

# Relative Efficiency Analysis of Selected Life Insurers in India using Data Envelopment Analysis

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## Abstract

To measure the relative performance efficiency of the selected life insurance companies in India individually, year wise, sector wise and as a whole, a linear programming non parametric technique of Data Envelopment Analysis (DEA) has been used in this study. DEA is typically used to measure the technical efficiency (TE) between 0 to 1 ranges. This study utilizes two inputs and two outputs, namely, commission paid and operating expenses as well as premium and net benefit respectively. This study is focused upon top 13 life insurance companies of India including 1 public sector and remaining 12 private sector covering a period of 10 years from 2002-03 to 2011-12. Since this study attempts to maximise output, so output oriented DEA is used. The results of the study shows that overall life insurers carrying life insurance business at an average technical efficiency of 82.6%, pure technical efficiency of 87.5% and scale efficiency of 94.7%. On the other hand individually and sector wise performance analysis, LIC (Life Insurance Corporation of India) performs better as compared to others.

## Keywords:

Efficiency, DEA, Technical Efficiency, Pure Technical Efficiency, Scale Efficiency. **JEL Classification:** G22, G23.

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## Introduction

The primary function of insurance is to act as a risk transfer mechanism to provide peace of mind and protect against losses. Insurance schemes utilize the combination method by persuading a large number of individuals to pool their risks into a large group to minimize overall risk. In the developed world, insurance is part of society such that some forms of cover are required by law. In developing countries like India, the need for such a safety net is much greater, particularly at the poorest levels where vulnerability to risks is much greater and there are fewer opportunities available to recover from a large loss. Therefore, in the developing countries which are characterized as having low-income levels, and lacking access to social security systems, healthcare, and education, sanitation, and employment opportunities, the need for insurance as a risk transfer mechanism is even more imperative. With the recommendation of Malhotra Committee in 1994 on life insurance business in India, expansion of private and foreign life insurance companies were gradually increased. The IRDA also began enforcing uniform rules and regulations and allowed the emergence of private life insurers to operate simultaneously with the public sector to maintain a healthy competitive environment in the life insurance business. It has been observed that in many cases public sector insurer lags behind the private sector insurers in terms of

quality of customer services and cost control mechanism. So measurement of life insurers' efficiency is very relevant in this transition. In this backdrop, an attempt has been made in this study to evaluate the relative performance efficiency of the selected public and private sector life insurers in India.

### Review of Literature

Various studies related directly or indirectly to the objectives of the present study have been reviewed. Charnes, Cooper and Rhodes (1978) provided with a nonlinear programming model which has given a new definition of efficiency with reference to observational data for multi-input and multi-output. Praetz (1980) has explored the average cost relationship between life insurers and each of ten insurer characteristics on 90 insurers with more than half the life insurance in force with U.S. insurers. The study reveals that the following independent variables are significant in producing economies of scale, premium income, new business ratio, proportion of whole life business, and size of insurer. Weiss (1986) concluded that applicability of the output and productivity measurement methodologies developed is not limited to the specific insurers studied, but rather can be used as a guide in measuring the productivity of any life insurer. Fukuyama (1997) investigated the productive efficiency and productive changes of Japanese life insurance companies and reveals mutual and stock companies possess identical technologies, but the productive efficiency and productive performance changes from time to time in the case of stock and mutual under different economic conditions. Cummins and Misas (2001) analysed the causes and effects of consolidation in Spanish insurance industry and showed that many small, inefficient, and financially under-performing firms were eliminated from the market due to insolvency or liquidation and those acquirers in the mergers and acquisitions market prefer relatively efficient target firms. Boonyasai, Grace and Skipper (2002) examined the impact of liberalization and deregulation of four life insurance markets and found that liberalization and deregulation of the Korean and Philippine life insurance industries seem to have stimulated increases and improvements in productivity whereas liberalization of the Taiwanese and Thai life insurance industries seems to have had little effect on increases and improvements in productivity. Cummins, Weiss and Zi (2003) provided the evidence for the existence of weak economies of scope in the U.S. insurance industry and also that strategic focus appears to be a better strategy. Chang (2006) concluded that both return on assets and sign of profitability influence a heavier financial ratio as well as operating index on performance. Bikker and Leuvensteijn (2008) have examined the competitive nature of Dutch life insurance industry and provided that limited competition in Dutch life insurance industry as compared to Netherlands. Eling and Luhn (2010) provided an overview on frontier efficiency measurement in the insurance industry and shown that there is a broad consensus with regard to the choice of methodology and input factors, the difference lies in case of in output measurement.

No research has been undertaken particularly in India to compare public sector life insurance company i.e. LIC with the private sector life insurance companies in terms of performance evaluation using DEA methodology. Even in this direction, the efforts are found fragmented. The present research seeks to fill this gap.

### Objectives of the Study

This study has the following specific objectives:

- a. To evaluate the relative performance efficiency of selected life insurance companies of their life insurance business.
- b. To determine the improvement space and improvement direction in order to render the inefficient company to be efficient.

### Data Source and Methodology

The data of the selected top 13 life insurers for the period 2002-03 to 2011-12 used in this study have been collected from the secondary sources i.e. year wise annual reports of IRDA. The base year is taken as 2002-03. The basic reason behind the selection of base year as 2002-03 lies in the fact that, this is the exclusive year in which maximum numbers of life insurance companies are operating in insurance industry and started extension of insurance business in India under their existing network of service and their availability of data. The companies under the scope of study include, Aviva Life Insurance Co. Ltd. (AVIVA), Bajaj Allianz Life Insurance Co. Ltd. (BAJAJ), Birla Sun Life Insurance Co. Ltd. (BIRLA), HDFC Standard Life Insurance Co. Ltd. (HDFC), ICICI Prudential Life Insurance Co. Ltd. (ICICI), ING Vysya Life Insurance Co. Ltd. (ING VYS), Kotak Mahindra Old Mutual Life Insurance Co. Ltd. (KOTAK), Life Insurance Corporation of India (LIC), Max Life Insurance Co. Ltd. (MAX LIFE), Met Life India Insurance Co. Ltd. (METLIFE), Reliance Life Insurance Co. Ltd. (RELIANCE), SBI Life Insurance Co. Ltd. (SBI LIFE), TATAAIG Life Insurance Co. Ltd. (TATA AIG). For analyzing data a non-parametric linear programming (LP) method, Data Envelopment Analysis (DEA) has been used. The most common methods of comparison or performance evaluation were regression analysis and stochastic frontier analysis. These measures are often inadequate due to the multiple inputs and outputs related to different resources, activities and environmental factors. DEA provides a means of calculating apparent efficiency levels within a group of or organizations. In DEA study, efficiency of an organization or DMU (decision making unit) is calculated relative to the group's observed best practice. DEA evaluates the input consumed and output produced by DMUs and identifies those units that comprise an efficient frontier and lie below this frontier. The standard DEA models have an input and output orientation. An input orientation identifies the efficient consumption of resources while holding output constant. An output orientation identifies the efficient level of output given existing resource consumption. The output orientation provides estimates of the amount by which output could be proportionally expanded given existing input levels. Two basic Data Envelopment Analysis (DEA) models namely; Charnes–Cooper–Rhodes (CCR) model for constant return to scale (CRS) and Banker–Charnes–Cooper (BCC) model for variable return to scale (VRS) have been applied to estimate the relative efficiency of the selected life insurance companies for the study period.

Scale efficiency is calculated as follows:

Scale Efficiency (SE) = (TE obtained from CRS/TE obtained from VRS)

This study has used output-oriented DEA model, which emphasized on the maximization of outputs and the inputs are held at their current levels. In this study input vector includes

commission paid and operating expenses; and output vector includes premium income and net benefit. To determine the DEA result *DEA Analyst* software has been used in this study.

### Empirical Results and Interpretation

**Analysis on Technical Efficiency, Pure Technical Efficiency and Scale Efficiency:** The analysis of TE, PTE and SE of life insurers has done by two ways: Company wise analysis and Year wise analysis.

**A. Company wise analysis:** This has been done to arrive at conclusive findings of TE, PTE and SE of life insurance business of selected insurance companies in India during the period under consideration. In other words the effort has been made to find out individually i.e. which of the company lie on the frontier and which are away from the frontier.

Table 1 has shown that Life Insurance Corporation of India (LIC) is the fully efficient company during 5 out of 10 years of period under consideration. Its efficiency remains static during 2006-07 to 2008-09 thereafter its efficiency score shows decreasing trend for the period 2009-10 which might be attributable to the fact that the company has achieved the level of maturity and due to competition its position is gradually acquired by private sector life

insurance companies but after that again up to the last year of the study period it shows its static or optimum performance. On the other hand the study shows that there are three inefficient life insurance companies of private sector group and they lie on the frontier for a single year. ICICI Prudential Life Insurance Co. Ltd., Kotak Mahindra Old Mutual Life Insurance Co. Ltd and TATA AIG Life Insurance Co. Ltd. are the most inefficient companies as their efficiency score were equal to 1 only for a single year of the study period. But if we compare these three inefficient companies with others, it will provide insight that although these three private sector life insurance companies do not lie on the frontier more than a single time, yet their efficiency scores improve over a period of time. Whereas Birla Sun Life Insurance Co. Ltd. and Reliance Life Insurance Co. Ltd. show the reverse trend in most of the time period under consideration. This table also shows that only public sector company i.e. LIC shows a consistent performance throughout the study period although sometimes market has taken over by the selected private sector companies with regard to life insurance business in India. This can be regarded as good sign for LIC because even increasing competition in the market, public sector company i.e. LIC enhances the product choice for consumers with efficient quality of services.

Table 1 shows the Company wise Performance Analysis of TE, PTE and SE

Aviva Life Insurance Co. Ltd.					Bajaj Allianz Life Insurance Co. Ltd.				
Years	TE	PTE	SE	RTS	Years	TE	PTE	SE	RTS
2003	0.248	1.000	0.248	Increasing	2003	0.289	1.000	0.289	Increasing
2004	0.199	0.336	0.591	Increasing	2004	0.280	0.433	0.646	Increasing
2005	0.428	0.576	0.743	Increasing	2005	0.725	0.874	0.830	Increasing
2006	0.571	0.639	0.893	Increasing	2006	0.999	1.000	0.999	Increasing
2007	0.651	0.670	0.971	Increasing	2007	0.773	0.773	1.000	Increasing
2008	0.685	0.783	0.875	Decreasing	2008	0.753	0.852	0.884	Decreasing
2009	0.624	0.825	0.757	Decreasing	2009	0.879	0.930	0.944	Decreasing
2010	0.812	0.984	0.825	Decreasing	2010	1.000	1.000	1.000	Constant
2011	1.000	1.000	1.000	Constant	2011	1.000	1.000	1.000	Constant
2012	1.000	1.000	1.000	Constant	2012	1.000	1.000	1.000	Constant
Birla Sun Life Insurance Co. Ltd.					HDFC Standard Life Insurance Co. Ltd.				
Years	TE	PTE	SE	RTS	Years	TE	PTE	SE	RTS
2003	0.330	1.000	0.330	Increasing	2003	0.399	1.000	0.399	Increasing
2004	0.753	0.947	0.775	Increasing	2004	0.425	0.768	0.554	Increasing
2005	1.000	1.000	1.000	Constant	2005	0.497	0.585	0.851	Increasing
2006	1.000	1.000	1.000	Constant	2006	0.691	0.749	0.923	Increasing
2007	0.930	0.937	0.992	Decreasing	2007	0.740	0.769	0.962	Increasing
2008	0.966	0.990	0.976	Decreasing	2008	0.745	0.754	0.989	Increasing
2009	0.742	0.777	0.955	Decreasing	2009	0.694	0.696	0.997	Increasing
2010	0.840	0.935	0.898	Decreasing	2010	0.719	0.731	0.984	Decreasing
2011	0.966	0.974	0.992	Decreasing	2011	1.000	1.000	1.000	Constant
2012	1.000	1.000	1.000	Constant	2012	1.000	1.000	1.000	Constant
ICICI Prudential Life Insurance Co. Ltd.					ING Vysya Life Insurance Co. Ltd.				
Years	TE	PTE	SE	RTS	Years	TE	PTE	SE	RTS
2003	0.347	1.000	0.347	Increasing	2003	0.241	1.000	0.241	Increasing
2004	0.408	0.668	0.611	Increasing	2004	0.326	0.481	0.679	Increasing
2005	0.627	0.812	0.772	Increasing	2005	0.658	0.910	0.723	Increasing
2006	0.720	0.821	0.877	Increasing	2006	0.574	0.678	0.846	Increasing
2007	0.636	0.653	0.973	Increasing	2007	0.663	0.711	0.932	Increasing
2008	0.568	0.758	0.749	Decreasing	2008	0.817	0.833	0.980	Increasing
2009	0.688	0.859	0.801	Decreasing	2009	0.961	0.964	0.996	Increasing
2010	0.860	0.925	0.930	Decreasing	2010	1.000	1.000	1.000	Constant
2011	1.000	1.000	1.000	Constant	2011	1.000	1.000	1.000	Constant
2012	0.870	0.877	0.992	Increasing	2012	1.000	1.000	1.000	Constant

Kotak Mahindra Old Mutual Life Insurance Co. Ltd.					Life Insurance Corporation of India				
Years	TE	PTE	SE	RTS	Years	TE	PTE	SE	RTS
2003	0.202	1.000	0.202	Increasing	2003	0.698	1.000	0.698	Increasing
2004	0.317	0.620	0.511	Increasing	2004	0.704	0.909	0.774	Increasing
2005	0.791	1.000	0.791	Increasing	2005	0.769	0.933	0.823	Increasing
2006	0.876	1.000	0.876	Increasing	2006	0.834	0.964	0.865	Increasing
2007	0.763	0.805	0.948	Increasing	2007	1.000	1.000	1.000	Constant
2008	0.752	0.761	0.988	Increasing	2008	1.000	1.000	1.000	Constant
2009	0.728	0.787	0.924	Decreasing	2009	1.000	1.000	1.000	Constant
2010	0.944	0.967	0.976	Decreasing	2010	0.988	1.000	0.988	Decreasing
2011	0.969	1.000	0.969	Decreasing	2011	1.000	1.000	1.000	Constant
2012	1.000	1.000	1.000	Constant	2012	1.000	1.000	1.000	Constant
Max Life Insurance Co. Ltd.					Met Life India Insurance Co. Ltd.				
Years	TE	PTE	SE	RTS	Years	TE	PTE	SE	RTS
2003	0.453	1.000	0.453	Increasing	2003	0.165	1.000	0.165	Increasing
2004	0.463	0.626	0.739	Increasing	2004	0.149	0.358	0.416	Increasing
2005	0.550	0.650	0.847	Increasing	2005	0.196	0.249	0.788	Increasing
2006	0.525	0.584	0.899	Increasing	2006	0.264	0.305	0.866	Increasing
2007	0.594	0.650	0.914	Increasing	2007	0.440	0.476	0.924	Increasing
2008	0.638	0.645	0.989	Increasing	2008	0.563	0.572	0.984	Increasing
2009	0.854	0.855	0.998	Increasing	2009	0.653	0.746	0.876	Decreasing
2010	1.000	1.000	1.000	Constant	2010	0.770	0.947	0.813	Decreasing
2011	0.961	0.968	0.993	Decreasing	2011	1.000	1.000	1.000	Constant
2012	1.000	1.000	1.000	Constant	2012	1.000	1.000	1.000	Constant
Reliance Life Insurance Co. Ltd.					SBI Life Insurance Co. Ltd.				
Years	TE	PTE	SE	RTS	Years	TE	PTE	SE	RTS
2003	0.248	1.000	0.248	Increasing	2003	1.000	1.000	1.000	Constant
2004	0.363	0.475	0.764	Increasing	2004	0.783	0.856	0.914	Decreasing
2005	0.865	0.942	0.919	Increasing	2005	0.868	0.975	0.890	Decreasing
2006	1.000	1.000	1.000	Constant	2006	0.587	0.602	0.975	Decreasing
2007	0.715	0.726	0.985	Decreasing	2007	0.677	0.696	0.973	Increasing
2008	0.800	0.805	0.994	Decreasing	2008	0.815	0.826	0.986	Increasing
2009	0.598	0.748	0.800	Decreasing	2009	0.819	0.826	0.992	Increasing
2010	0.940	1.000	0.940	Decreasing	2010	1.000	1.000	1.000	Constant
2011	0.980	1.000	0.980	Decreasing	2011	1.000	1.000	1.000	Constant
2012	1.000	1.000	1.000	Constant	2012	1.000	1.000	1.000	Constant
TATA AIG Life Insurance Co. Ltd.									
Years	TE	PTE	SE	RTS					
2003	0.268	1.000	0.268	Increasing					
2004	0.461	0.738	0.626	Increasing					
2005	0.526	0.649	0.810	Increasing					
2006	0.634	0.711	0.892	Increasing					
2007	0.802	0.867	0.925	Increasing					
2008	0.610	0.613	0.995	Increasing					
2009	0.537	0.693	0.775	Decreasing					
2010	0.713	0.877	0.813	Decreasing					
2011	0.889	1.000	0.889	Decreasing					
2012	1.000	1.000	1.000	Constant					

[Source: Collected and computed from year wise annual reports of IRDA]

**B. Year wise analysis:** Table 2 shows that the year wise efficiencies of various selected life insurance companies in India under consideration i.e. the effort has been made to find out the year in which the maximum number of life insurance companies lie on the frontier with efficiency score equal to 1 or no one company lies on the frontier. In all the years of the study period public sector company i.e. LIC is found on the frontier. Among the private sector

life insurance companies SBI Life Insurance Co. Ltd. and ICICI Prudential Life Insurance Co. Ltd. are found most efficient because they are on the frontier during most of the time period. Most of the selected companies are found efficient in the year 2008, 2009, 2010 and 2011 as there are no reverse trends of return to scale (RTS) during those periods.

Table 2 shows Year wise Performance Analysis of TE, PTE and SE

2003				2004					
DMUs	TE	PTE	SE	RTS	DMUs	TE	PTE	SE	RTS
AVIVA	0.166	0.180	0.921	Decreasing	AVIVA	0.195	0.243	0.801	Decreasing
BAJAJ	0.257	0.369	0.698	Decreasing	BAJAJ	0.286	0.326	0.876	Decreasing
BIRLA	0.305	0.385	0.791	Decreasing	BIRLA	0.518	0.551	0.935	Decreasing
HDFC	0.438	0.556	0.788	Decreasing	HDFC	0.510	0.544	0.937	Decreasing
ICICI	0.559	0.900	0.621	Decreasing	ICICI	0.661	0.922	0.717	Decreasing
ING VYS	0.108	0.173	0.627	Decreasing	ING VYS	0.210	0.259	0.810	Decreasing
KOTAK	0.188	0.299	0.631	Decreasing	KOTAK	0.384	0.452	0.849	Decreasing
LIC	1.000	1.000	1.000	Constant	LIC	1.000	1.000	1.000	Constant
MAX LIFE	0.224	0.380	0.590	Decreasing	MAX LIFE	0.284	0.381	0.744	Decreasing
METLIFE	0.122	1.000	0.122	Increasing	METLIFE	0.178	1.000	0.178	Increasing
RELIANCE	0.100	0.818	0.122	Increasing	RELIANCE	0.237	1.000	0.237	Increasing
SBI LIFE	1.000	1.000	1.000	Constant	SBI LIFE	1.000	1.000	1.000	Constant
TATA AIG	0.288	0.380	0.758	Decreasing	TATA AIG	0.389	0.438	0.889	Decreasing
2005				2006					
DMUs	TE	PTE	SE	RTS	DMUs	TE	PTE	SE	RTS
AVIVA	0.293	0.298	0.984	Increasing	AVIVA	0.386	0.387	0.997	Decreasing
BAJAJ	0.504	0.547	0.920	Increasing	BAJAJ	0.674	0.675	0.998	Decreasing
BIRLA	0.532	0.661	0.804	Increasing	BIRLA	0.572	0.593	0.964	Increasing
HDFC	0.497	0.574	0.866	Decreasing	HDFC	0.844	0.858	0.984	Decreasing
ICICI	0.775	0.964	0.804	Decreasing	ICICI	0.990	1.000	0.990	Decreasing
ING VYS	0.409	0.417	0.980	Decreasing	ING VYS	0.398	0.399	0.999	Decreasing
KOTAK	0.666	0.884	0.754	Increasing	KOTAK	0.711	1.000	0.711	Increasing
LIC	1.000	1.000	1.000	Constant	LIC	1.000	1.000	1.000	Constant
MAX LIFE	0.304	0.376	0.810	Decreasing	MAX LIFE	0.387	0.389	0.994	Decreasing
METLIFE	0.219	0.271	0.808	Increasing	METLIFE	0.329	0.329	0.999	Decreasing
RELIANCE	0.527	1.000	0.527	Increasing	RELIANCE	1.000	1.000	1.000	Constant
SBI LIFE	1.000	1.000	1.000	Constant	SBI LIFE	1.000	1.000	1.000	Constant
TATA AIG	0.347	0.355	0.976	Decreasing	TATA AIG	0.439	0.440	0.997	Decreasing
2007				2008					
DMUs	TE	PTE	SE	RTS	DMUs	TE	PTE	SE	RTS
AVIVA	0.427	0.436	0.980	Increasing	AVIVA	0.526	0.607	0.866	Increasing
BAJAJ	0.393	0.397	0.990	Decreasing	BAJAJ	0.410	0.412	0.996	Increasing
BIRLA	0.588	0.592	0.993	Increasing	BIRLA	0.603	0.644	0.936	Increasing
HDFC	0.904	0.912	0.992	Increasing	HDFC	0.841	0.892	0.943	Increasing
ICICI	1.000	1.000	1.000	Constant	ICICI	1.000	1.000	1.000	Constant
ING VYS	0.499	0.586	0.852	Increasing	ING VYS	0.657	1.000	0.657	Increasing
KOTAK	0.822	1.000	0.822	Increasing	KOTAK	0.665	1.000	0.665	Increasing
LIC	1.000	1.000	1.000	Constant	LIC	1.000	1.000	1.000	Constant
MAX LIFE	0.438	0.439	0.998	Increasing	MAX LIFE	0.436	0.453	0.962	Increasing
METLIFE	0.313	1.000	0.313	Increasing	METLIFE	0.273	0.486	0.562	Increasing
RELIANCE	0.676	0.782	0.864	Increasing	RELIANCE	0.667	0.735	0.908	Increasing
SBI LIFE	1.000	1.000	1.000	Constant	SBI LIFE	0.972	1.000	0.972	Increasing
TATA AIG	0.478	0.482	0.991	Increasing	TATA AIG	0.541	0.618	0.876	Increasing
2009				2010					
DMUs	TE	PTE	SE	RTS	DMUs	TE	PTE	SE	RTS
AVIVA	0.598	0.822	0.727	Increasing	AVIVA	0.548	0.849	0.646	Increasing
BAJAJ	0.577	0.587	0.984	Increasing	BAJAJ	0.643	0.667	0.965	Increasing
BIRLA	0.495	0.526	0.940	Increasing	BIRLA	0.504	0.542	0.931	Increasing
HDFC	0.597	0.628	0.951	Increasing	HDFC	0.599	0.633	0.945	Increasing
ICICI	1.000	1.000	1.000	Constant	ICICI	1.000	1.000	1.000	Constant
ING VYS	0.596	1.000	0.596	Increasing	ING VYS	0.524	1.000	0.524	Increasing
KOTAK	0.536	0.673	0.796	Increasing	KOTAK	0.703	1.000	0.703	Increasing
LIC	1.000	1.000	1.000	Constant	LIC	1.000	1.000	1.000	Constant
MAX LIFE	0.449	0.477	0.940	Increasing	MAX LIFE	0.464	0.495	0.938	Increasing
METLIFE	0.325	0.367	0.887	Increasing	METLIFE	0.428	0.530	0.807	Increasing
RELIANCE	0.403	0.411	0.982	Increasing	RELIANCE	0.494	0.516	0.958	Increasing
SBI LIFE	0.931	1.000	0.931	Increasing	SBI LIFE	1.000	1.000	1.000	Constant
TATA AIG	0.522	0.611	0.855	Increasing	TATA AIG	0.494	0.570	0.868	Increasing
2011				2012					
DMUs	TE	PTE	SE	RTS	DMUs	TE	PTE	SE	RTS
AVIVA	0.728	1.000	0.728	Increasing	AVIVA	1.000	1.000	1.000	Constant
BAJAJ	0.637	0.673	0.946	Increasing	BAJAJ	1.000	1.000	1.000	Constant
BIRLA	0.529	0.560	0.944	Increasing	BIRLA	0.708	0.730	0.970	Decreasing
HDFC	0.672	0.689	0.976	Increasing	HDFC	0.695	0.731	0.952	Decreasing
ICICI	1.000	1.000	1.000	Constant	ICICI	1.000	1.000	1.000	Constant
ING VYS	0.418	1.000	0.418	Increasing	ING VYS	0.496	1.000	0.496	Increasing
KOTAK	0.717	1.000	0.717	Increasing	KOTAK	1.000	1.000	1.000	Constant
LIC	1.000	1.000	1.000	Constant	LIC	1.000	1.000	1.000	Constant
MAX LIFE	0.418	0.424	0.986	Increasing	MAX LIFE	0.434	0.457	0.951	Decreasing
METLIFE	0.901	1.000	0.901	Increasing	METLIFE	0.865	0.906	0.955	Increasing
RELIANCE	0.463	0.470	0.984	Increasing	RELIANCE	0.565	0.570	0.992	Decreasing
SBI LIFE	1.000	1.000	1.000	Constant	SBI LIFE	1.000	1.000	1.000	Constant
TATA AIG	0.515	0.587	0.877	Increasing	TATA AIG	0.976	0.985	0.991	Decreasing

[Source: Collected and computed from year wise annual reports of IRDA]

**Analysis of Mean of Technical, Pure Technical and Scale Efficiency:** The analysis of mean of TE, PTE and SE has shown by two ways: **A.** Sector wise analysis; and **B.** Overall analysis.

**A. Sector wise analysis:** According to the background of the life insurers in India it can be separated in two groups: **1)** Public Sector Insurers; **2)** Private Sector Insurers. In the sector wise analysis efforts has been made to evaluate the mean of technical efficiency, pure technical efficiency and scale efficiency of public sector as well as of private sector for the period under consideration.

From Table 3, the mean of TE of selected private sector life insurance companies have shown increasing trends over a period of time as it is 0.313 in the year 2002-03 which increases to 0.812 in the year 2011-12 except the year 2006-07 and 2008-09 in which there is found slightly decrease in mean TE, which might be attributable to change in the economies of scale. As far as the mean

of TE of public sector insurance company i.e. LIC is concerned it is found that it follows the static or optimum trend over a period of time.

Whereas the mean PTE is concerned, the private sector life insurers have shown the diverse trends over a period of time. The mean of PTE of private sector is 0.537 in the year 2002-03 which increases to 0.865 in the year 2011-12. But they show the reduced value of 0.675 in the year 2008-09. As far as the public sector is concerned it remains static throughout the study period. The mean of scale efficiencies of private and public sector is reverse to each other. The mean of scale efficiency of public sector is static over a period of time. On the other hand the mean of scale efficiency of private sector is found 0.639 in the year 2002-03 to 0.942 in the year 2011-12.

**Table 3 shows the Group wise Performance Analysis of mean of TE, PTE and SE**

Years	Groups	Mean TE	Mean PTE	Mean SE
2003	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.313	0.537	0.639
2004	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.404	0.593	0.748
2005	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.506	0.612	0.853
2006	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.644	0.673	0.970
2007	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.628	0.719	0.900
2008	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.633	0.737	0.862
2009	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.586	0.675	0.882
2010	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.617	0.733	0.857
2011	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.666	0.784	0.873
2012	PUBLIC	1.000	1.000	1.000
	PRIVATE	0.812	0.865	0.942

[Source: Collected and computed from year wise annual reports of IRDA]

**B. Overall analysis:** To measure the overall performance analysis, the mean of TE, PTE and SE are computed to know the year in

which they are found highest as against the period for all the select life insurers as a whole.

**Table 4 shows Overall Performance Analysis of mean of TE, PTE and SE**

Years	Company	Mean TE	Mean PTE	Mean SE
2003	All select Insurers	0.366	0.572	0.667
2004	All select Insurers	0.450	0.625	0.767
2005	All select Insurers	0.544	0.642	0.864
2006	All select Insurers	0.672	0.698	0.972
2007	All select Insurers	0.657	0.740	0.907
2008	All select Insurers	0.661	0.757	0.873
2009	All select Insurers	0.618	0.700	0.891
2010	All select Insurers	0.646	0.754	0.868
2011	All select Insurers	0.692	0.800	0.883
2012	All select Insurers	0.826	0.875	0.947

[Source: Collected and computed from year wise annual reports of IRDA]

The table 4 shows that there is an increasing trend in mean technical efficiency, which can be attributable to increase in PTE and SE. For the purpose of overall performance analysis we have classified the mean efficiency scores into 0-0.6, 0.6-0.9 and 0.9-1 and thereafter the comparison of all the life insurers have been made with respect to their efficiency scores in order to find out the range within which they lie. By following the same we found that only in the year 2002-03, 2003-04 and 2004-05 the mean TE and in the year 2002-03 the mean PTE, all the select life insurers fall in the first category. Thereafter in all the years they prevail in the higher interval of 0.6-0.9 and 0.9-1. This might be because of they are operating on increasing return to scale or it can be contributed by PTE and SE. Moreover it has shown that the mean of TE increases from 0.366 in the year 2002-03 to 0.826 in 2011-12. By comparing it is found that all the insurers are also better at PTE, as that mean of PTE is more as compared with the mean of TE for all the periods.

But this is also vanishing if we make the comparison of mean PTE for the period 2007-08 which is 0.757 with the mean of PTE for the year 2008-09 which is 0.700. This can be justified through scale economies, as most of the life insurers have strong increasing return to scale and also taking the advantages from the scale economies as it has increased from 0.667 in the year 2002-03 to 0.947 in the year 2011-12.

#### ***Analysis of Improvement Direction and Improvement Space for Life Insurers:***

On the basis of technical efficiency scores of various companies, the improvement direction and improvement space are derived in Table 5. It signifies the percentage of technical efficiency scores which require for them to be on the frontier i.e. the additional scores needed to be on the frontier.

**Table 5 shows Improvement Direction and Improvement Space of Performance**

DMUs	2003 (%)	2004 (%)	2005 (%)	2006 (%)	2007 (%)	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)
AVIVA	75.2	80.1	57.2	42.9	34.9	31.5	37.6	18.8	0	0
BAJAJ	71.1	72.0	27.5	0.1	22.7	24.7	12.1	0	0	0
BIRLA	67.0	26.7	0	0	7.0	3.4	25.8	16.0	3.4	0
IIDFC	60.1	57.5	50.3	30.9	26.0	25.5	30.6	28.1	0	0
ICICI	65.3	59.2	37.3	28.0	36.4	43.2	31.2	14.0	0	13.0
ING VYS	75.9	67.4	34.2	42.6	33.7	18.3	3.9	0	0	0
KOTAK	79.8	68.3	20.9	12.4	23.7	24.8	27.2	5.6	3.1	0
LIC	30.2	29.6	23.1	16.6	0	0	0	1.2	0	0
MAX LIFE	54.7	53.7	45.0	47.5	40.6	36.2	14.6	0	3.9	0
METLIFE	83.5	85.1	80.4	73.6	56.0	43.7	34.7	23.0	0	0
RELIANCE	75.2	63.7	13.5	0	28.5	20.0	40.2	6.0	2.0	0
SBI LIFE	0	21.7	13.2	41.3	32.3	18.5	18.1	0	0	0
TATA AIG	73.2	53.9	47.4	36.6	19.8	39.0	46.3	28.7	11.1	0

[Source: Collected and computed from year wise annual reports of IRDA]

The table 5 shows that there is found diverse trends of improvement direction and improvement space over a period of time. For both the public and private sector life insurers, the improvement space is found decreasing trend, particularly which is a good sign for the private sector companies as it signifies that their distance from the frontier is becoming narrow and they are directing toward frontier. As stated numerically, initially the improvement space is 75.2%, 71.1%, 67.0%, 60.1%, 75.9%, 79.8%, 54.7%, 83.5%, 75.2% and 73.2% in the year 2002-03 for AVIVA, BAJAJ, BIRLA, HDFC, ING VYS, KOTAK, MAX LIFE, METLIFE, RELIANCE and TATA AIG respectively which decreases to 0% in the year 2011-12. This shows that most companies in the private sector are expanding their activities as well as outreach in order to survive and grow in the competitive market and consequently these are finding place on the frontier or coming near to frontier.

As far as the public sector company is concerned i.e. LIC is showing also the direct improvement space and direction to the frontier except in the year 2010. The reason behind this lies in the fact that this is going out of the frontier as shown in the table that initially the improvement space is 30.2% in the year 2003 which decreases over a time and become 0% in 2007 and it continues up to 2012 except the year 2010. It indicates that although the public sector company i.e. LIC is on or near the frontier most of the time of the study period but sometime this sector is facing the competition and its position is slowly and steadily taken over by the private sector companies.

### Conclusion

It is observed that the selected life insurers carrying life insurance business at an average technical efficiency of 82.6%, pure technical efficiency of 87.5% and scale efficiency of 94.7%. On the other hand, sector wise performance analysis has indicated that technical efficiency of the public sector company is 100% which is 18.8% more than that of private sector companies. This can be attributable to the fact that public sector company i.e. LIC is operating on increasing return to scale and taking the more advantages of pure technical efficiency and scale efficiency than others. While both the private sector and public sector companies are becoming more mature, started operating on decreasing return to scale and due to competition gradually the one position has taken over by another, still private sector is lagging behind than public sector i.e. LIC. It is observed that by improved handling of operating expenses and commission paid and by boosting premium income and net benefit, the less efficient company can successfully achieve the optimum performance level.

But at the end it can be said from the above study that those inefficient companies which are having increasing return to scale should expand their business by deploying more input resources, providing different product choice for customers with efficient quality of services and by utilising modern technology to reach at the optimum level of output. Further investigations are needed in order to identify approaches for each company to increase premium income and net benefit by moving towards the efficient frontier.

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