

DEA in Health and Life Insurance Companies: A Review

M.S.Pawar Waghavkar¹, S.L.Sananse²

¹Research Scholar, Department Of Statistics, Dr. Babasaheb Ambedkar Marathwada, University, Aurangabad- 431004.
(M.S.), India

²Professor, Department Of Statistics, Dr. Babasaheb Ambedkar Marathwada, University, Aurangabad- 431004. (M.S.), India

ABSTRACT: Insurance industry extends the productivities and services with providing safety and confidence. These companies have positive effects on economics growth of the country. Efficiency measurement in the insurance companies increases the quality of their activities and also assists them to identify and solve the problems. Data envelopment analysis (DEA) is a technique that is widely applied to measure the relative efficiency of a set of production systems. DEA (Data Envelopment Analysis) is widely used in the analysis and study relating to productivity or efficiency of educational and academic research units, the financial industry, the transportation business, mobile phones, and other science and technology industries. In this paper we reviewed the use of DEA in life and health insurance companies.

KEYWORDS: Data envelopment analysis, Life Insurance Companies, Health Insurance Companies.

I. INTRODUCTION

Actuarial science is an applied science based on concepts and observations distilled from the experience of practitioners and from other sciences. Actuarial science is primarily concerned with the study of consequences of events that involve risk and uncertainty. Actuarial practice identifies, analyses and assists in the management of the outcomes including costs and benefits associated with events that involve risk and uncertainty. Understanding the principles underlying actuarial science enables actuaries to develop models of such events and other techniques to solve practical problems.

The first Indian insurance company under the name 'Bombay Life Insurance Society' started its operation in 1870, and started covering Indian lives at standard rates. Later 'Oriental Government Security Life Insurance Company', was established in 1874, with Sir Phiroz shah Mehta as one of its founder director. The insurance industry of India consists of 52 insurance companies of which 24 are in life insurance business and 28 are non-life insurers.

Insurance care is important for development of any economy because it is the insurance by which the people can grow and develop the society through better business formats based on risk coverage. The new economic policy and liberalization has paved the way for the liberalization of the insurance sector giving lot of options to the people to invest.

Types of Insurance: There are several major types of insurance policies. Some companies offer the entire suite of insurance, while others specialize in specific areas:

Life Insurance - Insurance guaranteeing a specific sum of money to a designated beneficiary upon the death of the insured, or to the insured if he or she lives beyond a certain age.

Health Insurance - Insurance against expenses incurred through illness of the insured.

Insurance industry extends the productivities and services with providing safety and confidence. Insurance industry also causes stability and reduces the anxiety due to identification. Efficiency measurement in the insurance companies increases the quality of their activities and also assists them to identify and solve the problems. Measuring the performance of a production system is an important task for the purpose of control and planning. Data envelopment analysis (DEA) is a technique that is widely applied to measure the relative efficiency of a set of production systems, or decision making units (DMUs) which apply the same inputs to produce the same outputs.

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Building on the ideas of Farrell (1957), the seminal work Measuring the Efficiency of Decision Making Units by Charnes, Cooper and Rhodes (1978) introduced the concept of data envelopment analysis (DEA) in the literature, and since then, it has emerged as a powerful management science tool for measuring and evaluating the performance of different kinds of entities engaged in many different activities in various contexts around the globe. Now a day's DEA represents a milestone in the progression of continuously advancing methodology for data analysis, which finds extensive use industry, society and even in education.

Data envelopment analysis (DEA) is a data based mathematical approach, which handles large numbers of variables, constraints, and data. Hence, data play an important and critical role in DEA.

Literature Review: Many researchers studied insurance business by using DEA techniques as follows

Fecher et al. (1993) studied the French insurance industry for 84 life and 243 non-life companies. They used a DEA and a parametric Cobb-Douglas model. They estimated DEA model in three versions, including aggregate gross premiums, gross premiums in three branches (civil liability, fire property and accident-health) and gross premiums in auto and non-auto branches. In the case of life insurance, the net returns on financial investment serve as an additional output, along with gross premiums. They used the following variables as inputs; wage bill and a composite input consisting of various outlays such as capital consumption, purchase of equipment and supplies. They estimated econometric model with one output, gross premium, while the same inputs used as in the DEA model.

Rai (1996) examined the cost efficiency of insurance companies in a sample of 11 developed countries, found that inefficiencies vary by country, size, and specialization. Specifically, and he found that small firms, compared to a worldwide average, were more cost efficient than large firms, and that firms wrote both life and non-life insurance were less efficient than specialized firms.

Fukuyama(1997) analyzed the production efficiency and productivity of life insurance companies in Japan over the period 1988-1993 using DEA. Life insurance companies were assessed in two separate groups as mutual and stock companies. He concluded that the main reason for the overall technical inefficiency is pure technical inefficiency in mutual companies and scale inefficiency in stock companies.

J. David Cummins and Hongmin zi (1998) provided new information on the performance of efficiency estimation methods by applied a wide range of econometric and mathematical programming techniques to a sample of U.S. life insurers. They suggested that the controversy regarding distributional error term assumptions in the econometric approach may be a bit of a red herring, but this found needs to be tested for robustness used other data sets and they analyzed and found that the data envelopment analysis (DEA) and the free disposal hull (FDH) mathematical programming methodologies tend to give significantly different results.

J. David Cummins et.al.(1998) examined the relationship between mergers and acquisitions, efficiency, and scale economies in the US life insurance industry and they found that acquired firms achieved greater efficiency gains than firms that had not been involved in mergers or acquisitions.

Noulas et.al. (2001) studied Greek non-life insurance companies. They applied DEA method and used two inputs (including expenses and payment to insurers) and two outputs (including premium incomes and revenue from investment activities). They concluded that the industry was highly inefficient, with considerable differences between insurance companies.

Diacon et.al. (2002) studied the relative efficiency of 450 European insurance companies. They applied two stages approach. As the first step, they estimated efficiency scores with a VRS DEA model. They used four inputs including total operating expenses net of reinsurance commissions, total capital, total technical reserves and total borrowings from creditors. They also used three output including insurance net earned premiums, long term insurance net earned premiums and total investment income. In the second step, they estimated a Tobit regression. The main conclusion of the study is that the most efficient insurers are those that specialize in particular market.

Mahlberg and Url (2003) analysed Austrian insurance industry with the use of two DEA models. As a first step they used input oriented CCR model and also BCC model. They used four inputs (number of employees, liquid investment, gross technical provision and reinsurance premium) and four outputs (market share, profit, total

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investment income and premium issued) to make the models. As the second step, they estimated Malmquist Productivity index.

Tone and Sahoo (2005) analyzed the efficiency of Life Insurance Corporation of India using DEA over the period 1982-2001. They detected that the cost efficiency of the corporation within the period analyzed is significantly dispersed.

Zijiang Yang(2006) introduced a new two-stage DEA model to evaluated systematic efficiency for the Canadian Life and health insurance industry and they concluded that the Canadian L&H insurance industry operated fairly efficiently during the examined period (the year 1998).

Norma Md. Saad et.al.(2006) investigated the efficiency of the life insurance industry in Malaysia during the period 2002 to 2005. And result indicated that Malaysia's insurance industry had great potential to further increase its TFP through an improvement in technical components such as optimizing the use of information and communication technology in provided good services to customers.

Desheng Wu et.al.(2007) data envelopment analysis (DEA) model was created to provided valuable managerial insights when assessing the dual impacts of operating and business strategies for Canadian life and health (L&H) insurance industry. and the results showed that the Canadian L&H insurance companies operated very efficiently for the 3-year period (1996–1998) and no scale efficiency in the Canadian L&H insurance industry was found.

Hussels and Ward(2007) compared the life insurance companies in Germany and UK over the period 1991-2002. They concluded that German industry dominated UK cost efficiency in this study aiming to conduct an inter-country analysis of deregulation and industry efficiency in the European insurance industry.

Maria Rosa Borges et.al.(2008) used the DEA-CCR and the DEA-BCC models to evaluated the performance of Greek life insurance companies in the period 1994 to 2003, and found that large and quoted life insurance companies, as well as those involved in mergers and acquisitions, exhibit higher efficiency. They suggested that Greek life insurance companies display relatively average management skills, being VRS-efficient for the most part and conclude that scale is of paramount importance to insurance companies and thus, the DEA-CCR models should not be used alone in the evaluation of their performance.

Chiang Kao, Shih-Nan Hwang(2008) modified the conventional DEA model by taken into account the series relationship of the two sub-processes within the whole process, and developed relational model was more reliable in measured the efficiencies and consequently was capable of identified the causes of inefficiency more accurately. Based on the structure of the model, the idea of efficiency decomposition can be extended to systems composed of multiple stages connected in series.

Lucinda Trigo- Gamarra and Christian Growitsch (2010) explained the success of different distribution strategies in the life insurance industry, and analyzed the performance of single- and multichannel distribution firms in the German life insurance industry and found that the absence of performance advantages of specialized insurers was the most important reason for the coexistence of different distribution systems.

Talat Afza and Muhammad Jam-E-kausar ali Asghar (2010) studied applied non-parametric Data Envelopment Analysis (DEA) estimated the efficiency of insurance companies in Pakistan over the period 2003 to 2007. They found that allocative and cost efficiencies were improved from 2003 to 2005 but significantly decreased in 2006 whereas; technical efficiency is increased over the study period.

Eling and Luhnen (2010) survey 14 international insurance studies on efficiency conducted during the last 20 years that focused on the relationship between efficiency and market liberalization, mergers and acquisitions, and scale economies. They found that efficiency in developed countries is higher than that in emerging markets and that technical progress has had a positive impact on productivity and efficiency worldwide.

Cheng-Ru Wu(2011) investigated the relative efficiency of each life insurance company at various stages of production activities Companies that belong in the stare zone were Cathay, Shin Kong and Mass Mutual Mercuries. These companies are considered good role models for others. Dogs zone were perform below both operational efficiency and profitability efficiency.

P. Saeidy and S.A. Kazemipour (2011) used linear programming examined and compared the technical efficiency, allocation and economic public and private insurance companies in Iran. The results indicated significant difference in average technical efficiency, allocation and economic public and private insurance companies.

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Dr. Sumninder Kaur Bawa and Miss Ruchita (2011) used DEA, to evaluate the efficiencies of health insurance business of general insurance companies in India and observed that private sector companies was operated on increased return to scale and taken the advantages of pure technical efficiency and scale efficiency.

Norma Md Saadand Nur Edzalina Haji Idris (2011) used Data Envelopment Analysis (DEA) to explored the contributions of technical and efficiency change to the growth of productivity in the Malaysian and Brunei life insurance industries applied the generalized output-oriented Malmquist index for the year 2000-2005. They found that, on average, the TFP of the life insurance industry was mained of both efficiency and technical changes where the main source of the efficiency change is scale efficiency rather than pure efficiency.

Shahroudi et.al. [2011] analyzed the efficiency of insurance companies in Iran over the period 2006-2007 using the traditional DEA and two-stage DEA models. They specified the inputs and outputs as investment and marketing. They concluded that the Iran Moein company was efficient in terms of marketing over the period investigated and this company was inefficient in 2007 due to the weakness in the investment sub-process.

Dr. Martina R. Noronh and Dr. Sanjay R. Shinde (2012) compared international life insurance density and penetration and evaluated the cost efficiency of life insurance companies operating in India for the period 2000-01 to 2009-10. They concluded that the Life Insurance Corporation of India has consistently secured a cost efficiency score of 1 in all the years from 2000-01 to 2009-10 and scored the highest rank for all the years. Finally, they suggested that private life insurance companies should improve their cost efficiency score by increasing outputs i.e. benefits paid to the customers and net premium and decreasing inputs i.e. operating expenses and commission expenses.

Dr. Ruchita Verma(2012) examined the productivity as well as change in productivity of health insurance business and identified the various derives behind such change and concluded that health insurance in India was concerned that it was still at embryonic stage.

K. Shahroudi et.al.(2012) used traditional DEA model and two-stage DEA model to measured the efficiency of Iranian private insurance companies during 2007-2009 and they found that the investment weakness was the main reason of Iranian private insurance companies' analyzed in the study period.

Md. Azizur Rahman (2013) examined the efficiency in the both life insurance and life Takaful industry of Bangladesh and result of study indicated that in the life insurances industry of Bangladesh, the smaller the size of the companies in Takaful life insurances, the higher probability for the companies to be more efficient in utilizing their inputs to generate more outputs.

J. David Cummins and Xiaoying Xie(2013) examined the efficiency, productivity and scale economies in the U.S. property-liability insurance industry. The results indicated that the majority of firms below median size in the industry were operated with increased returns to scale, and the majority of firms above median size are operated with decreased returns to scale.

Raha Jalili Sabet and Arefeh Fadavi (2013) used two-stage data envelopment analysis for measured the performance of insurance firms, which were active over the period of 2006-2010 and result indicated that market was monopolized mostly by a limited number of insurance firms and competition was not fare enough to let other firms participate in economy, more efficiently.

Nilüfer Dalkılıç and Aysen Altun Ada (2014) studied the scale efficiencies of life insurance and/or private pension companies in Turkey using Data Envelopment Analysis (DEA) over the period 2010-2011 and concluded that life insurance companies was more efficient than life insurance and/or private pension companies.

Carlos pestana Barros et.al.(2014) studied variety of approaches used to assess the efficiency of a sample of major insurance companies in Angola between 2003 and 2012 and they found that older insurance companies with Portuguese origin tend more efficient and also suggested that opportunities for accommodating future demand appear scarce.

Tanuj Mathur and Ujjwal Kanti Paul (2014) studied to measured the efficiency of non life insurance companies operated in India. The results showed directional impact the ratios had on the technical efficiency of the insurers.

Jayanta Kumar Nandi (2014) measured the relative performance efficiency of the selected life insurance companies in India individually, year wise, sector wise and as a whole, used a linear programming non parametric technique of Data Envelopment Analysis (DEA). The results of the study showed that overall life insurers carried life insurance business at an average technical efficiency of 82.6%, pure technical efficiency of 87.5% and scale

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efficiency of 94.7%. Individually and sector wise performance analysis, LIC (Life Insurance Corporation of India) performs better as compared to others.

Mogtaba Afsordeh and Hamid Moridipour (2014) evaluated the performance of representatives of insurance companies in Iran. The results showed that, the DEY insurance company in comparison with other companies had more efficiency and the RAZI insurance company had weaker efficiency than other firms.

Qian Long Kweh, Noor Azlinna Azizan (2015) used a two-stage approach in data envelopment analysis (2S-DEA) methodology and found that the sample firms had to first improved their managerial efficiency, and then proceed to improved their profitability efficiency.

Setareh Sajedi and Nader Sh. Kandelousi (2015) studied the efficiency of insurance companies at a double-stage production process where out-puts of first stage are inputs of second stage and they indicated that used of double-stage model provided more accurate assessment compared to independent model and though responded of relational and independent models were correlated, the former presents more reasonable and reliable responded.

II.CONCLUSION

This paper conducted a comprehensive review of studies related to DEA. Efficiency measurement in the insurance companies increases the quality of their activities therefore Data envelopment analysis technique is used to measure the relative efficiency of a set production system. Most of papers focused on the measurement and explanation on efficiency of insurance companies. DEA technique is used to measure the managerial performance of insurance companies which is very useful to take decision to generate profit for the companies by providing service to their clients.

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