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An Evaluation of Investment Performance of Private Life Insurance Industry in India

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Abstract

Data Envelopment Analysis (DEA) model is used to provide valuable information on investment efficiency of private life insurance industry in India. This study utilizes two inputs (shareholders' investments and policyholders' investments) and two outputs (net returns on investments to the shareholders and net returns on investments to the policyholders). This study focuses upon 20 private life insurance companies operating in India over a period of 4 years from 2010-11 to 2013-14. Since this study attempts to maximize output, an output oriented DEA model is used. The study finds that investment efficiency of private life insurance industry has improved on Banker, Charnes and Cooper (BCC) model and Charnes, Cooper and Rhodes (CCR) model. The study further highlights that during all years under study, 15% to 40% life insurance companies have been found on the CRS frontier and 40% to 60% life insurance companies have been found on the VRS frontier. With regard to scale efficiency issues, 15% to 40% companies have been operated at their most productive scale over the study period.

Keywords: Data envelopment analysis; Technical efficiency; Pure technical efficiency; Scale efficiency

Introduction

Insurance industry plays crucial part in economic and social development of India through its role as intermediary between investors and industry. Two insurance categories are identified based on the type of risk underwritten: life and general (non-life). The insurance companies provide a source of long-term funds to the government and various industries in the financial markets. The industry has ₹ 20972.75 billion assets under management which represents 36.52% of GDP and 52 companies competed aggressively at the end of 2014. Over the last decade Indian insurance industry has experienced exceptional changes and confronted more difficulties. As an aftermath of deregulation and globalization foreign companies entered in Indian market place. The competitive pressures force many insurance companies to change corporate strategies in order to reduce operating costs while keeping up or improving the quality of their services. Investment activity is a crucial issue of the insurance sector because the ultimate performance of the sector relies upon the return of its investment. Investment returns made by insurance companies constitute a major portion in operating performance and enhance their standing in competitive market place. Investment gains are reflecting financial wellbeing of insurance companies and facilitate designing of pricing and dividend policies. Strong investment returns facilitate insurance companies to offset their underwriting losses and allow them to report overall profitability. As the marketplace continues to evolve at a rapid pace, it is imperative to find a tool to help managers in identifying the companies that are best positioned to thrive in a changing environment. Along these lines, assessing performance in the insurance industry remains an important objective and has always been the subject of considerable interest. This research proposed a DEA model which estimate investment performance of Indian private life insurance industry. The paper successfully provides a comprehensive evaluation for insurance companies. The rest of the paper is organized as follows. Section 2 gives a brief review of investment performance. Section 3 provides the models and methodology utilized in this paper. Section 4 gives the DEA results and further discussion. Finally, our conclusions are presented in Section 5.

Insurance industry performance evaluation

Some work has been done on investment performance evaluation of insurance industry. The most widely acknowledged technique used by insurance companies to benchmark their performance has been the ratio analysis. The well-known ratios used to evaluate investment performance of insurance companies are the ratio of investment income to investment assets or the ratio of investment income to net premiums [1]. Both of the ratios are widely used by industry experts, since investments generate a significant proportion of income for the insurance industry. Ratio analysis provides relatively insignificant amount of information when considering the effects of economies of scale, identification of benchmarking policies and estimation of investment performance measures of firms. As a result, there is an incentive to use more successful strategies in evaluating the investment performance of insurers. Bhawa and Kaur [2] determined technical efficiency, pure technical efficiency and scale efficiency of general companies using DEA over the years from 2002-2003 to 2009-10. For this purpose claim incurred was taken as output and investment income as well as net income were taken as input. Their study declared some improvement in overall efficiency of general insurance companies over the period of study. Hsiao (n.d) determined capital investment efficiency and efficiency changes using DEA and malmquist productivity index over the years from 1998 to 2008. The researcher had also made some hypotheses to test if there is a statistically significant difference among the DEA model and TFI of CAMEL-S model for life insurers. The result of study suggested that insurers should revise their investment strategies to improve company's overall financial performance.

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Hsiao and Su [3] employed DEA and malmquist productivity index to measure relative efficiency and investment performance of 24 life insurers in Taiwan from 1998 to 2002. The main findings disclosed that efficiency and investment performance are the main determinants of business performance. Wu et al. [4] developed a new problem-oriented DEA model to simultaneously assess the production and investment performance of insurers, differing from classical DEA models appropriate for independent performance evaluation. The results showed that Canadian L and H insurance companies operated very efficiently for the examined 3-year period (1996-1998). Yang (2006) constructed a two-stage DEA model to provide valuable managerial insights while assessing the dual impacts of operating and business strategies for the Canadian life and health (L and H) insurance industry. The results of study showed that the Canadian L and H insurance industry operated efficiently during the period examined (the year 1998). Adam [5] examined the relationship between investment earning of life insurance firms in New Zealand and their organizational characteristics using a pooled weighted least squares regression model over the period 1988-1993. The empirical result of study indicated that investment earnings are positively associated with size, leverage, underwriting risk and stock companies. Adams and Buckle [6] examined the determinants of corporate (i.e. underwriting and investment related) financial performance in the Bermuda insurance market using panel data for 1993-1997. The study found that highly leveraged, lowly liquid companies, reinsurers and companies with higher underwriting risk have better operational performance. Binay [7] measured the risk-adjusted equity investment performance of all institutional investors in the United States during 1981-2002. The results indicated that institutional investors have been successful in managing client assets and displayed significant stock selection skills during the period. Joo [8] analyzed the impact of various factors on solvency position of non life insurers by applying multiple regression analysis over the period of 2004-05 to 2008-09. The factors taken for analysis were firm size, investment performance and liquidity ratio. The study found that claim ratio and firm size have greater impact on solvency position of non life insurance companies. Kamau [9] evaluated the relationship between underwriting profit and investment income. The result of study presented low correlation between underwriting profit and investment income. Underwriting profit has low correlation with all other selected variables notably admitted assets, admitted liabilities, capital employed, non-life net premium unlike investment income that have high correlation. Kumar [10] revealed that public sector general insurance companies have higher underwriting loss than private sector general insurance companies, but higher investment income of public sector compensated their high underwriting loss, leading to higher profitability than private sector general insurance companies. Kumari [11] evaluated the financial performance of life insurance industry in India through various financial ratios. These ratios are based on Gart NAIC guidelines and Insurance Regulatory and Development Authority of India (IRDA) norms. Some of these ratios are Total Assets to Earned Premium Ratio, Investment Income to Earned Premium Ratio, Investment Income to Total Investments Ratio, Current Ratio [12]. Overall result of these ratios gives the positive indication of financial soundness. Other important literatures are shown in Table 1.

Models and Methodology

This paper develops a comprehensive DEA model to measure investment efficiency for the Indian life insurance industry. In the investment approach, insurers are viewed as financial intermediaries whose functions are to issue contingent claims to policyholders and use the proceeds to purchase a portfolio of assets [13]. They invest these assets to maximize rate of return on capital and value ownership claims. Thus, the objective of this approach is to measure the ability of an insurer to maximize profits. The study has two inputs which are shareholders' investments and policyholders' investments, and two outputs which are Investment income to the shareholders and Investment income to the policyholders. The diagram for the investment model is provided in Figure 1.

Mathematical solution

The study adopts both types of envelopment surfaces, BCC and CCR in order to examine scale efficiency issues as given in equation 1 and equation 2. This method provides a convenient way to categorize efficiency as technical efficiency, pure technical efficiency and scale efficiency [14].

Pure Technical Efficiency (PTE): In PTE, efficiency is measure relative to variable return to scale (VRS) frontier. It takes into account the variation of efficiency with respect to the scale of operation.

Scale Efficiency (SE): Scale efficiency perceives that economy of scale cannot be achieved at all scales of production and there is one most productive scale size, where the scale efficiency is at 100 per cent [15]. The scale efficiency is measured by dividing technical efficiency with the PTE.

Technical efficiency (TE): TE can be viewed as the product of PTE and SE. It mirrors the ability of a firm to obtain the maximum output from a given set of input or the efficiency with which inputs are transformed into output or just the output/input ratio. Output orientation (the LP is oriented to maximize outputs) was selected for the investment model, since the management wants to maximize the investment gains [16].

The mathematical solution to implement the conceptual model is given in equation 1 and equation 2. Assume there are data on K inputs and M outputs on each of N firms or DMUs. For i^{th} DMU these are represent by vector of x_i and y_i respectively. The K×N input matrix, X, and the M×N output matrix, Y, represent data of all N DMUs. λ is a vector of constant.

Equation 1 represents output oriented CCR DEA model and Equation 2 represents output oriented BCC DEA model.

$$\max_{\Phi,\lambda} \Phi,$$
$$\lambda Y \geq \Phi y_i \quad (1)$$
$$\lambda X \leq x_i$$
$$\lambda \geq 0$$

Performing a DEA analysis requires the solution of n linear programming problems of the above form, one for each DMU [17]. In the study, there are data on twenty life insurance companies for 4 years; hence there are twenty linear programming problems for CRS DEA to be solved in a particular year. The CRS linear programming can be

Figure 1: Investment Model.

Authors	Countries	No. of DMUs	Sample period	Input	Output
Ahmad [12]	India	10	2001-2009	Share capital including the reserves and surpluses	Shareholders' investment
Barros and Obijiaku [13]	Nigeria	10	2001-2005	Capital, operative costs, number of employees, total investments	Profits, net premiums, settled claims, outstanding claims, investment income
Bawa and Kaur [2]	India		2003-2010	Investment	Investment income to the policyholders, Investment income to the shareholders
Cummins et al. [16]	Italy	94	1985-1993	Labor (acquisition, admin.), fixed capital expense, equity capital	Life: sum of life insurance benefits, changes in reserves, invested assets. Non-life: Losses incurred, invested assets
Fukuyama and Weber [18]	Japan	17	1983-1994	Labor (office, sales), capital	Reserves, loans, investment
Cummins and Nini [14]	US	770-970	1993-1998	Labor (office, sales), materials and business service, financial equity capital	Present value of losses incurred, total invested asset
Cummins and Xie [15]	US	1550	1994-2003	Labor (admin., agent), materials and business services, financial equity capital	Present value of losses incurred, real invested assets
Hao and Chou [19]	Taiwan	26	1977-1999	labor, physical capital, claim	Premiums, investment
Hwang and Gao [21]	Ireland	11	1991-2000	Labor (admin, agent), financial capital	Insurance benefits, investible funds
Klumpes [22]	UK	40	1994-1999	Labor (home office, agent), business services, financial capital	Claims, real invested assets
Mahlberg and Url [23]	Austria	70	1992-1999	Expenditures on labor, material, energy, depreciation, marketing, commissions (1 input); capital management cost (1 input)	Claims, net change in provisions, allocated investment returns, bonuses and returned premia
Noulas et al. [24]	Greece	16	1991-1996	Salaries and expenses (1 input) and payment to insurers and expenses incurred in the production of services(1 input)	Premium income, revenue from investment activities
Diacon et al. [17]	15 European countries	454	1996-1999	Total operating expenses, total capital, total technical reserves, total borrowings from creditors	Net earned premiums (general, long-term), total investment income
Qiu and Chen [25]	China	14-32	2000-2003	Labor, equity capital,	Benefit payments, additions to reserve, yield of investment
Wu et al. [4]	Canada	71-78	1996-1998	Prod: Labor expenses, general operating expenses, capital equity, claims incurred Inv: Net actuarial reserves, investment expenses, total investments, total segregated funds	Prod: Net premiums written, net income Inv: Investment gains in bonds and mortgages, investment gains in equities and real estate
Yang [26]	Canada	72	1998	Prod: Labor expenses, general operating expenses, capital equity, claims incurred Inv: Net actuarial reserves, investment expenses, total investments, total segregated funds	Prod: Net premiums written, net income Inv: Investment gains in bonds and mortgages, investment gains in equities and real estate
Yao et al. [27]	China	22	1999-2004	Labor, capital, payment and benefits	Premiums, investment income

Table 1: Table from past Literature

easily modified to account for VRS by adding the convexity constraint: N1'λ = 1 to equation 1 to provide:

$$\max_{\Phi,\lambda} \Phi,$$
$$\lambda Y \geq \Phi y_i \quad (2)$$
$$\lambda X \leq x_i$$
$$N1'\lambda = 1$$
$$\lambda \geq 0$$

N1 is N* 1 vector of ones. The approach forms a convex hull of intersecting plans which envelope the data point more tightly than CRS hull and thus provide technical efficiency score which is greater than or equal to those obtained using the CRS model [18].

Note that the linear programming problem given in equation 2 must be solved N times, once for each DMU in the sample for a particular year. In the study, there are data on twenty life insurance companies for 4 years; hence there are twenty linear programming problems for VRS DEA to be solved in a particular year [19].

Data

The empirical results of the study are primarily based on financial data of private life insurance companies. Audited and accounting data for 2010-11 to 2013-14 (denominated in Rs.) were obtained for 20 major private life insurers from IRDA annual reports and annual reports of respective companies [20]. Some firms eliminated from the sample because of data problems such as companies come into existence after study period or non availability of data. The firms remaining in the sample account for about 90% of premium volume in the private life insurance market in each year of the sample period [21]. The data is from annual balance sheets, policyholders account and shareholders account of following companies:

1. Aegon Religare Life Insurance Company Ltd.
2. Aviva Life Insurance Company Ltd.
3. Bajaj Allianz Life Insurance Company Ltd.
4. Bharti AXA Life Insurance Company Ltd.
5. Birla Sunlife Insurance Company Ltd.
6. DLF Pramerica Life Insurance Company Ltd.
7. Future Generali Life Insurance Company Ltd.
8. HDFC Standard Life Insurance Company Ltd.
9. ICICI Prudential Life Insurance Company Ltd.
10. IDBI Federal Life Insurance Company Ltd.

11. IndiaFirst Life Insurance Company Ltd.
12. Exide Life Insurance Company Ltd.
13. Kotak Mahindra OM Life Insurance Company Ltd.
14. Max Life Insurance Company Ltd.
15. Metlife India Insurance Company Ltd.
16. Reliance Life Insurance Company Ltd.
17. SBI Life Insurance Company Ltd.
18. Shriram Life Insurance Company Ltd.
19. Star Union Dai-ichi Life Insurance Company Ltd.
20. TATA AIA Life Insurance Company Ltd.

To evaluate the investment efficiency of private life insurance companies in India, the essential element is the selection of input and output variables [22]. Variables were selected on the basis of research aim and availability of data. Variables of the study are as follows:

- Shareholders' investment.
- Policyholders' investment.
- Investment income to the shareholders.
- Investment income to the policyholders.

Results and Discussions

Table 2 shows the gross efficiency (Overall Technical Efficiency) of private life insurers calculated at constant return to scale. The insurance companies which achieve values of the OTE scores equal to one form the CRS frontier; and those having the values less than one are below the frontier and termed as inefficient. Table reveals that during all years under study, 3 (15%) to 8 (40%) life insurance companies have been found on the frontier. DLF Life has efficient maximum number of times in twelve years; while Aviva Life, BIRLA Life, IDBI Life, EXIDE Life, MAX Life and TATA Life have not shown efficiency score of 1 in any years from 2010 to 2014. DLF Life scored highest rank in overall technical efficiency with mean efficiency score estimated to be 1 and SBI Life has scored lowest rank in overall technical efficiency with mean efficiency stood at 0.75. Investment efficiency of private life insurance industry has shown an increasing trend from 2010-11 to 2013-14. Average efficiency has increased from 0.857 in 2010-11 to 0.908 in 2013-14. Notably, in the year 2012-13 insurance industry found to be highly efficient as mean efficiency stood at 0.948. The study further highlighted that least number of companies found to be efficient on constant return to scale during 2011-12 which is mainly due to the decline in income from investment. This decline in income from investments was a reflection of the condition prevailing in stock market and a decline in the unit linked business for life insurance industry (Table 3).

DMUs	2010-11	2011-12	2012-13	2013-14	Mean
Aegon Life	0.913	1.000	1.000	0.847	0.94
Aviva Life	0.698	0.809	0.884	0.859	0.81
Bajaj Life	1.000	0.819	0.988	1.000	0.95
Bharti Life	0.963	0.865	1.000	1.000	0.95
Birla Life	0.769	0.809	0.889	0.846	0.82
DLF Life	1.000	1.000	1.000	1.000	1
Future Life	0.975	0.721	0.853	1.000	0.88
HDFC Life	0.988	0.801	1.000	1.000	0.94
ICICI Life	1.000	0.641	0.972	0.869	0.87
IDBI Life	0.628	0.891	0.941	0.908	0.84
IndiaFirst Life	1.000	0.881	0.828	0.716	0.85
Exide Life	0.656	0.908	0.964	0.740	0.81
Kotek Life	0.870	0.769	1.000	0.816	0.86
Max Life	0.817	0.737	0.818	0.863	0.80
Met Life	1.000	0.877	0.942	0.852	0.91
Reliance Life	1.000	0.583	1.000	1.000	0.89
SBI Life	0.368	0.715	1.000	0.948	0.75
Sriram Life	0.727	0.820	1.000	0.951	0.87
Star Life	1.000	1.000	0.892	1.000	0.97
TATA Life	0.764	0.731	0.986	0.940	0.85
Mean	0.857	0.810	0.948	0.908	

Table 2: Efficiency Score at Constant Return to Scale i.e. Overall Technical Efficiency

DMUs	2010-11	2011-12	2012-13	2013-14	Mean
Aegon Life	0.920	1.000	1.000	1.000	0.98
Aviva Life	0.699	0.937	0.925	0.868	0.85
Bajaj Life	1.000	1.000	1.000	1.000	1
Bharti Life	1.000	0.872	1.000	1.000	0.96
Birla Life	0.772	0.947	0.920	0.879	0.87
DLF Life	1.000	1.000	1.000	1.000	1
Future Life	1.000	0.902	0.874	1.000	0.94
HDFC Life	1.000	0.946	1.000	1.000	0.98
ICICI Life	1.000	1.000	1.000	1.000	1
IDBI Life	0.645	0.939	1.000	0.959	0.88
IndiaFirst Life	1.000	1.000	0.857	0.725	0.89
Exide Life	0.664	0.974	1.000	0.744	0.84
Kotek Life	0.878	0.905	1.000	0.822	0.90
Max Life	1.000	1.000	0.936	0.880	0.95
Met Life	1.000	1.000	0.977	0.887	0.96
Reliance Life	1.000	0.681	1.000	1.000	0.92
SBI Life	0.483	0.918	1.000	1.000	0.85
Sriram Life	0.747	0.855	1.000	1.000	0.90
Star Life	1.000	1.000	0.923	1.000	0.98
TATA Life	0.773	0.834	0.988	1.000	0.89
Mean	0.879	0.935	0.970	0.938	

Source: Computed through DEAP version 2.1

Table 3: Efficiency Score at Variable Return to Scale i.e. Pure Technical Efficiency .

Table 3 evinces technical efficiency (pure technical efficiency) of private life insurers calculated at variable return to scale. Table reveals that during all years under study, 8 (40%) to 12 (60%) life insurance companies have been found on the frontier. BAJAJ Life, DLF Life and ICICI Life have efficient maximum number of times in twelve years; while Aviva Life and BIRLA Life have not shown efficiency score of 1 in any years from 2010 to 2014. BAJAJ Life, DLF Life and ICICI Life scored highest rank in overall technical efficiency with mean efficiency score estimated to be 1 and EXIDE Life has scored lowest rank in overall technical efficiency with mean efficiency stood at 0.84. Investment efficiency of private life insurance industry has shown an increasing trend from 2010-11 to 2013-14. Average efficiency has increased from 0.879 in 2010-11 to 0.938 in 2013-14. Notably, in the year 2012-13 insurance industry found to be highly efficient as mean efficiency stood at 0.970. The study further highlighted that least number of companies found to be efficient on variable return to scale during 2011-12 which is mainly due to the decline in income from investment. This decline in income from investments was a reflection of the condition prevailing in stock market and a decline in the unit linked business for life insurance industry (Table 4).

DMUs	2010-11	2011-12	2012-13	2013-14	Mean
Aegon Life	0.993	1.000	1.000	0.847	0.96
Aviva Life	0.999	0.863	0.955	0.990	0.95
Bajaj Life	1.000	0.819	0.988	1.000	0.95
Bharti Life	0.963	0.992	1.000	1.000	0.98
Birla Life	0.997	0.854	0.966	0.963	0.94
DLF Life	1.000	1.000	1.000	1.000	1
Future Life	0.975	0.800	0.976	1.000	0.93
HDFC Life	0.988	0.847	1.000	1.000	0.95
ICICI Life	1.000	0.641	0.972	0.869	0.87
IDBI Life	0.972	0.949	0.941	0.946	0.95
IndiaFirst Life	1.000	0.881	0.965	0.987	0.95
Exide Life	0.988	0.933	0.964	0.994	0.96
Kotek Life	0.990	0.849	1.000	0.994	0.95
Max Life	0.817	0.737	0.874	0.981	0.85
Met Life	1.000	0.877	0.964	0.961	0.95
Reliance Life	1.000	0.855	1.000	1.000	0.96
SBI Life	0.761	0.779	1.000	0.948	0.87
Sriram Life	0.973	0.960	1.000	0.951	0.97
Star Life	1.000	1.000	0.966	1.000	0.99
TATA Life	0.989	0.877	0.998	0.940	0.95
Mean	0.970	0.87	0.976	0.968	

Source: Computed through DEAP version 2.1

Table 4: Scale Efficiency Scores

Years	IRS	CRS	DRS	Total
2010-11	9	7	4	20
2011-12	-	3	17	20
2012-13	2	8	10	20
2013-14	6	7	7	20

Source: Computed through DEAP version 2.1

Table 5: Economies of Scale of the Insurance Companies.

Table 4 depicts the scale efficiency of life insurers which is the ratio of CRS efficiency score to VRS efficiency score. This table represents that during all the years under study 3 (15%) to 8 (40%) companies have been operated at their most productive scale. DLF Life has scored highest rank in scale efficiency as average efficiency score stood at 1 while MAX Life has scored lowest rank as average efficiency score is estimated to be 0.85. Efficiency of private life insurance industry has improved from 2002-03 to 2013-14 as average efficiency increased from 0.970 in 2010-11 to 0.968 in 2013-14. Notably, in the year 2012-13 insurance industry found to be highly scale efficient as mean efficiency stood at 0.976. The study further highlighted that least number of companies found to be scale efficient during 2011-12 which is mainly due to the decline in income from investment. This decline in income from investments was a reflection of the condition prevailing in stock market and a decline in the unit linked business for life insurance industry (Table 5).

The above table shows in the year 2010-11 most of insurers have marked increasing return to scale which reveals increase in output has been more than proportionate increase in input. In the year 2011-12 and 2012-13 most of insurers have marked decreasing return to scale. Decreasing return to scale reveals that increase in output has been less than proportionate increase in input. However it is important to note that in year 2013-14, 7 (35%) insurers depicted constant return to scale and 7 (35%) insurers exhibited decreasing return to scale.

Conclusion

The deepening of insurance market makes a positive contribution to the economic growth. Insurance companies earn their profits through underwriting of premium from various policies and investing in various securities as prescribed by the regulatory body [23]. Investment activity is an essential issue of insurance sector because the ultimate performance of the sector depends on the return of its investment whether it is life or general insurance. Thus, an attempt has been made to estimate investment efficiency of 20 private life insurers over the period from 2011-14 using DEA [24]. The study finds that during all years under study, 15% to 40% life insurance companies have been found on the CRS frontier and 40% to 60% life insurance companies have been found on the VRS frontier [25]. With regard to scale efficiency issues, 15% to 40% companies have been operated at their most productive scale over the study period. The study also reveals that investment efficiency of private life insurance industry has improved on both BCC and CCR model [26]. The study further highlighted that least number of companies found to be efficient during 2011-12 which is mainly due to the decline in income from investment [27]. This decline in income from investments was a reflection of the condition prevailing in stock market and a decline in the unit linked business for life insurance industry.

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