

Capital Adequacy of Private and Public Life Insurance Companies in India: An Empirical Analysis

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ABSTRACT

After 1999 private players are allowed to enter into the life insurance market. Foreign direct investment in the Life Insurance sector has been increased from 49 % to 74%. LIC the only public life insurer is going towards an initial public offering. Given the aforementioned conditions, the effectiveness and capital sufficiency of Indian life insurance companies must be evaluated.

This study examines the comparative efficiency of capital adequacy of life insurance companies in India.

To judge the efficiency of capital adequacy of life insurance companies in India, 2 methods are followed. One is the traditional method i.e. CAMEL model and another one is the modern method i.e. Data Envelopment analysis.

Levene's test is used to judge the equality of variance. An equality of variance test is required to know whether we used a parametric or non-parametric test. Levene's test shows that there is no homogeneity of variance so the Mann-Whitney U test is used to judge the statistical significance.

According to the study, public and private life insurers' mean capital adequacy differs significantly, with LIC managing capital the most effectively.

KEYWORD: Capital Adequacy, Levene's test, Mann-Whitney U test, LIC, Private insurance companies, DEA.

1. INTRODUCTION

To reduce the risk to life and property insurance is used as a social device. Life Insurance, Insurers safeguard the policyholder against a regular payment termed as a premium. When a policyholder gets a safeguard against non-life i.e. fire, accidents burglary, etc., it is called non-life insurance.

In India, life insurance has a long history that began in the early 1800s. Europeans founded the Oriental Life Insurance firm, India's first life insurance firm, in Calcutta in 1818. However, this firm only provided a restricted range of services to Indians, mostly serving European consumers.

The Indian Life Assurance Companies Act was created in 1870 to regulate the life insurance industry in India. As a result, other Indian life insurance firms were established. The "Bombay Mutual Life Assurance Society" was founded in 1871 and covered the lives of Indians.

FDI on the life insurance sector has been raised to 24%, private insurance companies were given licenses to operate in the Indian market from 2000-2001.

Now there are 24 life insurance companies in India. Only 1 company i.e. Life Insurance Corporation (LIC) of India is the only public sector company and the other 23 are private sector companies.

Efficiency is the ability of a business to provide desired goods or services with the least amount of waste, costs, and resources. When more outputs of a given quality are produced with the same or fewer resource inputs, efficiency is thought to have increased. Greater efficiency is demonstrated by more production per unit of input variables. The insurance business has tried to strengthen its position in the market to run as efficiently as possible in the age of competition.

Capital adequacy is a ratio that indicates insurers' ability to accept the loss. It also considers capital as the main indicator to measure the financial health of the life insurance companies.

1.1. Motivation of the Proposed Study

Almost 40% of the life insurance market in India, is covered by the private sector, and public life insurance is covered by 60%. This share of private life insurance companies is gradually increasing year after year. Common people still believe more in public insurance. But with the sale of stake common people have a doubt in mind regarding the financial efficiency

of the LIC. Therefore, we would like to know if the LIC continues to be more efficient than the other private life insurers or if the public life insurance business loses its efficiency.

1.2. Novelty of the present study

- 1) Public life insurers and 10 private life insurers are considered for the evaluation of efficiency scores.
- 2) In the paper Levene's test has been used to assess whether the variances across different groups are equal or not, a condition known as **homogeneity of variance**. According to the homogeneity of variance, we used a parametric or a non-parametric test to test whether there is any significant difference between the mean capital adequacy of public and private life insurers. In the study, the Mann-Whitney U test is used to test equality.
- 3) Efficiency is measured in both the parameters that is CAMEL model and the DEA model.

2. REVIEW OF LITERATURE

The concepts of various ratios are used numerous times to judge the capital adequacy of life insurance companies in India. More recently some empirical studies have been reviewed which are as follows.

Rohila R. L. (2023) researched to determine the size of the life insurance market in India. ANOVA and the F test were two of the statistical tests utilized in the study, along with CAMEL's framework ratios. The analysis reveals that the earnings and profitability of all the life insurance businesses declined over the study period.

According to research by **Professor Valeed Ansari and Mr. Wugshut Fola (2014)**, private life insurance businesses have much higher mean capital adequacy levels than state life insurance companies.

As stated by **Javed Ahmed Bhat and Showket Ahmed Dar (2015)**. The average capital adequacy level of commercial and state life insurance businesses differs in a way that is statistically significant.

Dr, L. Krishna Veni and Karteek Chedadeepu (2018) show that there is no significant difference between the life insurance companies in capital adequacy

Dr. R. Jayanthi (2019) made an effort to investigate the performance and financial stability of India's Life Insurance Corporation (LIC). Insurance businesses' financial performance is examined using CAMEL criteria

The capital sufficiency of both public and commercial life insurance businesses is examined by **Kumari (2013)**. Numerous metrics, including capital, total assets, and solvency ratios, have been employed for this purpose. According to the study, the Indian life insurance industry's capital adequacy significantly increased following privatization. The primary goal of all of the aforementioned studies is to determine the capital sufficiency of Indian life insurance companies with a comparative perspective over specific periods. Nonetheless, the current analysis focuses on a few chosen life insurance providers from the last ten years.

3. RESEARCH GAP

It has been acknowledged that insurance efficiency is a key factor in modern-day GDP development. To completely comprehend the complex effects of efficiency, on insurance developments, several study gaps still need to be filled despite the field's expanding body of literature. In the various literature reviews, there is no test to find out the homogeneity of variance. Without knowing the equality of variance, the various studies used the parametric test to find out whether there is any significant difference between mean capital adequacy between public and private life insurers.

Most of the studies consider the public and private life insurance companies in a single frame and measure their efficiency. But did not separately measure technical efficiency through the CAMEL model and DEA method.

4. OBJECTIVE OF THE STUDY

- To evaluate the capital adequacy of selected public and private life insurance companies in India.
- To find out whether there is any significant difference between the mean capital adequacy of public and private life insurers.
- To make the DEA to find the efficiency of capital invested in public and private life insurance companies in India.

5. HYPOTHESIS

H₀₁: The capital to total assets ratios of India's state and private life insurance companies do not differ significantly.

H₀₂: The capital-to-mathematical reserve ratios of India's public and private life insurance companies do not differ significantly.

H₀₃: The solvency ratios of India's state and private life insurance companies do not differ significantly.

H₀₄: The capital adequacy of state and private life insurance companies do not differ significantly.

6. RESEARCH METHODOLOGY

6.1. Data source: Secondary Data has been collected for the last 8 years i.e. from 2015-16 to 2022-23 from IRDA

To compare the efficiency of capital adequacy of private sector insurers with that of public sector insurers, a sample of ten private sector life insurance companies was selected from a population of twenty-three private life insurance enterprises in India, as well as the Life Insurance Corporation of India (LIC). Based on the total amount of life insurance premiums received, the top 10 private sector insurance providers are chosen.

- 1) "Life Insurance Corporation of India" (LIC)
- 2) "Aditya Birla Sunlife Insurance Company Ltd." (ABSLIC)
- 3) "Bajaj Allianz Life Insurance Company Ltd" (BALIC)

- 4) “Canara HSBC OBC Life Insurance Company Ltd” (CHOLIC)
- 5) “HDFC Life Insurance Company Ltd” (HDFCLIC)
- 6) “ICICI Prudential Life Insurance Company Ltd” (IPLIC)
- 7) “Kotak Mahindra Life Insurance Ltd” (KMLIC)
- 8) “MaxLife Insurance Company Ltd” (MLIC)
- 9) “PNB Metlife India Insurance Company Ltd” (PNBMLIC)
- 10) “SBI Life Insurance Company Ltd” (SBILIC)
- 11) “TATA AIA Life Insurance Company Ltd” (TATALIC)

6.2. Research Variables: To examine Capital Adequacy and efficiency following ratios have been used. Capital adequacy is judged based on the CAMEL framework. The CAMEL method was proposed by “DAS, Davies, and Podpiera (2003)” in a working paper of the IMF. In the CAMEL model, C stands for Capital Adequacy.

	Variables chosen for study	
Capital adequacy	Core set	Encouraged set
	Capital to Total Assets	Solvency Ratio
	Capital to Mathematical Reserves	

6.3. Capital to total assets indicates the sound financial position of the firm. The bigger ratio indicates that the company has more capital, so the company has a bigger portion of its liabilities.

6.4. Capital to Mathematical Reserves Ratio shows the amount of share capital required to support one unit of the mathematical reserve. Provisions made by an insurer to cover liabilities arising under or in connection with long-term insurance contracts are called Mathematical Reserves.

A lower ratio is good because a lower ratio means a high mathematical reserve and a high reserve indicates a good financial position of the company.

The solvency ratio of an insurance company is its capital relative to all risks it has taken.

The DEA approach was employed in the second step to determine the most effective life insurance. This study's DEA analysis calculates relative efficiency without making any functional form assumptions, which made it impossible to properly compare the inputs used and the outputs generated. The operational traits and efficacy of the aforementioned life insurance businesses from 2015–16 to 2022–23 were highlighted by DEA.

- Input for DEA method = Capital
 - Output for DEA method = Profit after Tax and Net Premium
- Here The formula for share capital is equity plus reserve and surplus.

DATA ANALYSIS

Table 1. Capital Adequacy Indicator

Sl No	Insurer		2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	MEAN	SD	RANK	AVG RANK	COMPARANK
1	LIC	1	0.0003	0.0003	0.0003	0.0003	0.0002	0.0002	0.0002	0.0017	0.0005	0.0005	1	4.3	3
		2	0.0027	0.0025	0.0024	0.0023	0.0024	0.0027	0.0025	0.0098	0.0047	0.0054	1		
		3	1.54	1.55	1.55	1.58	1.58	1.60	1.55	1.76	1.59	0.07	11		
2	ABSLIC	1	0.4312	0.3312	0.2572	0.1964	0.1600	0.1270	0.1092	0.0910	0.2129	0.1116	11	10	11
		2	2.0803	1.3614	1.2009	0.8434	1.0438	0.7175	0.6753	0.4368	1.0449	0.4535	9		
		3	1.86	2.05	2.11	2.00	2.14	1.98	1.78	1.80	1.97	0.13	10		
3	BALIC	1	0.1465	0.1406	0.1531	0.1526	0.1580	0.1555	0.1562	0.1424	0.1506	0.0062	10	7.3	9
		2	1.9873	2.2831	3.2446	3.9439	5.1103	3.4217	3.0784	1.9689	3.1298	0.9461	11		

		3	7.34	7.61	7.93	5.82	5.92	8.04	7.45	6.66	7.10	0.81	1		
4	CHOLIC	1	0.04 54	0.04 43	0.04 77	0.04 36	0.04 19	0.03 76	0.04 40	0.03 23	0.04 21	0.00 46	4	2.6	1
		2	0.59 63	0.80 55	(5.07 98)	0.71 04	0.82 14	0.53 38	3.30 32	0.21 41	0.23 81	2.07 57	2		
		3	3.59	3.16	4.11	4.01	3.82	3.93	3.65	3.27	3.69	0.32	2		
5	HDFCLIC	1	0.09 06	0.08 11	0.08 38	0.07 83	0.07 72	0.07 46	0.07 92	0.07 44	0.07 99	0.00 50	7	6.6	7
		2	0.46 95	0.50 63	0.64 94	0.47 80	0.46 03	0.48 12	0.51 42	0.40 52	0.49 55	0.06 21	4		
		3	1.94	1.96	1.98	1.92	1.92	1.88	1.84	2.01	1.93	0.05	9		
6	IPLIC	1	0.09 00	0.07 38	0.07 09	0.07 07	0.06 79	0.06 11	0.06 41	0.05 97	0.06 98	0.00 89	6	6.3	6
		2	1.69 91	1.42 10	1.43 82	0.88 27	0.86 63	0.59 42	0.46 15	0.61 77	0.99 76	0.40 69	7		
		3	3.72	3.37	3.20	2.81	2.52	2.15	1.94	2.17	2.73	0.61	6		
7	KMLIC	1	0.01 61	0.01 58	0.01 83	0.01 86	0.02 02	0.02 13	0.02 79	0.02 42	0.02 03	0.00 39	2	4.3	3
		2	1.27 21	1.13 59	1.08 99	1.05 94	0.89 06	0.75 29	0.70 27	0.87 74	0.97 26	0.17 47	6		
		3	3.02	3.13	3.11	3.00	3.05	3.02	2.90	2.90	3.02	0.08	5		
8	MLIC	1	0.09 41	0.07 09	0.05 94	0.05 94	0.05 37	0.04 63	0.03 93	0.03 55	0.05 73	0.01 76	5	3.6	2
		2	0.55 94	0.34 31	0.44 68	0.32 51	0.35 58	0.27 97	0.36 72	0.30 19	0.37 24	0.07 99	3		
		3	4.85	4.25	3.43	3.09	2.75	2.42	2.07	2.02	3.11	0.96	3		
9	PNBMLIC	1	0.12 69	0.10 92	0.10 53	0.08 94	0.06 88	0.05 76	0.05 33	0.03 96	0.08 13	0.02 90	8	8.6	10
		2	2.24 27	1.29 42	3.61 38	1.10 31	0.92 51	0.61 85	1.04 52	0.37 44	1.40 21	0.92 64	10		
		3	2.28	2.19	2.11	2.03	2.02	1.97	1.89	1.90	2.05	0.13	8		
10	SBILIC	1	0.08 67	0.08 67	0.08 77	0.08 64	0.08 96	0.09 02	0.09 51	0.08 87	0.08 89	0.00 27	9	7	8
		2	0.56 75	0.66 60	0.70 03	0.64 62	0.91 78	0.81 47	0.77 55	0.63 74	0.71 57	0.09 99	5		
		3	2.28	2.16	2.12	2.04	2.06	2.13	1.95	2.15	2.11	0.09	7		
11	TATAALIC	1	0.05 27	0.04 35	0.04 10	0.03 41	0.02 89	0.02 34	0.02 07	0.01 44	0.03 23	0.01 21	3	4.6	5
		2	1.71 62	1.65 45	1.37 02	1.06 56	0.96 65	0.58 53	0.45 51	0.23 10	1.00 55	0.48 81	8		
		3	4.09	4.17	3.48	3.15	2.93	2.68	2.35	2.04	3.11	0.72	3		
	Total Pvt LIC (Avg)	1	0.11 80	0.09 97	0.09 24	0.08 30	0.07 66	0.06 95	0.06 89	0.06 02	0.08 35	0.01 78			
		2	1.31 90	1.14 71	0.86 74	1.10 58	1.23 58	0.87 99	1.13 78	0.60 65	1.03 74	0.21 93			
		3	3.49 76	3.40 50	3.35 83	2.98 57	2.91 30	3.01 99	2.78 21	2.69 18	3.08 17	0.28 23			

1. "Capital to Total Assets"
2. "Capital to Mathematical Reserve"
3. "Solvency ratio"

It is shown from TABLE 1 that LIC has the lowest capital to Total asset ratio (0.0005) followed by KMLIC (0.0203). However, the Highest ratio is found in ABSLIC (i.e. 0.2129). According to the research, life insurance uses capital more effectively to build a stable asset base because its capital levels are comparatively lower than its assets. So from the study, it is revealed that public life insurance companies are far ahead of private life insurance companies in their financial position.

LIC has the highest CA-to-TA ratio and it has the lowest Standard deviation. It means the performance of LIC is more stable and consistent which is also an indication of a sound financial position for the only public life insurance company. From TABLE 1 it has been observed that LIC has the lowest capital to Math Reserve. Among the private life insurance companies CHOLIC has the lowest capital to mathematical reserve (0.2381). However, BALIC has the highest capital to math reserve which means BALIC has a low reserve to meet sudden claims in unforeseen circumstances.

LIC has the lowest Standard deviation. It means the performance of LIC in Capital to Mathematical Reserve is more stable and consistent which is also an indication of sound financial position for the only public life insurance company.

The solvency ratio of the LIC is just touching the statutory requirement. The statutory requirement of the ratio is 1.50 and the solvency ratio of the only public life insurance company is 1.54. the solvency ratio of the LIC is remained constant during the last eight years.

Whereas in the private life insurance companies BALIC has the highest solvency ratio of 7.10 followed by CHOLIC an average 3.69 solvency ratio.

Though BALIC has the highest solvency ratio it has a high Standard deviation which means the solvency of the firm is not stable and consistent, whereas LIC has a low Standard Deviation which means it has stable and consistent solvency through the last eight years.

Comparing the composite ranking of all the life insurance companies it is found that

CHOLIC has the highest ranking i.e. rank 1, followed by MLIC (rank 2).

The only public life insurance company i.e. LIC is ranked 3 which may be due to its low solvency ratio. Though LIC has the lowest equity share capital i.e. only 100 crore. Whereas ABLIC ranked last (ranked 11) followed by PNB.

Table 2. Descriptive Statistics

variables	Public life Insurance company		Pvt Life Insurance company	
	Mean	S.D	Mean	S.D
Total Capital to Total Asset ratio	0.0005	0.0005	0.0835	0.0178
Capital to Mathematical Reserve ratio	0.0047	0.0054	1.0374	0.2193
Solvency Ratio	1.5892	0.0676	3.0817	0.2823

According to the above data, the average capital to reserve, capital to total assets, and solvency margin for private life insurers are 0.0835, 1.0374, and 3.0817, whereas the corresponding figures for public life insurance companies are 0.0005, 0.0047, and 1.5892.

Table 3. Capital Adequacy determinant variables

	Category	N	Mean	SD	S.E of Mean
Total Capital to Total Asset ratio	public	8	0.0005	0.0005	0.0001
	private	80	0.0835	0.0178	0.0019
Capital to Mathematical Reserve ratio	public	8	0.0047	0.0054	0.0019
	private	80	1.0374	0.2193	0.0245
Solvency Ratio	public	8	1.5892	0.0676	0.0239
	private	80	3.0817	0.2823	0.0315

Table 4. Levene's Test for Equality of Variances

		F	Sig.	
CA to TA	H_0 = Equal variances assumed	15.590	0.001	$P < 0.05$. H_0 rejects and indicates unequal variance
CA to MR	H_0 = Equal variances assumed	19.854	0.001	$P < 0.05$. H_0 rejects and indicates unequal variance
Solvency	H_0 = Equal variances assumed	17.232	0.001	$P < 0.05$. H_0 rejects and indicates unequal variance

We have done Levene's test to determine whether there is equal variance among the 2 sets of data or not. We found that in each case, the p-value is less than 0.05. There is unequal variance. So we go on a Nonparametric test to determine whether the various parameters of capital adequacy differ significantly between public and private life insurance companies or not.

Table 5. Independent-Samples Mann-Whitney U Test Summary

Mann-Whitney U Test for CA to TA ratio		Mann-Whitney U test for CA to MR ratio		Mann-Whitney U Test for Solvency Ratio	
N	16	N	16	N	16
Mann-Whitney U	64.000	Mann-Whitney U	64.000	Mann-Whitney U	64.000
Test Statistic	64.000	Test Statistic	64.000	Test Statistic	64.000
Standard Error	9.522	Standard Error	9.515	Standard Error	9.522

Standardized Test Statistic	3.361	Standardized Test Statistic	3.363	Standardized Test Statistic	3.361
Asymptotic Sig. (2-sided test)	0.001	Asymptotic Sig. (2-sided test)	0.001	Asymptotic Sig. (2-sided test)	0.001
Exact Sig. (2-sided test)	0.000	Exact Sig. (2-sided test)	0.000	Exact Sig. (2-sided test)	0.000

Null Hypothesis	Test	Sig.	Decision
There is no sig difference between the CA to TA ratio in public and private life insurers	Mann-Whitney U Test	0.000	Reject H ₀ .
There is no sig difference between the CA to MR ratio in public and private life insurers	Mann-Whitney U Test	0.000	Reject H ₀ .
There is no sig difference between the solvency ratio in public and private life insurers	Mann-Whitney U Test	0.000	Reject H ₀ .

The null hypothesis (H₀) is rejected since the p-value is less than 0.05, suggesting that the capital-to-solvency ratio, capital-to-mathematical reserve ratio, and capital-to-total assets ratio of public and private life insurance firms differ significantly. Thus, we may say that private and state life insurers have very different mean capital adequacy.

6.1. Data Envelopment Analysis

The CARMEL model is the traditional method for analyzing efficiency. Data Envelopment Analysis is used to measure the insurance efficiency of the 11 life insurers. Data envelopment analysis (DEA) is a linear programming-based technique for measuring the relative performance of organizational units where the presence of multiple inputs and outputs makes comparisons difficult.

- A fraction whose numerator and denominator contain choice factors is nonlinear. Given that we are employing a linear programming approach, we must first linearize the formulation such that the objective function's denominator is 1, and then we must maximize the numerator.
- In DEA models we measure the most efficient decision-making unit and then we put such weights into inputs and in outputs so that each decision-making unit becomes the most efficient DMU.

Input: Capital

Output: PAT (Profit after Tax) and Net premium

Technical efficiency – “CCR model” (Charnes, Cooper, and Rhodes, 1978)

DEA analysis is done based on 2 types of return to scale. One is a Constant return to scale (CRS) and the other one is a variable return to scale (VRS). CRS assumes that the DMU's efficiency and scalability have no meaningful correlation. So, CRS measures the technical efficiency (TE) of the DMUs.

When there is “n” number of DMUs and DMUs used “m” inputs in such that $X_{ij} = (X_{1j}, X_{2j}, \dots, X_{mj})$ to produce “s” outputs such that $Y_{rj} = (Y_{1j}, Y_{2j}, \dots, Y_{sj})^T$.

Assume there is a non-negative scalar λ_j

So possible inputs = $\sum X_{ij}\lambda_j$ and

Possible outputs = $\sum Y_{rj}\lambda_j$.

So the production function

“P” is = $\{(X, Y) \mid X \geq \lambda X, Y \leq \lambda Y, \lambda \geq 0\}$

θ = technical efficiency of a DMU

θ is obtained from the following linear programming

Min θ

Subject to $\theta X_{io} = \sum_{j=1}^n X_{ij}\lambda_j$ where $i = 1, 2, \dots, n$

$Y_{ro} \leq \sum_{j=1}^n Y_{rj}\lambda_j$ where $r = 1, 2, \dots, n$

$\lambda_j \geq 0$ where $j=1, 2, \dots, n$

Table 5. TE (technical efficiency score) based on CRS assumption with CRR model

DMU	TE	RANK
LIC	1.000	1
HDFCLIC	0.124	2
IPLIC	0.122	3
MLIC	0.117	4
KMLIC	0.102	5
SBILIC	0.097	6
CHOLIC	0.060	7
BALIC	0.049	8

ABSLIC	0.046	9
TATAALIC	0.040	10
PNBMLIC	0.024	11

From the final efficiency table, it is found that LIC is the most efficient life insurance company, as its efficiency score is 1, and also LIC is ranked 1st among the other life insurance companies.

After LIC, HDFCLIC and IPLIC ranked 2nd and 3rd respectively. 0.124 and 0.122. However, PNBIC and TAT LIC are ranked last and last but one and also their efficiency score are very low i.e. 0.024 and 0.040.

So the only public life insurance company is most efficient in capital adequacy.

Table 8. Composite Rank Considering Both CARMEL Model & DEA Model

	CARMEL rank	DEA rank	avg rank	comp rank
LIC	3	1	2	1
MLIC	2	4	3	2
CHOLIC	1	7	4	3
KMLIC	3	5	4	3
HDFCLIC	7	2	4.5	5
IPLIC	6	3	4.5	5
SBILIC	8	6	7	7
TATAALIC	5	10	7.5	8
BALIC	9	8	8.5	9
ABSLIC	11	9	10	10
PNBMLIC	10	11	10.5	11

7. FINDINGS

- CHOLIC is found the most efficient life insurer regarding capital adequacy of selected public and private life insurance companies in India under the CARMEL model.
- The mean capital adequacy of commercial life insurers and public life insurance firms differs statistically significantly.
- LIC is the most efficient life insurer regarding capital adequacy under the DEA method. LIC is also ranked 1 under overall capital adequacy followed by MLIC.

8. CONCLUSIONS

1) Examining the capital sufficiency of a few private life insurance firms and a public life insurance company was the aim of this study. The aforementioned survey revealed that, out of all the chosen life insurance firms, the public insurance company came in first. According to Prof. Valeed Ansari and Mr. Wugshut Fola's (2014) research, private life insurance businesses have a much higher mean capital adequacy level than public life insurance companies. The study mentioned above provides some support for this. The aforementioned data shows that the public life insurance company's capital to total assets and capital to reserve category mean is much lower than the private life insurance company's mean.

But in the solvency position private life insurance companies is far ahead of private life insurance companies.

2) According caramel model most efficient life insurance company is CHOLIC followed by MLIC. Both stand 1st and 2nd respectively in the ranking according caramel model.

3) LIC stands 3rd among the 11 life insurance companies in the above category.

4) Public life insurance businesses lag much behind private life insurance firms in the solvency ratio. Therefore, we endorse the research of Showket Ahmed Dar and Javed Ahmed Bhat (2015), which found that due to increased capital infusion over time, private life insurance companies have been able to maintain a sufficient level of capital base, which has allowed them to maintain a solvency margin above the IRDA-mandated threshold.

5) The results of statistical testing indicate that public and private life insurance firms differ significantly in terms of capital sufficiency. In the Solvency ratio, public life insurance companies are far behind private life insurance companies. So we support the study of Showket Ahmed Dar and Javed Ahmed Bhat (2015), Which revealed that private life insurance companies have been able to maintain a sufficient level of capital base due to more capital infusion over some time which in turn enabled them to maintain solvency margin above the required as prescribed by IRDA.

6) In statistical tests it is found that there is a significant difference in capital adequacy between public life insurance companies and private life insurance companies.

Therefore, this analysis does not corroborate the findings of Dr. L. Krishna Veni and KarteeK Chedadeepu's (2018) study, which found no discernible differences in capital adequacy amongst life insurance firms.

7) But when we used modern techniques of efficiency measurement i.e. DEA then we found that Life Insurance Company has ranked 1st among all the life insurance companies and its efficiency score is 1. And all the other private life insurance companies are far behind the LIC.

8) According to DEA it is found HDFCLIC Company ranked 2nd and IPLIC stood 3rd among the life insurance companies.

- 9) That means the above life insurance companies i.e. LIC, HDFCLIC, and IPLIC worked more efficiently than all the other life insurance companies. However PAT is more in all these life insurance companies.
- 10) In composite ranking LIC has ranked top among all the life insurance firms.

9. RECOMMENDATION

Private life insurance firms must increase their capital adequacy, particularly ABSLIC, BALIC, and PNB LIC. ABSLIC and PNB LIC must also increase the sufficiency of their capital. because their capital to total assets and capital to math reserve mean values are quite high. In terms of chronological order, PNB LIC and ABSLIC were ranked 10th and 11th, respectively. This indicates that the three private life insurance businesses mentioned above rely heavily on capital and use it inefficiently to build assets.

Capital adequacy may be improved by improving all three 3 ratios, But in capital to total assets and capital to mathematical reserve, LIC ranked 1st but LIC is far behind in solvency ratio. So solvency ratio of the LIC must be improved.

ABSLIC and PNB LIC also give importance to their efficiency level. They have to improve their efficiency by increasing PAT. PAT may be increased by reducing operating expenses and commission expenses.

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