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POST-REFORM LIFE INSURANCE INDUSTRY IN INDIA: A STUDY ON SCALE EFFICIENCY

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Abstract

Indian life insurance industry witnesses a rapid growth during the post-reform period. The current statistics on number of policies and branches, sum assured, premium, share capital, insurance penetration, insurance density etc., show noticeable hike, compared to their respective values at the outset of reform. Also, total fund registers a steep rise with a compound annual growth rate of approximately 17.90% in the last seventeen years. In view of this magnanimous growth of scale, represented here by the summation of total fund and income there from, the present article seeks to measure scale efficiency of the Indian public and private life insurance sectors, both sector-wise and in totality, during the post-reform period. This study applies Econometric Frontier Approach (EFA) to estimate Transcendental Logarithmic (Translog) cost function consisting of one output and two input variables, labour and capital for a time period from 2003-04 to 2017-18. Results on scale efficiency scores of private and public life insurance sectors are 0.274378 and 0.808870 respectively. However, though both the sectors exhibit scale economies, a cautious cost effective policy should be adopted in future by public life insurance sector to raise total fund and to invest them. Indian life insurance industry as a whole portrays huge opportunity to scale-up its total fund as current scale efficiency score is as low as 0.140533.

Keyword: *Life Insurance, Public and Private Sector, Scale Efficiency, EFA*

Broadening geographical spread, growing premium and sum assured, mounting number of life insurance policies could not belittle concerns like expensive insurance covers, limited public awareness, sluggish growth of insurance penetration and density, backward technology, limited product-mix,

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poor work culture etc. during the pre-reform period, which ultimately paved the way to reform. In consequence, the Insurance Regulatory and Development Act, 1999 was passed and the Insurance Regulatory and Development Authority (IRDA) was constituted on the recommendations of the Malhotra Committee. The primary objectives of the IRDA were to capture huge untapped market, to infuse efficiency through opening up the insurance sector for private and foreign players and to ensure financial security. Performance of the Indian life insurance sector during the post-reform period with respect to the parameters like number of policies and branches, sum assured, premium, share capital, total fund or asset under management, insurance penetration and density is noteworthy. Insofar as the number of policies and sum assured are concerned, their growth rates over last thirteen years are 71.22% and 708.72% respectively, which ensures the rise of the sum assured per policy. Concurrently, number of branches, life insurance premium and share capital register a hike of 325.42%, 588.34% and 740.44% respectively over last fifteen years. Along with these absolute parameters, the ratios like life insurance penetration and life insurance density become the part of this growth saga. This unabated expansion was aimed for at the time of liberalisation. But growing parameters lead to immediate concern over their impact on cost. Positive association between cost and most of the parameters requires us to measure responsiveness of cost due to change in individual parameters. In this respect, present study opts to measure fund elasticity of cost or scale efficiency scores, where scale being total fund and income from its investment. With the compound annual growth rate of 17.90% in total fund, a frequent check on its impact on cost is essential to ensure that further accumulation and investment of funds do not lead to scale diseconomies. In the presence of high scale efficiency score hovering around unity or more than that, cost controlling techniques need to be implemented to accumulate funds and investment avenues should be chosen on the ground of return potential.

The present paper attempts to measure scale efficiency scores for Indian life insurance industry as a whole, and also those for private and public life insurance sectors individually. The prime objective is to examine whether the change in cost is exactly in proportion to change in scale or there is an existence of scale economies / diseconomies.

This article consists of four sections. Section I reviews the relevant literature in a nutshell, and Section II discusses its methodological framework. We present the dataset along with the empirical findings in Section III. Section IV concludes.

I

Most of the studies on the efficiency appraisal of insurance companies are related to the U.S economy. A few scholars have tried it for other developed countries like the U.K, Canada, Austria etc. Though in the Indian context, efficiency studies are mostly associated with banking industry, the Indian life insurance sector does not remain virgin, but most of the studies are slanted towards the DEA approach. Literature on efficiency measurement with econometric tools appears scant in respect of the Indian insurance industry. Present study is an attempt to this end.

In the existent efficiency literature, the disagreements prevail mainly in point of difference in country-specificity, the nature of models employed, and the definition of variables. While the impacts of the country-variations on the result are understood, the sensitivities of model and variable specifications give rise to the theoretical debates. Several efficiency measures can be grouped under two broad categories, parametric or statistic based econometric approach and non-parametric or mathematical programming approach. The former approach (Econometric Frontier Approach) requires *a specific functional structure of the production function and distributional form for the inefficiency term. It* recognizes randomness in the real life phenomenon. But there are quite variations in the mathematical form underlying relationship among the variables under study. Stochastic Frontier Analysis (SFA), Thick Frontier Analysis (TFA), Distribution Free Approach (DFA) etc. are different types of parametric approach. *The* non-parametric *approach provides the methodology to measure the relative efficiency of several units without any a priori assumptions. This method does not require any parametric functional form. Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH) fall under this approach. Here the parametric approach is used to measure scale efficiency.*

Earlier studies use a simple linear relationship followed by the Cobb-Douglas function and the CES function. These functions are linear in logarithms. The study of Clark (1984) falls in this group. But under these specifications, the estimated relationship indicates either monotonically increasing or decreasing returns to scale, as they cannot capture variation in returns to scale. To overcome this weakness, recent studies use Transcendental Logarithmic (Translog) Function. Such a function is used by Reece (1992), Ennsfellner *et.al.* (2004) etc.

Aoba (2006) uses Cobb-Douglas production function under parametric approach to measure efficiency of the twenty two Japanese life insurance companies. His analysis is based on panel data. Results indicate an adverse impact of regulated price on overall efficiency. Barros *et.al.* (2006) attempt to measure technical efficiency of the Portuguese life insurance industry for a period from 1995 to 2003 with the help of EFA. They obtained mixed results. Some results indicate the existence of constant returns to scale while others do not. Such empirical contradictions prevail over the entire literature.

There are also differences in the literature on the specifications of output and input variables. Reece (1992) defines output as a complete set of entire financial services or contingent claims on real goods and services, whereas Ennsfellner *et al.* (2004) consider three output-variables for life and health insurance *viz.,* incurred benefits net of reinsurance, changes in reserve net of reinsurance, and total invested assets. Borges *et al.* (2008) use labour and equity capital as inputs and invested assets, losses incurred, reinsurance reserve and other reserves as outputs. A recent study by Dutta and Sengupta (2011) chooses operating expenses related to the insurance business, commission paid to the agents, and net benefits paid to the policyholders as inputs and net premium revenues as output.

In the Indian context, as mentioned earlier, efficiency studies are skewed more towards the DEA approach, for example, Sinha and Chatterjee (2009), Sinha (2007), Dutta and Sengupta (2011), Tone and Sahoo (2011), Chakraborty and Sengupta (2012), etc. A recent study by Dash and Muthyala (2018) also adopts the DEA approach to measure cost efficiency of top fifteen life insurance companies of India with multiple input and output variables over the period from 2010 to 2017. Its findings show that Life Insurance Corporation of India is the most efficient firm throughout followed by SBI Life and ICICI Prudential. Similar findings are previously obtained by Nandi in 2014. This study utilises output oriented DEA technique to evaluate the relative performance efficiency of top thirteen Indian life insurance companies individually, year-wise and sector wise over a period from 2002-03 to 2011-12. Results designate LICI as best performer year-wise, company-wise and sector-wise followed by private firms SBI Life and ICICI Prudential. As per the study of Kamlesh (2017), LICI leads on the ground of revenue efficiency also. Fewer studies *e.g.* Gowd *et al.* (2012), Mushtaq (2014) etc. use the econometric approach to analyse the performance of the Indian life insurance industry. These studies use statistical tools like co-efficient of variation, ANOVA and Trend Analysis. In this context, a study by Kamat *et al.* (2016) is worth mentioning. The liquidity ratio, solvency ratio, premium growth and age of the firm are regressed on Return on Assets (ROA) to evaluate financial performance of all life insurance companies for a sample period from 2009 to 2014. Their results indicate that profitability of life insurers is positively associated with liquidity, solvency and age, whereas the relationship between profitability and premium growth is negative.

Though fewer studies on performance of the Indian life insurance industry involve econometric tools but the summary of existing literature indicates a gap with respect to measuring scale efficiency on the basis of econometric approach in general and translog cost equation in particular.

The present paper attempts to measure the scale efficiency scores on the basis of the translog cost equation for the life insurance industry as a whole and for the private and public sector. On the basis of such scores, it aims to throw light on scale economies / diseconomies currently being experienced by private and public life insurance sector.

II

Firm achieves efficiency due to scale economies, scope economies or X-efficiency. Scale economies occur when with the proportional increase in inputs, the output increases at a higher rate. When output-mix remains unaltered under scale economies, it is called Ray Scale Economies (RSCE). But in practical world, change in scale mostly lead to change in output-mix. It is the case of Expansion Path Scale Economies (EPSCE). Scope economies are related to joint and specialised production. A firm becomes scope inefficient if it produces joint product whereas specialised production is profitable, or it confines itself to specialised production when production of multiple products is profitable. Cost efficiency sometimes contains elements which cannot be fully explained by scale economies and scope economies. These elements are captured by X-efficiency. In some of the studies, X-efficiency is equated to the managerial efficiency and entrepreneurial skills. Present study adopts Econometric Frontier Approach to measure scale efficiency chiefly because it recognises randomness in the real life phenomenon. This approach requires identification of a production/cost function. Firm's efficiency is measured with the help of estimated parameters of chosen function.

In efficiency literature, profit function is adapted in fewer studies *viz.,* Mullineaux (1978), Berger *et.al.* (1993), Kumbhakar (1996), Clark and Siems (2002), Sensarma (2005) etc. In consistence with the major portion of efficiency literature, the cost function is estimated here. It is the derivation of production function.

Initially it was the simple linear relationship which used to be estimated and then the Cobb-Douglas production function gained popularity. It is of the following form

$$Q = AK^{\alpha}L^{\beta} \qquad ....(1)$$

where Q is the total output, K and L are the inputs, capital and labour respectively. A, α, β are the parameters. Since the above function is based upon highly restrictive assumptions like constant returns to scale, unitary elasticity of substitution etc., it cannot represent most likely relationship between input(s) and output(s). The Constant Elasticity of Substitution (CES) production function is superior to the Cobb-Douglas function as here the the sum of the parameters α and β is not required to be unity. It takes the following form:

$$Q = A[\alpha K^{-\varrho} + (1-\alpha)L^{-\varrho}]^{-1/\varrho} \qquad ....(2)$$

But the CES function is also unrealistic as the sum of the parameters, though not equal to unity, but is a constant. Hence, this function also cannot capture variations in returns to scale. Also, all these functions have restricted applicability as these can assume only one output. To overcome this weakness and to present variations in returns to scale in relation to an industry which accommodates an age old state monolith LICI along with tiny new entrants, the present study uses the Transcendental Logarithmic (Translog) cost function. It can adopt various outputs and measure variable returns to scale. In general the translog specification of cost function is

$$LnC = \alpha_0 + \sum_i^n \alpha_i lny_i + \sum_j^m \beta_j lnp_j + 1/2\sum_i^n\sum_k^n \sigma_{ik} lny_i lny_k + 1/2\sum_j^m\sum_h^m \gamma_{jh} lnp_j lnp_h$$
$$+ \sum_i^n\sum_j^m \Omega_{ij} lny_i lnp_j + \varepsilon \qquad ....(3)$$

In the above equation, restrictions of symmetry and linear homogeneity have been imposed on the input prices.

A suitable model selection along with proper definition of variables is prerequisite for an appropriate estimation. Choice of input and output variables depends upon the nature of the industry. Unlike manufacturing firms which are always producer by nature, researchers face dilemma to establish the nature of financial firms, as producer or as intermediary. Studies such as Cummins and Weiss (1993), Berger and Humphrey (1997), Cummins, Weiss and Zi (1999) etc. have treated financial services firms as producer to measure efficiency, whereas Sealey and Lindley (1977) consider insurance firms as a mediator to channelize the fund from surplus to deficit sector and generate profit in the process.

The present study considers insurance industry as an intermediary. The adopted translog cost function consists of two inputs, labour and capital, along with single output. Labour is pertinent as labour in the form of agents is the most effective and active medium to persuade the prospective investors for policy purchase. Simultaneously, the role of share capital also cannot be denied for as it provides the sense of security to existing and prospective shareholders and policyholders. It acts as a buffer when premium falls short to predictable or actual claims. 'Operating expenses related to insurance business' is used to represent cost (C). Labour has been priced with commission per agent (W). Here the term 'agent' includes both individual and corporate agents. To price the other input variable i.e., capital (R), 'Income from Investments per rupee of share capital' has been considered. Output (Q) is represented by the total of all funds *viz.,* Life Fund, Pension & General Annuity Fund and Unit Linked Fund and income generated from investments of those funds. These funds are invested in several central government securities, state government securities, other approved securities, infrastructure investments etc.

The translog equation, thus formed, assumes the following form after estimation:

$$\ln C = \hat{\beta}_Q \ln Q + \hat{\beta}_R \ln R + \hat{\beta}_W \ln W + 1/2\hat{\beta}_{QQ}(\text{Ln}Q)^2 + 1/2\hat{\beta}_{RR}(\ln R)^2 + 1/2\hat{\beta}_{WW}(\ln W)^2 + \hat{\beta}_{QR}\ln Q \ln R + \hat{\beta}_{RW}\ln R \ln W + \hat{\beta}_{WQ}\ln W \ln Q + \varepsilon \quad ....(4)$$

where 'hat' over a parameter represents its estimated value. Now, scale economies stand for percentage change in operating expenses for the percentage change in the output. Hence it can be represented as follows:

$$\text{Scale economies } (\delta \ln C/\delta \ln Q) = \hat{\beta}_Q + \hat{\beta}_{QQ}\ln Q + \hat{\beta}_{QR}\ln R + \hat{\beta}_{WQ}\ln W \quad ....(5)$$

A greater than, equal to and less than value of the above equation represent scale diseconomies, constant returns to scale and scale economies respectively.

III

Secondary data have been collected from annual reports published by the Insurance and Regulatory Development Authority from 2003-2004 to 2017-18 and Handbook on Indian Insurance Statistics from 2013-2014 to 2017-18. There are twenty-four life insurance companies presently operating in India. The list of all existing life insurance companies along with their registration date has been provided in annexure I. Sector-wise summary statistics of cost, output and prices of input variables are presented in annexures II, III, IV and V respectively. Table 1 presents year-wise summary of cost, output and prices of inputs (average of both the sectors). But, for estimation of the translog equation, time series of the concerned variables are considered for individual cases (instead of average ones). So far as cost and output figures are concerned, more or less they follow increasing trend. During the sample period, mean of the price of capital and price of labour are ₹1.141738 and ₹0.752477 respectively with a standard deviation of 1.119864 and 0.228185 respectively. The price of labour follows an increasing trend. However, the price of capital shows a sudden decline in 2011-12. That is due to introduction of further share capital into public sector (Life Insurance Corporation of India). Since the inception share capital of LICI was ₹5 crores which increased to ₹100 crores in 2011-12 and remained at that level further.

Table 1: ANNUAL AVERAGE OF COST, OUTPUT AND PRICES FOR PUBLIC AND PRIVATE SECTOR

Year	Cost (₹ in Lakhs)	Output (₹ in Lakhs)	Price of Capital (₹)	Price of Labour (₹ in Lakhs)
2003-04	321242	19130447	1.03184	0.280029
2004-05	410780	23258336	1.096455	0.555301
2005-06	480553	26499851	1.010205	0.787332
2006-07	679292	32617231	1.593883	0.592796
2007-08	1015337	41228385	1.571849	0.598143
2008-09	1291595	47413110	2.820804	0.550218
2009-10	1445314	67994891	2.992449	0.629227
2010-11	1647115	77529790	3.393823	0.696973
2011-12	1482805	65029802	0.188068	0.7553
2012-13	1577619	94457824	0.20427	0.863536
2013-14	1873271	107081215	0.215911	0.920552
2014-15	1842958	124655726	0.220103	0.888163
2015-16	1938894	133610522	0.218954	0.978192
2016-17	2306944	155543957	0.31022	1.019511
2017-18	2441035	172304310	0.257239	1.171884

Source: Annexures II, III, IV and V

This article uses a truncated from of translog cost function where the input prices, as also their squared terms, are avoided. We exclude those terms since they exhibit little changes in the series. The truncated translog equation for private-sector and public-sector life insurance firms along with the whole life insurance industry is estimated on the basis of the linear regression method for 2003-04 to 2017-18. Table 2 presents test statistics for goodness-of-fit like R^2, Adjusted R^2, Standard Error of Estimate, F-statistics, and Durbin-Watson (dw) statistics for the industry as a whole and for the public and private life insurance sector. It shows that R^2 and Adjusted R^2 values are in the neighbourhood of unity for the industry and for the sectors. These statistics, along with high significance levels of F statistics, indicate high goodness-of-fit. The Durbin-Watson (dw) statistic for auto correlation indicates that the estimation is not inflicted by the problem of serial correlation.

Table 2: SECTOR WISE RELEVANT STATISTICS FOR TRANLOG MODEL

Industry/ Sector	R-squared	Adj. R-squared	Standard Error of Estimate	F (Sig.)	dw
Life Insurance Industry	0.999918	0.999577	0.3968768	7084.35 (0.000)	1.099
Private	0.999930	0.999883	0.19895	21446.73 (0.000)	1.724
Public	0.999983	0.999974	0.0944236	117598.07 (0.000)	1.974

Table 3 shows that either the output variable (LnQ) or its squared term is very significant in these estimations. But the products of output variable with both input prices are insignificant. These results may induce us to adopt a simple quadratic cost function (which is, indeed, a variety of truncated translog function) on the surmise that input prices are parameters. But it does not reflect the underlying feature of the data set where input prices are found varying over the years.

Table 3: ESTIMATED PARAMETERS AND THEIR RELEVANT STATISTICS

	LnQ			(LnQ)^2			LnQlnR			LnWlnQ		
Indstry / Sector	Coeff.	S.E	t (sig.)	Coeff.	S.E	t (sig.)	Coeff	S E	t (sig.)	Coeff	S.E	t (sig.)
Life Insurance Industry	Excluded		1.695 (0.124)	0.006	0.004	1.677 (0.125)	Excluded	-1373 (0.203)		Excluded		2.651 (0.026)
Pri vate	Excluded		0.404 (0.697)	0.013	0.002	6.066	Excluded	-1.593 (0.150)		Excluded		0.401 (0.699)
Pub lic	0.763	0.029	2.374 (0.000)	Excluded		0.574 (0.580)	Excluded	1.189 (0.265)		0.010	0.006	1.558 (0.150)

On the basis of estimated parameters, the scale efficiency for the industry and both the sectors has been calculated. Scale efficiency of the Indian life insurance industry as a whole is worked out at 0.140533 which indicates that India's life insurance industry enjoys substantial scale economies and hence, there is enough scope for its further expansion. Individually, the scale efficiency score of the private sector is 0.274378, and that of the public sector is 0.808870. Hence, both are enjoying scale economies signifying potential for future scale efficiency gains.

IV

Based on the recommendations of the Malhotra Committee, the Indian insurance industry was liberalised in the year 1999. One of the basic objectives behind liberalisation was to foster efficiency. Present Study is an attempt to this end. It ascertains scale efficiency scores of the Indian life insurance industry as a whole and both the sectors during the post-reform period to find out whether the industry as a whole or the sectors in particular are experiencing scale economies or scale diseconomies.

Scale efficiency score of the industry in the present study indicates that neither any sector nor the industry are scale efficient i.e., efficiency score equals to unity. Rather, Indian life insurance industry enjoys substantial scale economies with scale efficiency score of 0.140533. , the scale efficiency score of public life insurance sector is, however, 0.808870, and that of the private sector is 0.274378. Thus, the conclusion should be like this: a) the private sector of the industry and the industry as such operate with enormous prospect of further expansion, and b) although currently public life insurance sector is also enjoying scale economies, they need to be cautious while framing further expansion policy since their scale efficiency score is in the neighbourhood of unity.

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Annexure: I

LIST OF CURRENTLY OPERATING LIFE INSURANCE COMPANIES IN INDIA

Sl. No.	Name (Abbreviation)	Date of Registration
1	Bajaj Allianz Life Insurance Co. Ltd. (ABLIC)	03.08.2001
2	Birla Sun Life Insurance Co. Ltd. (BSLIC)	31.01.2001
3	HDFC Standard Life Insurance Co. Ltd. (HSLIC)	23.10.2000
4	ICICI-Prudential Life Insurance Co. Ltd. (IPLIC)	24.11.2000
5	Exide Life Insurance Co. Ltd. (formerly ING Vysya) (IVLIC)	02.08.2001
6	Life Insurance Corporation of India (LIC)	01.09.1956
7	Max Life Insurance Co. Ltd. (MNLIC)	15.11.2000
8	PNB Metlife India Insurance Co. Ltd. (MIIC)	06.08.2001
9	Kotak Mahindra OM Life Insurance Co. Ltd. (OKMLIC)	10.01.2001
10	SBI Life Insurance Co. Ltd. (SBLIC)	29.03.2001
11	TATA-AIA Life Insurance Co. Ltd. (TALIC)	12.02.2001
12	Reliance Nippon Life Insurance Co. Ltd. (formely AMP Sanmar) (ASAC)	03.01.2002
13	AVIVA Life Insurance Co. Ltd. (ALIC)	14.05.2002
14	Sahara India Life Insurance Co. Ltd. (SILIC)	06.02.2004
15	Shriram Life Insurance Co. Ltd. (SHLICL)	17.11.2005
16	Bharti AXA Life Insurance Co. Ltd. (BALIC)	14.07.2006
17	IDBI Federal Life Insurance Co. Ltd (IDFLIC)	19.12.2007
18	Future Generali Life Insurance Co. Ltd. (FGLIC)	04.09.2007
19	Canara HSBC OBC Life Insurance Co. Ltd (CHOLIC)	08.05.2008
20	DHFL Pramerica Life Insurance Co. Ltd (DPLIC)	27.06.2008
21	Aegon Life Insurance Co. Ltd. (ARLIC)	27.06.2008
22	Star Union Dai-ichi Life Insurance Co. Ltd (SUDLIC)	26.12.2008
23	India First Life Insurance Co. Ltd. (IFLIC)	05.11.2009
24	Edelweiss Tokio Life Insurance Co. Ltd. (ETLIC)	10.05.2011

Source: Handbook on Indian Insurance Statistics 2017-18

Annexure: II

SUMMARY STATISTICS OF COST

(₹ in Lakhs)

Sector	Number of Observations	Mean	Maximum	Standard Deviation	Minimum
Life Insurance Industry	15	2767300.219	4882069.168	1350260.95	642483
Private Sector	15	1231826.2	1867829.6	586119.62	138250
Public Sector	15	1535474.047	3014239.54	857893.2257	504233

Annexure: III

SUMMARY STATISTICS OF OUTPUT

(₹ in Lakhs)

Sector	Number of Observations	Mean	Maximum	Standard Deviation	Minimum
Life Insurance Industry	15	236483149.3	1300596056	310800196.8	38260894
Private Sector	15	29106632.76	71420419.76	23902239.88	480407
Public Sector	15	207376516.6	1269340073	303434771.2	37780487

Annexure: IV

SUMMARY STATISTICS OF PRICE OF CAPITAL

(₹)

Sector	Number of Observations	Mean	Maximum	Standard Deviation	Minimum
Life Insurance Industry	15	0.066912	0.139456	0.042998	0.025377
Private Sector	15	0.065483	0.13818	0.043397	0.02291
Public Sector	15	2.217994	6.752	2.269874	0.318294

Annexure: V

SUMMARY STATISTICS OF PRICE OF LABOUR

(₹ in Lakhs)

Sector	Number of Observations	Mean	Maximum	Standard Deviation	Minimum
Life Insurance Industry	15	0.769105	1.214523	0.244959	0.279894
Private Sector	15	0.465635	0.90047	0.191582	0.038568
Public Sector	15	1.039319	1.585935	0.349977	0.52149