency of the company was lower than the industry average ($OTE=0.610$). However, its volatility was high as compared to the industry average (18.6%). The company achieved efficient status only in 2013 and 2014. Following its incorporation, the operating efficiency of the company rose to almost 50% level in 2008 with a minor reversal in 2005. However, global financial crisis dragged it down to slightly below 40% level. The operating efficiency again started to rise from 2010 and reached almost 100% level by the end of 2015. However, since then it was continuously falling till the end of the study period currently settling at below 40% level (Table 4).

2. Year-wise Analysis

2.1. Year 2001-02

In 2001-02, there were 12 companies in the industry, out of which only two were efficient (LIC and SBI Life) in terms of their operational performance ($OTE=1$). Apart from these two companies ICICI Prudential also reported an operating efficiency which was higher than the industry average ($OTE=0.324$) for that year. Reliance Nippon was the worst performing company in terms of their operating efficiency ($OTE=0.052$) (Table 4).

2.2. Year 2002-03

In 2002-03, with the entry of Aviva Life, there were 13 companies in the industry, out of which only two were efficient (LIC and SBI Life) in terms of their operational performance ($OTE=1$). Apart from these two companies ICICI Prudential also reported an operating efficiency which was higher than the industry average (Industry $OTE=0.353$) for that year. Aviva Life was the worst performing company in terms of their operating efficiency ($OTE=0.045$) (Table 4).

2.3. Year 2003-04

In 2003-04, there were 13 companies in the industry, out of which only two were efficient (LIC and SBI Life) in terms of their operational performance ($OTE=1$). Apart from these two companies, ICICI Prudential and HDFC Life also reported operating efficiencies which were higher than the industry average (Industry $OTE=0.353$) for that year. PNB MetLife was the worst performing company in terms of their operational results ($OTE=0.0176$) (Table 4).

2.4. Year 2004-05

In 2004-05, with the entry of Sahara India Life, there were 14 companies in the industry, out of which only two were efficient (LIC and SBI Life) in terms of their operational performance ($OTE=1$). Apart from these two companies, ICICI Prudential, Kotak Mahindra Life, Aditya Birla Sunlife and Reliance Nippon Life also reported operating efficiencies which were higher than the industry average (Industry $OTE=0.513$) for that year. Sahara India Life was the worst performing company in terms of their operational results ($OTE=0.152$) (Table 4).

2.5. Year 2005-06

In 2005-06, with the entry of Shriram Life, there were 15 companies in the industry, out of which only three were efficient (LIC, Reliance Nippon Life and SBI Life) in terms of their operational performance (OTE=1). Apart from these three companies, Bajaj Allianz Life, HDFC Life, ICICI Prudential, Kotak Mahindra Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.624) for that year. Shriram Life was the worst performing company in terms of their operational results (OTE=0.203) (Table 4).

2.6. Year 2006-07

In 2006-07, with the entry of Bharti AXA Life there were 16 companies in the industry, out of which only three were efficient (LIC, ICICI Prudential and SBI Life) in terms of their operational performance (OTE=1). Apart from these three companies, Bharti AXA Life, HDFC Life, Kotak Mahindra Life, Reliance Nippon Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.647) for that year. PNB MetLife was the worst performing company in terms of their operational results (OTE=0.311) (Table 4).

2.7. Year 2007-08

In 2007-08, with the entry of Aegae Federal Life and Future Generali Life there were 18 companies in the industry, out of which only three were efficient (LIC, Aegae Federal Life and Future Generali Life) in terms of their operational performance (OTE=1). Apart from these three companies, HDFC Life, ICICI Prudential Life, Reliance Nippon Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.642) for that year. PNB MetLife was the worst performing company in terms of their operational results (OTE=0.268) (Table 4).

2.8. Year 2008-09

In 2008-09, with the entry of Aegon Life, Canara HSBC OBC Life, Pramerica Life and Star Union Dai-Ichi Life, there were 22 companies in the industry, out of which only three were efficient (LIC, ICICI Prudential Life and Pramerica Life) in terms of their operational performance (OTE=1). Apart from these three companies, Aegae Federal Life, Aviva Life, Exide Life, HDFC Life, and SBI Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.578) for that year. Canara HSBC OBC Life was the worst performing company in terms of their operational results (OTE=0.168) (Table 4).

2.9. Year 2009-10

In 2009^[23]-10, with the entry of IndiaFirst Life, there were 23 companies in the industry, out of which only three were efficient (LIC, ICICI Prudential Life and IndiaFirst Life) in terms of their operational performance (OTE=1). Apart from these three companies, Aviva Life, Bajaj Allianz Life, Kotak Mahindra Life, Sahara India Life, SBI Life, Shriram Life, and Star Union Dai-Ichi Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.469) for that year. Future Generali Life was the worst performing company in terms of their operational results (OTE=0.104) (Table 4).

2.10. Year 2010-11

In 2010-11, there were 23 companies in the industry, out of which only four were efficient (LIC, ICICI Prudential Life, SBI Life and IndiaFirst Life) in terms of their operational performance (OTE=1). Apart from these three companies, Aviva Life, Bajaj Allianz Life, HDFC Life, Kotak Mahindra Life, PNB MetLife, Shriram Life, and Star Union Dai-Ichi Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.602) for that year. Future Generali Life was the worst performing company in terms of their operational results (OTE=0.186) (Table 4).

2.11. Year 2011-12

In 2011-12, with the entry of Edelweiss Tokio Life, the industry constituted its current structure with 24 members. Out of these 24 companies, only six were efficient (LIC, Aviva Life, ICICI Prudential Life, SBI Life, Kotak Mahindra Life and IndiaFirst Life) in terms of their operational performance (OTE=1). Apart from these six companies, Aditya Birla Sunlife, Canara HSBC OBC Life, PNB MetLife, Shriram Life, Star Union Dai-Ichi Life, and Tata AIA Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.655) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.109) (Table 4).

2.12. Year 2012-13

In 2012-13, out 24 companies, only six were efficient (LIC, Bajaj Allianz, ICICI Prudential Life, SBI Life, Tata AIA Life and IndiaFirst Life) in terms of their operational performance (OTE=1). Apart from these six companies, Aviva Life, Canara HSBC OBC Life, HDFC Life, Kotak Mahindra Life, Reliance Nippon Life, and Sahara India Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.653) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.1) (Table 4).

2.13. Year 2013-14

In 2013-14, out 24 companies, only six were efficient (LIC, Bajaj Allianz, ICICI Prudential Life, SBI Life, Tata AIA Life and IndiaFirst Life) in terms of their operational performance (OTE=1). Apart from these six companies, Aditya Birla Sunlife, Aviva Life, Canara HSBC OBC Life, HDFC Life, and Sahara India Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.661) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.094) (Table 4).

2.14. Year 2014-15

In 2014-15, out 24 companies, only five were efficient (LIC, Bajaj Allianz, ICICI Prudential Life, SBI Life, and IndiaFirst Life) in terms of their operational performance (OTE=1). Apart from these five companies, Aviva Life, Canara HSBC OBC Life, HDFC Life, and Sahara India Life, and Tata AIA Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.639) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.169) (Table 4).

2.15. Year 2015-16

In 2015-16, out 24 companies, only three were efficient (LIC, Aviva Life and IndiaFirst Life) in terms of their operational performance (OTE=1). Apart from these three companies, Aditya Birla Sunlife, Bajaj Allianz Life, Canara HSBC OBC Life, HDFC Life, ICICI Prudential Life, Pramerica Life, Sahara India Life, SBI Life and Tata AIA Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.657) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.232) (Table 4).

2.16. Year 2016-17

In 2016-17, out 24 companies, only seven were efficient (LIC, Aegon Life, Aviva Life, Bajaj Allianz Life, ICICI Prudential Life, SBI Life, and IndiaFirst Life) in terms of their operational performance (OTE=1). Apart from these seven companies, Aditya Birla Sunlife, HDFC Life, Pramerica Life, and Sahara India Life, also reported operating efficiencies which were higher than the industry average (Industry OTE=0.724) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.323) (Table 4).

2.17. Year 2017-18

In 2017-18, out 24 companies, only seven were efficient (LIC, Aegon Life, Aviva Life, Bajaj Allianz Life, ICICI Prudential Life, Sahara India Life and SBI Life) in terms of their operational performance (OTE=1). Apart from these seven companies, Aditya Birla Sunlife, Canara HSBC OBC Life and IndiaFirst Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.738) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.418) (Table 4).

2.18. Year 2018-19

In 2018-19, out 24 companies, only four were efficient (LIC, Aegon Life, Aviva Life, and SBI Life) in terms of their operational performance (OTE=1). Apart from these four companies, Aditya Birla Sunlife, Bajaj Allianz Life, Canara HSBC OBC Life, HDFC Life, IndiaFirst Life, Reliance Nippon Life, and Sahara India Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.694) for that year. Tata AIA Life was the worst performing company in terms of their operational results (OTE=0.395) (Table 4).

2.19. Year 2019-20

In 2019-20, out 24 companies, only five were efficient (LIC, Aegon Life, Aviva Life, IndiaFirst Life and SBI Life) in terms of their operational performance (OTE=1). Apart from these five companies, Aditya Birla Sunlife, Bajaj Allianz Life, HDFC Life, ICICI Prudential Life, and Sahara India Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.701) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.314) (Table 4).

2.20. Year 2020-21

In 2020-21, out 24 companies, only six were efficient (LIC, Aegon Life, Aviva Life, Sahara India Life, ICICI Prudential

Life, and SBI Life) in terms of their operational performance (OTE=1). Apart from these six companies, Aegon Federal Life, HDFC Life, and Reliance Nippon Life also reported operating efficiencies which were higher than the industry average (Industry OTE=0.683) for that year. Edelweiss Tokio Life was the worst performing company in terms of their operational results (OTE=0.287) (Table 4).

Conclusions

This paper observes that the Life Insurance Corporation of India (LIC), the sole public sector company in the industry, demonstrated operational efficiency in every year of the study period. The LIC achieved this feat due to its massive market share in premium mobilization, its substantial investible corpus, and its vast agency network. Conversely, none of the private insurers managed to maintain 100% efficiency throughout the study period; overall, the industry's operational efficiency averaged only 61%. Among the private insurers, SBI Life, ICICI Prudential Life, IndiaFirst Life, HDFC Life, and Canara HSBC OBC Life were found to be marginally inefficient during the study period. These companies could achieve efficiency by minimizing their agency costs or operating expenses. In contrast, Exide Life, Future Generali Life, PNB MetLife, Bharti AXA Life, and Edelweiss Tokio Life were the worst-performing units, remaining operationally inefficient throughout most of the years analysed. Because these companies are unlikely to improve their operational performance in the near future, they may need to amalgamate with more efficient firms to add value to the industry.

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