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# Are Indian Life Insurance Companies Cost Efficient? Some Recent Empirical Evidence

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*The present paper estimates cost efficiency of the life insurance companies operating in India for the period 2005-06 to 2009-10 using Farrell and Tone's measure. In both the approaches it is seen that the mean cost efficiency exhibit significant fluctuations during the period under observation implying significant divergence from the frontier. The study also decomposes the Farrell measure of cost efficiency into input oriented technical efficiency and allocative efficiency. Further the cost efficiency estimates were related (through a censored Tobit model) to product and channel composition of the in-sample insurance players.*

## *Section I*
## Introduction

Economic reforms in India initiated in the early 1990s saw the liberalization of insurance business become an integral component of the government's policy agenda. In 1993, the Central Government constituted a Committee under the Chairmanship of Shri R N Malhotra to suggest the roadmap for insurance sector reform. The Committee submitted its report in 1994 in which it favoured a gradual liberalization of insurance business in India, segregation of non-life and life business and the introduction of prudential solvency based regulation of the insurance sector. In 1999 an Insurance Regulatory Authority Act was promulgated for creating the necessary regulatory framework. The new regulator, Insurance Regulatory and Development Authority (IRDA) took office at the same time to oversee and regulate the market.

Following the opening up of the insurance sector, four new insurance companies (Birla Sun Life Insurance Company, ICICI Prudential Life Insurance Company, Max New York Life Insurance Company and HDFC Standard Life Insurance Company Ltd.) commenced their operations in 2000-01. In the next four years (2001-02 to 2004-05), nine more life insurance companies entered the market. Between 1999 and 2001, the number of players in the Indian life insurance market increased from one to twenty-three. Following the deregulation of the life insurance sector in end-1999, life insurance companies in India have made steady progress in terms of business growth. Armed with unit linked products, the life insurance companies have provided stiff competition to the mutual funds operating in India.

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## Life Insurance Sector in India: Growth in Premium Income and Expenses in the Recent Years

### *(a) Premium Income*

Table 1 provides the details regarding the growth in premium collection by LIC *vis-a-vis* private sector insurers. The total premium collected went up from Rs 1058760 million in 2005-06 to Rs 2654500 million in 2009-10. The share of the private life insurers in the total premia collected went up from 14.25 per cent in 2005-06 to 29.90 per cent in 2009-10 (Table 1).

***Table 1***
**Growth in the Collection of Premium (2005-06 to 2009-10)**

*(Rs in Million)*

| *Insurer* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| LIC | 907920 | 1278230 | 149790 | 1572880 | 1860770 |
| Private | 150840 | 282530 | 515610 | 645030 | 793730 |
| All | 1058760 | 1560760 | 2013510 | 2217910 | 2654500 |

*Source:* IRDA Annual Reports.

In the context of mobilization of premium, two discerning changes are worth noting: changes in product composition and changes in relative importance of channels through which such premiums are mobilized. During the period under consideration ULIP schemes have gained more popularity *vis-a-vis* non-ULIP schemes. Further there are significant divergences between the LIC and the private players in this matter (refer Table 2 for the position for 2009-10).

***Table 2***
**Relative Share of Linked Premium: LIC *vs* Private Sector**

*(Figures in Rs Crores for 2009-10)*

| *Insurer* | *Linked Premium* | | | *Non-Linked Premium* | | |
|---|---|---|---|---|---|---|
| | *First Year* | *Renewal* | *Total* | *First Year* | *Renewal* | *Total* |
| LIC | 28086 | 19176 | 47262 | 43436 | 95379 | 138815 |
| Private | 31839 | 36420 | 68259 | 6533 | 4581 | 11114 |
| All | 59925 | 55596 | 115521 | 49969 | 99961 | 149929 |

*Source:* IRDA Annual Report, 2009-10.

As it has been mentioned above, the relative importance of channels of mobilization is also changing and here also the public and private sector diverge considerably. Table 3 provides the picture for 2009-10.

***Table 3***
**Relative Importance of Various Channels of New Business Mobilization***

*(Figures in Rs Crores for 2009-10)*

| *Insurer* | *Individual Agents* | *Corporate Agents* | *Brokers* | *Direct Selling* |
|---|---|---|---|---|
| LIC | 50847 | 1167 | 264 | 19197 |
| Private | 16059 | 12034 | 1212 | 9065 |
| All | 66906 | 13201 | 1476 | 28262 |

*Note:* *including both individual and group new business.
*Source:* IRDA Annual Report, 2009-10.

### *(b) Expenses of Life Insurance Companies*

Life insurance companies have two major expense components: operating and commission expenses. Table 4 provides information relating to two major indicators of cost: operating cost ratio and commission expense ratio for the period 2005-06 to 2009-10. Operating expenses ratio is the ratio between operating expenses and the premium underwritten by the life insurers. Commission expenses ratio, on the other hand, is the ratio between commission expenses and the premium underwritten by the life insurers.

***Table 4***
**Operating and Commission Expenses Ratio of the Life Insurers**

| *Insurer* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| | | | **Operating Expenses Ratio** | | |
| LIC | 6.65 | 5.54 | 5.55 | 5.76 | 6.58 |
| Private | 23.67 | 23.01 | 23.34 | 25.99 | 20.86 |
| All | 9.08 | 8.70 | 10.10 | 11.60 | 10.85 |
| | | | **Commission Expenses Ratio** | | |
| LIC | 7.82 | 7.18 | 6.42 | 6.39 | 6.52 |
| Private | 10.23 | 10.92 | 9.87 | 8.49 | 7.63 |
| All | 8.16 | 7.85 | 7.30 | 7.00 | 6.85 |

*Source:* IRDA Annual Reports.

However, the relatively high degree of administrative expenses observed in respect of insurance companies has also been a cause for concern among the market regulator and other stakeholders. It will not be out of context to mention here that this concern has led the IRDA (Insurance Regulatory and Development Authority) to revise its guideline relating to the unit linked products for making the insurers more cost efficient. It is also essential to add here that the sector is still emerging and will take time to stabilize its operations.

Given this backdrop, the present paper makes a humble attempt to compare the cost efficiency of fifteen Indian life insurance companies which existed through the entire period of 2005-06 to 2009-10. Limited availability of data has compelled us to make use of the non-parametric approach only and that too for a five year span.

## *Section II*
## Life Insurer Efficiency: A Review of Literature

Yuengert (1992) estimated X-efficiency of US life insurance companies for the year 1989 using a frontier cost function. He made use of the heteroskedasticity imposed on the error structure by differences in X-inefficiency. For measuring X-inefficiency, he used a normal gamma mixed error model. Previous research with the normal-gamma model assumed that the moments of both distributions were fixed. However, in this paper, the parameters of both normal and gamma distributions were allowed to vary with firm size. Estimated differences in the mean of the gamma distribution allowed him to capture differences in X-inefficiency. Using estimates of a life insurance cost function, the Yuengert calculated scale and scope efficiency, the extent of X-inefficiency, and the relative importance of X-inefficiency and symmetric estimation errors. The empirical evidence suggested the existence of ray scale economies in the life industry. However, there was no evidence of any product mix economies. There was a substantial amount of X-inefficiency in the industry, but the differences across firm size were insignificant. On an average costs were 35-50 per cent higher than the level suggested by the cost frontier.

Gardner and Grace (1993) estimated hybrid translog cost functions for 561 US life insurers using six years of data (1985-1990). They examined the resulting residuals to determine the relative efficiency of insurers in the sample. They also tested the residuals to see if they are related to so-called X-efficiencies because of internal and external monitoring, or to other factors related to rent-seeking. Results show a large degree of persistent inefficiency seems to exist among sample firms, the inefficiencies relate to some internal or external monitoring, and rent-seeking may be occurring. These studies found evidence of significant scale economies in the industry. However, larger US firms were found to exhibit decreasing returns to scale.

Using data for the US life insurance industry during 1990-1995, Meador, Ryan, Jr. and Schellhorn (1997) empirically tested for a relationship between a firm's output choice and measures of X-efficiency. The empirical evidence suggested that diversification across multiple insurance and investment product lines resulted in greater X-efficiency than a more focused production strategy. The analysis in this article is consistent with the proposition that managers of multiproduct firms are able to achieve greater cost efficiencies than their counterparts in more focused firms by sharing inputs and efficiently allocating resources across product

lines in response to changing industry conditions. The findings justified the existence of multiproduct firms in the absence of cost complementarities and identify product diversification as a source of efficiency in the life insurance industry that should be recognized by managers, policyholders, and regulators.

Cummins,Tennyson and Weiss (1999) examined the relationship between mergers and acquisitions, efficiency, and scale economies in the US life insurance industry. They estimated cost and revenue efficiency of the life insurance companies for 1988-1995 using data envelopment analysis (DEA). The Malmquist methodology is used to measure changes in efficiency over time. They found that acquired firms achieve greater efficiency gains than firms that have not been involved in mergers or acquisitions. Relatively weaker firms were found to be acquisition targets. Overall, mergers and acquisitions in the life insurance industry resulted in providing a beneficial impact on efficiency.

Cummins and Zi (1998) presented a comparative analysis of cost efficiency of 445 US life insurers (for 1988-92) by the application of a wide range of econometric and mathematical programming techniques. The alternative methodologies gave significantly different estimates of efficiency for the insurers included in the sample. The efficiency rankings were quite well-preserved across the econometric techniques. However, the rank correlations between efficiency scores were found to be lower across econometric and mathematical programming techniques. The same was the case across alternative mathematical programming methodologies. Thus, the choice of methodology had a significant effect on the results. Most of the insurers exhibited either increasing or decreasing returns to scale. Further, stock and mutual insurers were found to be equally efficient after controlling for firm size.

Gamarra (2007) estimated cost and profit efficiency of three groups of German life insurance companies: multi-channel insurers, direct insurers, and independent agent insurers. Non-parametric DEA is used to estimate efficiencies for a sample of German life insurers for the years 1997-2005. Testing a set of hypothesis, she found economic evidence for the coexistence of the different distribution systems which is the absence of comparative performance advantages of specialized insurers. Further, she found evidence for scale economies in the German life insurance industry.

Boonyasai, Grace and Skipper, Jr. (2002) analyzed the impact of liberalization and deregulation of four life insurance markets: Korea, Philippines, Taiwan, and Thailand. The first two countries undertook major liberalization and deregulation efforts, whereas the latter two countries undertook modest liberalization efforts only. Using data envelopment analysis to measure cost efficiency, they found that liberalization and deregulation of the Korean and Philippine life insurance industries seem to have stimulated increases and improvements in productivity. Liberalization of the Taiwanese and Thai life insurance businesses, however, seems to have had little effect on increases and improvements in productivity. Their

findings suggest liberalization and deregulation together promote competition. Further, the results are consistent with the view that, in a restrictive regulatory environment, welfare gains will be minimal if deregulation does not closely follow liberalization.

Diboky and Ubl (2007) explored the nexus between ownership and efficiency in the context of the German life insurance market for the period 2002-05. In the German insurance market privately-owned companies face competition by public insurers and the paper considered the comparative performance of private and public ownership by examining all three kinds of ownership: stock, mutual and public ownership forms. The paper calculated technical, cost and allocative efficiency scores of the German life insurance companies to test the efficient structure hypothesis as well as the expense preference hypothesis.

Tone and Sahoo (2005) applied the new cost efficiency model (Tone 2002) to examine the performance of Life Insurance Corporation (LIC) of India. They have examined the performance trends of Life Insurance Corporation of India for the period 1982-83 through 2000-01. The findings show a significant heterogeneity in the cost efficiency scores (overall and scale efficiencies) over the course of 19 years. More importantly, there has been a downward trend in performance, measured in terms of cost efficiency, since 1994-95. This decline is due to the huge initial fixed cost of modernizing their operations. A significant increase in cost efficiency in 2000-01 is, however, cause for optimism. Results from a sensitivity analysis are in broad agreement with the main findings of this study.

Cummins, Weiss, Xie and Zi (2010) investigated economies of scope in the US insurance industry over the period 1993-2006. They tested the conglomeration hypothesis, which holds that firms can optimize by diversifying across businesses, *versus* the strategic focus hypothesis, which holds that firms optimize by focusing on core businesses. To be specific, they analysed whether it is advantageous for insurers to offer both life-health and property-liability insurance or to specialize in one major industry segment. Cummins, *et. al.* estimated cost, revenue, and profit efficiency utilizing data envelopment analysis (DEA) and tested for scope economies by regressing efficiency scores on control variables and an indicator for strategic focus. It was found that property-liability insurers realize cost scope economies, but they are more than offset by revenue scope diseconomies. Life-health insurers realize both cost and revenue scope diseconomies. Hence, strategic focus is superior to conglomeration in the insurance industry.

## *Section III*
## **Dataset**

The paper makes use of data pertaining to the life insurance in India for the years 2005-06 to 2009-10. For estimation purposes, we have considered fifteen companies which were in existence for the entire period. The data has been obtained

from the Annual Reports of the Insurance Regulatory and Development Authority (IRDA). The paper uses two outputs: sum assured and increment in asset under management and operating expenses, commission expenses, branch and agents as the inputs. The descriptive statistics of input/output variables are provided in the Appendixes A to C.

## *Section IV*
## Methodology of Measurement of Cost Efficiency

Cost efficiency of a productive enterprise is an important indicator of its performance. The cost efficiency of a firm is defined by the ratio of minimum costs to actual costs for a given output vector and is computed by measuring the distance of its observed (cost) point from an idealised cost frontier.

### 1. The Data Envelopment Approach

Data Envelopment Analysis (DEA) is a non-parametric linear programming tool generally used for performance evaluation of economic units through the construction of such an economic frontier. The advantage of DEA is that it requires very few prior assumptions on input-output relationship. The DEA method enables extension of the single input-single output technical efficiency measure to the multiple output-multiple input case. In its constant returns to scale form, the DEA methodology was developed by Charnes, Cooper and Rhodes (1978). Banker, Charnes and Cooper (1984) extended the approach to the case of variable returns to scale. These formulations, however, did not consider input/output price data. The application of the non-parametric approach was developed by Fare, Grosskopf and Lovell (1985) although the concept was introduced much earlier by Farrell (1957).

The principal advantage of the DEA approach stems from the fact that the assumption of a specific functional form of the underlying technology is not necessary. This makes DEA particularly useful when dealing with service industries, since we have very limited knowledge about the underlying production technology in such cases. Instead of using any functional form, DEA uses linear programming approaches to envelope the observed data as tightly as possible. It only requires that the production possibility set is convex and the inputs and outputs are disposable.

### 2. Estimation of Cost Efficiency Using DEA: The Farrell Approach

Suppose we have data on r inputs and s outputs for each of the n firms. The ith firm (i=1, 2, ..., n) uses a r x 1 input vector xi= ($x_1$, $x_2$, ..., $x_r$) to produce a s x 1 output vector y = ($y_1$, $y_2$, ..., $y_s$) where X is a r x n input matrix and Y is a s x n output matrix that represent data for all n sample firms. The underlying production possibility set is given by:

$$P = \{(x,y) \mid x \geq X\lambda, y \leq Y\lambda, \lambda \geq 0, \Sigma\lambda = 1\} \quad (1)$$

where X and Y refer to the input and output vectors respectively defined in physical terms. Estimation of cost efficiency thus requires information about input prices. In the presence of input price information, estimation of cost efficiency involves a two step process. Under variable returns to scale, in the first stage, the following linear programming problem (LP) is solved:

$$\text{Min } \omega'_i x_i^* \quad \text{s. t.} \quad x_i \geq X\lambda,\ y_i \leq Y\lambda,\ \lambda \geq 0,\ \Sigma\lambda = 1 \tag{2}$$

Whether, $w_i$ is a r x 1 input price vector for the i-th firm which corresponds to the input vector $x_i$, and $x_i^*$ is the cost-minimizing input vector for the i-th firm which is obtained by the LP.

In the second stage, the cost efficiency of the i-th firm is calculated as the ratio of minimum cost to observed cost: $CE = \omega'_i x_i^* / \omega'_i x_i$. The measure of cost efficiency is bound between 0 and 1. A cost efficiency of 1 represents a fully cost efficient firm; 1-CE represents the amount by which the firm could reduce its costs and still produce at least the same amount of output.

***Decomposition of Farrell Measure of Cost Efficiency***

The Farrell measure of efficiency can be decomposed into two components – technical efficiency and allocative efficiency. Technical efficiency refers to the ability of a productive unit/system to reduce all variable inputs to produce same level of output or to expand all variable outputs for given inputs. Formally, technical efficiency can be computed (if one uses the cost minimizing approach) from the following minimization exercise:

$$\text{Min } \mu \quad \text{s. t.} \quad \mu x^0 \geq X\lambda,\ y^0 \leq Y\lambda,\ \Sigma\lambda = 1 \tag{3}$$

The scalar (variable) $\mu$ is the (proportional) reduction applied to all inputs of the evaluated productive unit to improve efficiency.

Allocative efficiency refers to the ability of the productive system to select the right input/output vector in the light of the prevailing input and output prices. Obviously in the context of cost minimization, allocative efficiency corresponds to the ability of the firm to select the right input vector given the input prices. Allocative efficiency is computed indirectly by applying the equality AE = Cost Efficiency/Technical Efficiency.

**3. Estimation of Cost Efficiency: The New Approach**

In the present context, application of the Farrell measure of cost efficiency has two major shortcomings. To begin with, the Farrell measure of cost efficiency is based on the premise that all the producers face same input prices. If this is not the case then the Farrell measure may not provide correct estimation of cost efficiency (Tone 2002). Secondly, in the life insurance sector, input and output quantities are expressed in monetary terms and consequently the definition and calculation of input and output prices is a difficult proposition. Tone (2002)

proposed a different measure of cost efficiency which is based on a different production possibility set $P_C = \{(x_c,y) | x_c \geq X_c \lambda, y \leq Y\lambda, \lambda \geq 0, \Sigma\lambda = 1\}$, where $x_c$ and $X_c$ are defined in monetary terms.

In the present paper, cost efficiency is calculated by Tone's approach also. This is done by replacing the input vector $x_i$ expressed in physical terms by $z_i$ where $z_i$ is the vector of inputs expressed in monetary terms (i.e. $z_i = \omega'_i x_i$). This approach further allows us to model input prices $w_i$ being equal to unity for all selected inputs. Under variable returns to scale, the new LP is, therefore:

$$\text{Min } C = \Sigma z_i \quad \text{s.t. } z_i \geq Z\lambda,\ y \leq Y\lambda,\ \lambda \geq 0, \Sigma\lambda = 1 \qquad (4)$$

Cost efficiency is calculated like before as the ratio of minimum cost and observed cost. The present paper applies the following approach: In order to use DEA for estimating cost efficiency, it is essential to identify the relevant inputs and outputs of the life insurance firms. Selection of input/output variables, however, is rather difficult for insurance firms since input prices are often implicit, and many outputs are intangible.

***(a) Measurement of Output***

The outputs of financial service firms are measured according to three main approaches: the asset (intermediation) approach, the user-cost approach, and the value-added approach (Berger and Humphrey, 1992).

The asset approach treats financial service firms as pure financial intermediaries which borrow funds from their customers which are invested, and thus transformed into assets. Interest payments are paid out to cover the time value of the funds used. Applying the asset approach would mean that only the intermediation services provided by life insurance firms are taken into account without any regard to the risk-pooling and risk-bearing services rendered by them.

The user-cost approach was developed by Hancock (1985). It determines whether a financial product is an input or output by analyzing if its net contribution to the revenues of an insurance firm is positive or negative. According to that, a product is considered an output, if its financial return exceeds the opportunity costs of funds or if the financial costs of a liability are lower than the opportunity costs. Otherwise, the financial product would be classified as an input. This method would require precise information on product revenues and opportunity costs which cannot be obtained for the Indian life insurance firms.

The value-added approach differs from the asset approach and the user-cost approach as it considers all asset and liability categories to have some output characteristics. Those categories which have substantial value-added are then used as the important outputs. The remaining categories are treated as rather unimportant outputs, intermediate products, or inputs. An important advantage compared to the user-cost approach consists in the fact that the value-added

approach uses operating cost data rather than determining the costs implicitly or using opportunity costs. The value-added approach is considered to be the most appropriate method to measure output of financial firms and is widely used in recent insurance studies.

In the present study, we follow the value-added approach and have taken the incremental asset under management of the insurance companies as the proxy for output. In addition to this, the sum assured by the life insurance companies have also been considered as another output indicator. This is in recognition to the risk management function performed by the life insurers.

***(b) Measurement of Input***

The life insurers have two important cost components: operating expenses and commission expenses. In the Tone's approach we have included both of them in our study as inputs expressed in monetary terms. In the Farrell approach, however, it is essential to define inputs in physical terms. Consequently in this approach agents employed by the life insurance companies and the number of branches maintained by them have been taken as the inputs. The corresponding input prices are Commission Expenses Per Agent and Operating Expenses Per Branch.

***(c) Input-Output Correspondence***

The present paper thus proceeds with two different underlying cost functions. In the Farrell approach the underlying cost function is *Total Cost = f (Agents, Branches)*. The corresponding production function is Output *(Sum Assured, Incremental Asset Under Management) = f (Agents, Branches)*.

In the Tone's approach, the underlying cost function is *Total Cost = f (Operating Expenses, Commissions Paid)*. The corresponding production function is *Output (Sum Assured, Incremental Asset Under Management ) = f (Operating Expenses, Commissions Paid)*. Computation of the new cost efficiency (as suggested by Tone) has been made using DEA Solver Pro-7.0.

In the Farrell approach, the cost efficiency is further decomposed into technical efficiency and allocative efficiency. Computation of Farrell measures of cost and technical efficiency has been made by using DEAP 2.1. In both the Farrell and Tone's approaches, variable returns to scale have been assumed to allow for local variations.

## *Section V*
## **Results**

**1. Descriptive Statistics of Cost Efficiency**

Tables 5 and 6 provide the descriptive statistics of Farrell and Tone's cost efficiency of the in-sample life insurance companies for 2005-06, 2006-07, 2007-08, 2008-09 and 2009-10.

***Table 5***
**Descriptive Statistics of Cost Efficiency Scores (Farrell's Approach)**

| *Particulars* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| No. of Life Insurers | 15 | 15 | 15 | 15 | 15 |
| Mean Cost Efficiency | 0.719 | 0.499 | 0.533 | 0.460 | 0.557 |
| Mean Cost Efficiency of Private Insurers | 0.699 | 0.463 | 0.503 | 0.421 | 0.525 |
| Standard Deviation | 0.2958 | 0.2804 | 0.3013 | 0.2572 | 0.3277 |

*Source:* Calculated.

***Table 6***
**Descriptive Statistics of Cost Efficiency Scores (Tone's Approach)**

| *Particulars* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| No. of Life Insurers | 15 | 15 | 15 | 15 | 15 |
| Mean Cost Efficiency | 0.740 | 0.518 | 0.522 | 0.442 | 0.622 |
| Mean Cost Efficiency of Private Insurers | 0.722 | 0.483 | 0.488 | 0.402 | 0.595 |
| Standard Deviation | 0.2771 | 0.2846 | 0.2969 | 0.3108 | 0.2618 |

*Source:* Calculated.

### 2. Decomposition of Cost Efficiency

Under the Farrell approach cost efficiency scores have been decomposed in the manner stated in the methodology. Tables 7 and 8 provide the descriptive statistics of technical and allocative efficiency scores.

### 3. Returns to Scale

Table 9 provides the summary information relating to the returns to scale exhibited by the in-sample life insurance companies. The table shows that most of the life insurance companies exhibited either increasing or constant returns to scale for the five year period.

***Table 7***
**Descriptive Statistics of Technical Efficiency Scores (Farrell's Approach)**

| *Particulars* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| No. of Life Insurers | 15 | 15 | 15 | 15 | 15 |
| Mean Efficiency | 0.776 | 0.639 | 0.625 | 0.623 | 0.585 |
| Mean Efficiency of Private Insurers | 0.760 | 0.614 | 0.598 | 0.596 | 0.555 |
| Standard Deviation | 0.2811 | 0.3088 | 0.2890 | 0.271 | 0.3257 |
| Maximum | 1 | 1 | 1 | 1 | 1 |
| Minimum | 0.139 | 0.185 | 0.153 | 0.248 | 0.124 |

*Source:* Calculated.

***Table 8***
**Descriptive Statistics of Allocative Efficiency Scores (Farrell's Approach)**

| *Particulars* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| No. of Life Insurers | 15 | 15 | 15 | 15 | 15 |
| Mean Efficiency | 0.907 | 0.772 | 0.821 | 0.727 | 0.938 |
| Mean Efficiency of Private Insurers | 0.900 | 0.755 | 0.809 | 0.708 | 0.934 |
| Standard Deviation | 0.1235 | 0.1595 | 0.144 | 0.185 | 0.115 |
| Maximum | 1 | 1 | 1 | 1 | 1 |
| Minimum | 0.665 | 0.483 | 0.586 | 0.44 | 0.579 |

*Source:* Calculated.

***Table 9***
**Mean Cost, Technical and Allocative Efficiency**

| *Particulars* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| Technical Efficiency | 0.776 | 0.639 | 0.625 | 0.623 | 0.585 |
| Allocative Efficiency | 0.907 | 0.772 | 0.821 | 0.727 | 0.938 |
| Debreu-Farrell Measure of Cost Efficiency | 0.719 | 0.499 | 0.537 | 0.460 | 0.557 |
| Tone's Measure of Cost Efficiency | 0.740 | 0.518 | 0.522 | 0.442 | 0.622 |

*Source:* Calculated.

***Table 9a***
**Returns to Scale: Summary Information**

| *Returns to Scale* | *2005-06* | | *2006-07* | | *2007-08* | | *2008-09* | | *2009-10* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Effi-cient* | *Pro-jected* | *Effi-cient* | *Pro-jected* | *Effi-cient* | *Pro-jected* | *Effi-cient* | *Pro-jected* | *Effi-cient* | *Pro-jected* |
| No. of IRS | 2 | 5 | 3 | 10 | 1 | 9 | 1 | 13 | 1 | 6 |
| No. of CRS | 4 | 3 | 2 | 0 | 3 | 2 | 1 | 0 | 4 | 3 |
| No. of DRS | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 7 | 8 | 5 | 10 | 4 | 11 | 2 | 13 | 5 | 10 |

*Source:* Calculated.

## 4. Cost Efficiency and Operational Strategy: Some Econometric Evidence

In Section I of the present study, mention has been made about two interesting developments in the life insurance market in India: *(a)* the growing importance of unit linked insurance products relative to the non-linked products, and *(b)* the increasing importance of non-traditional channels of product promotion like corporate agents, brokers and direct selling in the promotion of insurance products. The present study also tries to assess possible influence of such developments on the cost efficiency of the in-sample life insurance companies. Many of the non-parametric studies on the efficiency of productive systems have used a two stage approach which involved estimation of technical/cost/revenue

efficiencies in the first stage and in the second stage the estimated efficiency scores are regressed on covariates which are proxies of environmental variables.

Taking a similar path, we now attempt to assess the influence of the factors mentioned above on the cost efficiency of the observed insurance companies. However, in order to do so, it is essential to elaborate a data generation process so that we can conceptually relate the efficiency scores with a new set of (environmental) variables. Towards this end, we relate the observed and optimal cost efficiency of the insurance companies in the following manner:

$$C_{oi} = C_{bi} + C_o \text{ x } U_i$$

Where $C_{oi}$ and $C_{bi}$ are the observed and benchmark total cost of the insurance company in question and $U_i$ (white noise)≥0. True cost efficiency of the company is:

$$\theta_c = C_{bi}/ C_{oi} = 1- U_i$$

We now relate $U_i$ with a set of environmental variables $Q_i$ through this linear relationship:

$$U_i = \alpha_0 + \alpha_1 Q_i + v_i$$

Thus $C_{oi}$ can be related to $Q_i$ in the following manner:

$$\theta_c = (1- \alpha_0) - \alpha_1 Q_i - v_i \text{ OR}$$

$$\theta_c = \beta_0 + \beta_1 Q_i + \varepsilon_i$$

Where $\beta_0 = 1- \alpha_0$, $\beta_1 = - \alpha_1$ and $\varepsilon_i = - v_i$.

For the purpose of estimation, we replace the true cost efficiency $\theta_c$ by the DEA estimate $\theta_{dea}$ :

$$\theta_{dea} = \beta_0 + \beta_1 Q_i + \varepsilon_i$$

Since the cost efficiency scores have lower and upper ceilings of 0 and 1 respectively, a censored tobit model has been employed for the purpose of estimation.

For our present purpose, two explanatory variables have been considered: Product Mix and Channel Mix. Product Mix represents the ratio of ULIP funds of the in-sample life insurance companies to their total Asset Under Management. The relative information is available from the IRDA Annual Reports for 2005-06 to 2009-10. Channel Mix on the other hand represents the ratio of new business premium collected by the individual agents to the total new business premium collected by all the channels collectively. The relative information is available from the IRDA Annual Reports for the period 2006-07 to 2009-10.

In the present study Product Mix and Channel Mix have been considered separately as regressors. Thus, four separate runs have been made taking new and old cost efficiency scores as the dependent variables. The period of observation is 2005-06 to 2009-10 for product mix and 2006-07 to 2009-10 for channel mix. Since the efficiency scores vary between 0 and 1, a censored Tobit Model has been applied for the estimation of the parameters. Further in all the four runs a cross section dummy variable has been used to control for idiosyncratic factors affecting cost efficiency. Estimation has been made using LIMDEP. The results obtained from the regression analysis indicate that the DEA based cost efficiency scores are negatively related to Product Mix but positively related to Channel Mix. The regression results are presented in Tables 10 to 13.

***Table 10***
**Cost Efficiency (Tone) and Product Mix**

| *Description* | *Coefficient(β)* | *Standard Error[SE(β)]* | *β/SE(β)* |
|---|---|---|---|
| Cost Efficiency (Dependent Variable) | – | – | – |
| Constant | 0.994 | 0.1843 | 5.394 |
| Cross Section Dummy | 0.00004 | 0.0112 | 0.003 |
| Product Mix (Explanatory Variable) | -0.6351 | 0.1927 | -3.296 |
| Disturbance Standard Deviation | 0.3511 | 0.0351 | 10.00 |
| ANOVA Based Fit Measure | | 0.4753 | |
| Decomposition Based Fit Measure | | 0.4532 | |

*Source:* Calculated.

***Table 11***
**Cost Efficiency (Farrell) and Product Mix**

| *Description* | *Coefficient(β)* | *Standard Error[SE(β)]* | *β/SE(β)* |
|---|---|---|---|
| Cost Efficiency (Dependent Variable) | – | – | – |
| Constant | 1.0785 | 0.1692 | 6.375 |
| Cross Section Dummy | 0.0052 | 0.0099 | 0.526 |
| Product Mix (Explanatory Variable) | -0.8715 | 0.1791 | -4.867 |
| Disturbance Standard Deviation | 0.3112 | 0.0309 | 10.07 |
| ANOVA Based Fit Measure | | 1.2148 | |
| Decomposition Based Fit Measure | | 0.5355 | |

*Source:* Calculated.

***Table 12***
**Cost Efficiency (Tone) and Channel Mix**

| *Description* | *Coefficient(β)* | *Standard Error[SE(β)]* | *β/SE(β)* |
|---|---|---|---|
| Cost Efficiency (Dependent Variable) | – | – | – |
| Constant | -0.1815 | 0.1577 | -1.151 |
| Cross Section Dummy | 0.0129 | 0.0098 | 1.320 |
| Channel Mix (Explanatory Variable) | 1.0422 | 0.2502 | 4.166 |
| Disturbance Standard Deviation | 0.3096 | 0.0339 | 9.145 |
| ANOVA Based Fit Measure | | 0.6608 | |
| Decomposition Based Fit Measure | | 0.4881 | |

*Source:* Calculated.

***Table 13***
**Cost Efficiency (Farrell) and Channel Mix**

| *Description* | *Coefficient(β)* | *Standard Error[SE(β)]* | *β/SE(β)* |
|---|---|---|---|
| Cost Efficiency (Dependent Variable) | – | – | – |
| Constant | 0.076 | 0.1585 | -0.480 |
| Cross Section Dummy | 0.0222 | 0.0099 | |
| Channel Mix (Explanatory Variable) | 0.722 | 0.2500 | 2.888 |
| Disturbance Standard Deviation | 0.3164 | 0.0342 | 9.243 |
| ANOVA Based Fit Measure | | 0.2699 | |
| Decomposition Based Fit Measure | | 0.4457 | |

*Source:* Calculated.

## *Section VI*
## Conclusions

The Structure-Conduct-Performance of the life insurance sector in India underwent radical changes following the opening up of the sector for the private players. Against this backdrop, the present study tried to address two specific research questions:

*(a)* How the players have performed (*vis-a-vis* one another) in terms of cost efficiency?

*(b)* How the cost efficiency of the life insurance companies can be related to their operational strategy (in particular, relative to their product composition and channel composition)?

Towards this end, the present study has compared the cost efficiency of 15 life insurance companies (which existed throughout the entire period of observation) using Farrell's approach as well as the new cost efficiency approach suggested by Tone (2002). The Farrell measure of cost efficiency has been decomposed into technical and allocative components. Since the cost benchmarks have been constructed on a year-wise basis and they are not related to one another, the results do not permit us to infer anything about the trend excepting the fact that a lower mean technical/cost efficiency imply greater divergence from the production/ cost frontier. The results show that mean cost efficiency scores have fluctuated over the observation period. Further, decomposition of the Farrell measure of cost efficiency into input oriented technical efficiency and allocative efficiency reveals that such divergence is more pronounced in case of allocative efficiency than in case of technical efficiency.

Relating to the second research question, the study reveals that cost efficiency of the in-sample life insurance companies is negatively related to the ratio of unit linked to non-unit linked products but is positively related to the ratio of premium collected through traditional channel (i.e. individual agents) compared to non-traditional channels.This result has significant implications relating to the operational practices of the life insurance companies operating in India.

A major shortcoming of the present study is that of limited availability of information. However, the Indian life insurance sector is expanding rapidly and competition is becoming more intense consequent on the arrival of newer players. With progressive widening and deepening of the life insurance market, more robust outcomes based on larger sample size can be expected from future research studies.

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## *Appendix A*
## Descriptive Statistics of Input and Output Variables

### *Appendix A1*
### Descriptive Statistics of Input/Output Variables (2005-06)

| *Statistical Measure* | *Operating Expenses (Rs Million)* | *Commission Paid (Rs Million)* | *Branch* | *Agent* | *Incremental Asset Under Management (Rs Million)* | *Sum Assured (Rs Million)* |
|---|---|---|---|---|---|---|
| Max | 60415.6 | 70949.2 | 2220 | 1052993 | 454820 | 427400 |
| Min | 65.8 | 35.8 | 11 | 78 | 190 | 3800 |
| Average | 6536.3 | 5813.3 | 257.6 | 105589.3 | 39132 | 163662 |
| SD | 14537.6 | 17431.4 | 540.1972 | 257451.9 | 111589.1 | 136597.2 |

*Source:* Calculated.

***Appendix A2***
**Descriptive Statistics of Input/Output Variables (2006-07)**

| *Statistical Measure* | *Operating Expenses (Rs Million)* | *Commission Paid (Rs Million)* | *Branch* | *Agent* | *Incremental Asset Under Management (Rs Million)* | *Sum Assured (Rs Million)* |
|---|---|---|---|---|---|---|
| Max | 70808.6 | 91690.7 | 2301 | 1103047 | 954290 | 33251640 |
| Min | 154.2 | 66.8 | 12 | 9797 | 380 | 16990 |
| Average | 9009.9 | 8183.3 | 357.1333 | 132795.5 | 77940 | 2571479 |
| SD | 16929.2 | 22432.6 | 568.1543 | 268053.5 | 234789.2 | 8204829 |

*Source:* Calculated.

***Appendix A3***
**Descriptive Statistics of Input/Output Variables (2007-08)**

| *Statistical Measure* | *Operating Expenses (Rs Million)* | *Commission Paid (Rs Million)* | *Branch* | *Agent* | *Incremental Asset Under Management (Rs Million)* | *Sum Assured (Rs Million)* |
|---|---|---|---|---|---|---|
| Max | 83093.2 | 95581 | 2522 | 1193744 | 1192020 | 17333280 |
| Min | 237.3 | 205.5 | 33 | 12839 | 1990 | 26960 |
| Average | 13335.8 | 9753.6 | 588.3333 | 167230.2 | 107584.7 | 1596896 |
| SD | 19984.1 | 23208.1 | 706.7927 | 287704.4 | 291391.2 | 4229475 |

*Source:* Calculated.

***Appendix A4***
**Descriptive Statistics of Input/Output Variables (2008-09)**

| *Statistical Measure* | *Operating Expenses (Rs Million)* | *Commission Paid (Rs Million)* | *Branch* | *Agent* | *Incremental Asset Under Management (Rs Million)* | *Sum Assured (Rs Million)* |
|---|---|---|---|---|---|---|
| Max | 90642.9 | 100332.4 | 3030 | 1344256 | 1211910 | 20375310 |
| Min | 397.3 | 241.5 | 49 | 13515 | 8900 | 40130 |
| Average | 16263.18 | 10203.4 | 758.8 | 191664.8 | 99286.67 | 1932282 |
| SD | 21186.16 | 24228.9 | 799.3754 | 317984.9 | 297836.6 | 4957120 |

*Source:* Calculated.

***Appendix A5***
**Descriptive Statistics of Input/Output variables (2009-10)**

| *Statistical Measure* | *Operating Expenses (Rs Million)* | *Commission Paid (Rs Million)* | *Branch* | *Agent* | *Incremental Asset Under Management (Rs Million)* | *Sum Assured (Rs Million)* |
|---|---|---|---|---|---|---|
| Max | 122458.2 | 121103.1 | 3250 | 1402807 | 1854350 | 23419370 |
| Min | 370 | 236.8 | 49 | 13856 | 3690 | 45830 |
| Average | 17896.7 | 11756.9 | 769.8667 | 192364.7 | 190059.3 | 2252827 |
| SD | 28712.3 | 29341.9 | 823.1099 | 331453 | 449408.4 | 5702234 |

*Source:* Calculated.

***Appendix B***
**Insurer-wise Cost Efficiency Scores: Farrell *vs* Tone**

***Appendix B1***
**Insurer-wise Cost Efficiency Scores (Farrell's Approach)**

| *Life Insurance Company* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| Aviva | 0.41 | 0.337 | 0.393 | 0.442 | 1 |
| Bajaj Allianz | 0.279 | 0.144 | 0.37 | 0.431 | 0.439 |
| Birla Sun Life | 0.571 | 0.344 | 0.279 | 0.297 | 0.297 |
| HDFC Bank | 0.675 | 0.232 | 0.235 | 0.245 | 0.397 |
| ICICIPru | 1 | 0.316 | 0.206 | 0.185 | 0.346 |
| ING Vysya | 0.419 | 0.206 | 0.236 | 0.271 | 0.351 |
| Kotak | 0.98 | 0.445 | 0.528 | 0.554 | 0.53 |
| LIC | 1 | 1 | 1 | 1 | 1 |
| Max New York Life | 1 | 0.728 | 0.823 | 0.338 | 0.266 |
| MetLife | 0.661 | 0.519 | 0.721 | 0.534 | 0.424 |
| Reliance | 0.118 | 0.191 | 0.14 | 0.127 | 0.184 |
| Sahara | 1 | 0.574 | 1 | 1 | 1 |
| SBI Life | 1 | 0.886 | 1 | 0.561 | 1 |
| Shri Ram Life | 1 | 1 | 0.732 | 0.646 | 1 |
| Tata AIG | 0.666 | 0.562 | 0.384 | 0.262 | 0.118 |

*Source:* Calculated.

***Appendix B2***
**Insurer-wise Cost Efficiency Scores (Tone's Approach)**

| *Life Insurance Company* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| Aviva | 0.377 | 0.256 | 0.211 | 0.266 | 1 |
| Bajaj Allianz | 0.648 | 0.261 | 0.423 | 0.544 | 0.624 |
| Birla Sun Life | 1 | 0.421 | 0.480 | 0.312 | 0.472 |
| HDFC Bank | 0.927 | 0.535 | 0.445 | 0.168 | 0.538 |
| ICICIPru | 1 | 0.573 | 0.490 | 0.361 | 0.875 |
| ING Vysya | 0.351 | 0.281 | 0.300 | 0.212 | 0.418 |
| Kotak | 1 | 0.405 | 0.357 | 0.256 | 0.458 |
| LIC | 1 | 1 | 1 | 1 | 1 |
| Max New York Life | 0.983 | 0.275 | 0.257 | 0.246 | 0.315 |
| MetLife | 0.465 | 0.299 | 0.257 | 0.252 | 0.380 |
| Reliance | 0.181 | 0.304 | 0.339 | 0.159 | 0.340 |
| Sahara | 0.677 | 1 | 1 | 1 | 1 |
| SBI Life | 0.881 | 0.844 | 0.985 | 0.683 | 1 |
| Shri Ram Life | 1 | 1 | 1 | 1 | 0.402 |
| Tata AIG | 0.616 | 0.312 | 0.286 | 0.169 | 0.505 |

*Source:* Calculated.

***Appendix C***
**Decomposition of Cost Efficiency and Returns to Scale: Farrell's Approach**

***Appendix C1***
**Technical Efficiency (Farrell's Approach)**

| *Life Insurance Company* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| Aviva | 0.526 | 0.528 | 0.628 | 0.881 | 1 |
| Bajaj Allianz | 0.406 | 0.185 | 0.452 | 0.687 | 0.49 |
| Birla Sun Life | 0.859 | 0.414 | 0.364 | 0.403 | 0.301 |
| HDFC Bank | 0.823 | 0.37 | 0.312 | 0.272 | 0.404 |
| ICICIPru | 1 | 0.349 | 0.351 | 0.389 | 0.598 |
| ING Vysya | 0.419 | 0.426 | 0.365 | 0.301 | 0.365 |
| Kotak | 1 | 0.676 | 0.68 | 0.785 | 0.534 |
| LIC | 1 | 1 | 1 | 1 | 1 |
| Max New York Life | 1 | 1 | 1 | 0.77 | 0.34 |
| MetLife | 0.665 | 0.708 | 0.743 | 0.576 | 0.426 |
| Reliance | 0.139 | 0.196 | 0.153 | 0.248 | 0.194 |
| Sahara | 1 | 1 | 1 | 1 | 1 |
| SBI Life | 1 | 1 | 1 | 0.885 | 1 |
| Shri Ram Life | 1 | 1 | 0.777 | 0.773 | 1 |
| Tata AIG | 0.8 | 0.738 | 0.552 | 0.37 | 0.124 |

*Source:* Calculated.

***Appendix C2***
**Allocative Efficiency (Farrell's Approach)**

| *Life Insurance Company* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| Aviva | 0.779 | 0.638 | 0.626 | 0.501 | 1 |
| Bajaj Allianz | 0.687 | 0.779 | 0.818 | 0.627 | 0.895 |
| Birla Sun Life | 0.665 | 0.831 | 0.767 | 0.738 | 0.984 |
| HDFC Bank | 0.82 | 0.627 | 0.751 | 0.901 | 0.983 |
| ICICIPru | 1 | 0.906 | 0.586 | 0.476 | 0.579 |
| ING Vysya | 0.999 | 0.483 | 0.646 | 0.901 | 0.963 |
| Kotak | 0.98 | 0.658 | 0.777 | 0.706 | 0.992 |
| LIC | 1 | 1 | 1 | 1 | 1 |
| Max New York Life | 1 | 0.728 | 0.823 | 0.44 | 0.782 |
| MetLife | 0.994 | 0.733 | 0.97 | 0.927 | 0.995 |
| Reliance | 0.846 | 0.971 | 0.917 | 0.511 | 0.948 |
| Sahara | 1 | 0.574 | 1 | 1 | 1 |
| SBI Life | 1 | 0.886 | 1 | 0.635 | 1 |
| Shri Ram Life | 1 | 1 | 0.942 | 0.835 | 1 |
| Tata AIG | 0.832 | 0.762 | 0.696 | 0.708 | 0.952 |

Source: Calculated.

***Appendix C3***
**Insurer-wise Returns to Scale (for the Observed Years)**

| *Life Insurance Company* | *2005-06* | *2006-07* | *2007-08* | *2008-09* | *2009-10* |
|---|---|---|---|---|---|
| Aviva | Constant | Increasing | Increasing | Increasing | Constant |
| Bajaj Allianz | Constant | Increasing | Constant | Increasing | Constant |
| Birla Sun Life | Increasing | Increasing | Increasing | Increasing | Increasing |
| HDFC Bank | Constant | Increasing | Increasing | Increasing | Increasing |
| ICICIPru | Constant | Increasing | Constant | Increasing | Constant |
| ING Vysya | Increasing | Increasing | Increasing | Increasing | Increasing |
| Kotak | Increasing | Increasing | Increasing | Increasing | Increasing |
| LIC | Decreasing | Constant | Constant | Constant | Constant |
| Max New York Life | Constant | Increasing | Constant | Increasing | Decreasing |
| MetLife | Increasing | Increasing | Increasing | Increasing | Increasing |
| Reliance | Increasing | Increasing | Increasing | Increasing | Constant |
| Sahara | Constant | Increasing | Increasing | Increasing | Increasing |
| SBI Life | Constant | Constant | Constant | Increasing | Constant |
| Shri Ram Life | Increasing | Increasing | Increasing | Increasing | Constant |
| Tata AIG | Increasing | Increasing | Increasing | Increasing | Increasing |

*Source:* Calculated.