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Scale Efficiency of the Life Insurance Corporation of India

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Abstract: ***Life Insurance Corporation of India (LICI) occupies an important place in the Indian financial sector in terms of providing finances to various socio-economic welfare and infrastructural schemes, inducing domestic capital formation, acting as a stabilizing agent in the stock market and providing insured protection against death and old-age economic insecurity. The present paper discusses into the issue of the scale economies and scale elasticity encountered by the Life Insurance Corporation of India in terms of cost and output at constant prices because we often want to compare the price of a goods today with what it was in the past or is likely to be in future. The main objective of this paper is to understand the concepts of cost, output and input in an insurance firm and then to discuss about estimation method of scale economies and scale elasticity of LICI. Lastly, I try to find out empirical results of Scale elasticity and aggregate scale economies during 1970-99 of LICI.***

Keywords: LICI, Scale Economy, Scale Elasticity, Efficiency.

1. Introduction

Most life insurance policies have a long-life span, which makes consumers sensitive to the reliability of the respective firms. Life insurance firms need to remain in a financially sound condition over decades in order to be able to pay out the promised benefits. The sector has a safety net arrangement in the case a life insurer fails, but that does not cover all risks and the funds involved are limited. Without sufficient profitability it could be questionable whether life insurers are able to face unfavorable developments such as a long-lasting decline of long-term interest rates. Obviously, there may be a complex tradeoff between heavy competition with the short-run advantage for consumers of low premiums, but possibly the drawback of higher long-run risk with respect to the insurance benefits. Life insurance firms sell different products using various distribution channels, thereby creating several sub markets. The degree of competition may vary across these sub markets. For instance, sub markets where parties bargain on collective contracts and sub markets for direct writers are expected to be more competitive than sub markets where insurance agents sell products to uninformed but trusting customers. Lack of sufficient data on prices of life insurance products, market shares of products and distribution channels, makes distinctions of competition on sub markets impossible. Heavy competition is assumed to force firms to operate more efficiently, so that high efficiency might indicate the existence of competition and vice versa. Efficiency measurement is one aspect of firm′s performance. Efficiency is measured with respect to an objective; it can be measured with respect to maximization of output, maximization of profits, or minimization of costs. Duality theory can be used to derive the cost function from the production function, and cost is a component of profit; hence, the three concepts are not independent. Scale economies, scope economies, and X-efficiency are different aspects of performance. Scale and scope economies refer to selecting the appropriate outputs, while X-efficiency refers to selecting the appropriate inputs. Typically, scale economies refer to how the firm's scale of operations (its size) is related to cost C i.e., what percentage increase in costs occurs with a 1-percent increase in scale. A firm is operating at constant returns to scale if, for a given mix of products, a proportionate increase in all its outputs would increase its costs by the same proportion; a firm is operating with scale economies if a proportionate increase in scale leads to a less than proportionate increase in cost; a firm is operating with scale diseconomies if a proportionate increase in scale leads to a more than proportionate increase in cost. Scope economies refer to how the firm's choice of multiple product lines is related to cost. A firm producing multiple products enjoys scope economies if it is less costly to produce those products together than it would be to separate production into specialized firms. We distinguish between various types of efficiency, particularly scale efficiency and X-efficiency. Scale economies are related to output volumes, whereas cost X-efficiency reflects managerial ability to drive down production costs, controlled for output volumes and input price levels. There are various methods to measure scale economies and X-efficiency. We use a translog cost function to reveal the existence of scale economies, and a stochastic cost frontier model to measure X-efficiency. Further, large unemployed scale economies may raise questions about the competitive pressure in the market. Note that the existence of scale efficiency is also important for the potential entry of new firms, an important determinant of competition. Strong scale effects would put new firms into an unfavorable position. A straightforward measure of competition is the profit margin. Supernormal profits would indicate insufficient competition. The business of insurance firms is the sale of protection against risks.

Objectives of the Study

1) To understand the concepts of cost, output and input in an insurance firm.
2) To discuss about estimation method of scale economies and scale elasticity of LICI.
3) To find out empirical results of Scale elasticity and aggregate scale economies during1970-99 of LICI.

2. Research Methodology

This study is mainly of descriptive and mathematical in nature and makes use of secondary information published in various annual reports of LICI, different Research Papers, Journals, Publications, and Websites etc. Also, various books have been referred for theoretical aspect.

Costs, Inputs and Outputs in the Insurance Sector

Items, which qualify as inputs and output in a financial firm, differ from those in a manufacturing firm. Conceptually, inputs include all labour and capital services, which need to be identified from the accounting data of a financial firm. Outputs are either the gross revenue or income of this type of company or money value of their earning assets. Total costs of producing a given level of output thus refer to the labour and capital costs. In economic terms, costs should imply opportunity costs, both private and social, for producing a given level of output. In reality, opportunity costs do not correspond with the accounting data recorded by firms. However, in the case of an insurance company, particularly in the case of LICI, such problem is less severe as production here involves few externalities. Furthermore, opportunity costs of convenience, trouble etc. is less significant in the case of LICI owing to its extensive operation through branch offices. There exist considerable number of disagreements with the identification of output in a financial firm. This is because financial firm yields services, not physical output. Services are not amenable to quantitative measurement like physical output of a manufacturing firm. One has to rely on the accounting financial data of a firm to define output to suit his purpose. For the banking sector's scale and scope economies measurement, several studies were carried out, which defined output of the banks in their own ways from this data. In this paper following Murray and White (1983), we have considered the rupee value of the earning assets as the output of LICI (Y). Total assets of the LICI are indicated by the aggregates of its loans and investments. Inputs are categorized as labour and capital services. Labour services include services of the LICI employees and commissioned agents. Capital services include services of fixed capital and materials. Following Murray and White (1983), a unit capital cost (W_1) is calculated by deflating the sum of the principal capital expenditures of the LICI, provided in its Annual Report, by the rupee value of the premiums paid in each year. The unit labour expense (W_2) is derived by dividing the total of annual salaries of the employees and commissions, paid to the agents, by the total number of employees and agents in a year. Now for aggregate measure most often used is wholesale price index (WPI). The WPI is calculated by the Reserve Bank of India Bulletin and is published monthly. Here we deflate Y, W_1 and W_2 by their respective WPI over the period 1970 – 99 with base period 1970 = 100.

Estimation method of scale economies and scale elasticity of LICI

Following Murray and White (1983), we presume that the LICI minimises the costs associated with a given level of output:

$$\text{Minimise } C = \sum_{i=1}^{n} p_i x_i \quad (1)$$

Subject to a production constraint:

$$F(y, x_1, \ldots, x_n) = 0 \quad (2)$$

Where C is the total cost of real capital and labour, p_i is the unit price of the i-th input, x_i is the quantity of the i-th factor input and y is the value of the output.

In several studies, a specific functional form on F was imposed and then was obtained the implied reduced form to solve for:

$$\text{Minimise } C^*(y, p) \quad (3)$$

The production functions they imposed on F are very restrictive (e.g. the Cobb-Douglus and CES). Although such specifications are convenient for the purpose of modelling and estimation, they indicate constant returns to scale across all output levels. Furthermore, the heterogeneous characteristic of most financial intermediation is missed as the production function is homogeneous with a constant or unitary elasticity of substitution. The translog cost functions are bereft of these shortfalls of Cobb-Douglus and/or CES specification. There is no need to assume a priori homogeneity and constant elasticity of substitution. The firm is assumed to pursue cost-minimising behaviour treating input prices and quantities as exogenous elements in its decision process. The translog cost function, used in our analysis, is a Taylor series expansion in output quantities and input prices, and can be written as :

$$\ln C = \alpha_0 + \alpha_3 \ln Y_j + \beta_1 \ln W_1 + \beta_2 \ln W_2 + 1/2\alpha_{33}(\ln Y_j)^2 + \beta_{13}(\ln W_1)(\ln Y_j) + \beta_{23}(\ln W_2)(\ln Y_j) + 1/2\beta_{11}(\ln W_1)^2 + \beta_{12}(\ln W_1)(\ln W_2) + 1/2\beta_{22}(\ln W_2)^2 \quad (4)$$

where Y_j (j = 1,2) denotes the LICI output with Y_1 representing the rupee value of LICI loans and investment in a year and Y_2 standing for rupee value of LICI loans, investments and physical assets including furniture etc. Y_1 is a subset of Y_2.The cost function (4) should be linearly homogeneous in all input prices, concave in W_1 and W_2 and increasing in Y and W_1 and W_2 with symmetric price response i.e. $\beta_{12} = \beta_{21}$. Moreover, it is quadratic in logarithms and linear in unknown parameters, which allow us to employ well-known OLS estimation. In fact, it can be reduced to some of the more popular restrictive functional forms like Cobb-Douglus and/or CES, by imposing zero restriction on selected parameters. Following Panzar and Willig (1977) and Kim (1986), a local measure of overall or aggregate scale economies (S_L) for the LICI is defined as:

$$S_L = [C(Y_j, W_1, W_2)/Y_j.MC] = 1/\eta_{cy} \quad (5)$$

where MC refers to the marginal cost with respect to output ($\delta C/\delta Y$) and η_{CY} (= $\delta \ln C/\delta \ln Y$) is the cost elasticity of output. The cost elasticity corresponding to the output (Y) obtained from the translog cost function (4) can be expressed as:

$$\eta_{CYj} = \alpha_3 + \alpha_{33} \ln Y_j + \beta_{13} \ln W_1 + \beta_{23} \ln W_2 \quad (6)$$

LICI will encounter decreasing return to scale if $\eta_{CYj} > 1$ (increasing return to scale if $\eta_{CYj} < 1$ and constant return to scale if $\eta_{CYj} = 1$). Putting it differently, decreasing return to scale will follow if $S_L < 1$, increasing return to scale if $S_L > 1$ and constant return to scale if $S_L = 1$.

Empirical results of Scale elasticities and aggregate Scale economies during1970-99

As is evident, equation (4) is linear in its unknown parameters and, therefore conforms to the OLS estimation. It provides a simple mean of deriving unbiased estimates despite its inability to render any extra information, which a restricted system of cost equation might have generated. The parameter estimates of the model and its relevant statistics are presented in Table 1.

Table 1: Estimated Parameters and the Relevant Statistics

Equation	R^2	F	DW	Parameter	Estimate	t-value
(4) (with Y_1 as explanatory variable)	0.81	9.85	2.09	α_0	-401.04	-1.59****
				α_3	77.41	1.66****
				β_1	71.73	1.49****
				β_2	-5.91	-0.09
				β_{11}	-5.63	-1.17
				β_{12}	-3.03	-0.58
				β_{13}	-5.80	-1.39****
				β_{22}	-1.03	-0.87
				β_{23}	-0.95	-0.17
				α_{33}	-6.52	-1.54****
(4) (with Y_2 as explanatory variable)	0.95	49.93	1.88	α_0	-226.93	4.62*
				α_3	-48.97	-4.03*
				β_1	-25.33	-1.68****
				β_2	75.23	7.58*
				β_{11}	1.18	0.74
				β_{12}	-3.92	-5.32*
				β_{13}	2.62	1.82***
				β_{22}	-0.37	-0.98
				β_{23}	-5.66	-8.74*
				α_{33}	4.89	3.80*

*=significant at 1%,** = significant at 5%, ***= significant at 10%, ****= significant at 20%

The table 1 indicates that all estimated relationships yield high degree of association, R^2 being 0.81 in first case and 0.95 in second case. The calculated F-statistic for Y_1 case is also significant at 1% level; a goodness of fit is seen for the equation under study. Here calculated DW statistic is at 2.09 and for n=30 and k = 9 at 1% level of significance it lies in the inconclusive region. But here the null hypothesis of no auto-correlation is rejected. For the Y_2 case the calculated F-statistic is 49.93 which is also significant at 1% level. The DW-statistic is 1.88 and for n=30 and k=9 at 1% level of significance it lies in the inconclusive region. Here, also the null hypothesis of no auto-correlation is rejected. Low significant levels of some estimated parameters (as seen from t values) are probably owing to the presence of multi-collinearity (though not perfect) among the arguments. This is often encountered in the estimation of translog function due to the incorporation of each argument both in linear and quadratic forms. Following Benston et. al. (1982) we may set the geometric means of Y_j, W_1 and W_2 in equation (6) and derive the scale economy with respect to Y_j over the entire period of our analysis. The geometric means of relevant variables are indicated in Table 2.

Table 2: Geometric Means of Y_1, Y_2, W_1 and W_2

Variable	Geometric Means
Y_1	3.1246E+08
Y_2	3.4189E+08
W_1	11849.01
W_2	27.11

By using (6), we estimate the scale elasticity with respect to output of equation (4) at the geometric mean and the value of scale elasticities are 52.12 with respect to Y_1 and 36.24 with respect to Y_2. They imply that proportionate escalations of total cost are 5212% and 3624% of proportionate increase in the LICI output Y_1 and Y_2.Thus our exercise indicates that over the years the LICI produced an overall scale inefficiency. Using equation (6), we have also calculated the scale elasticities at different output levels over the years and present them in table 3 and table 4.

Table 3: Scale Elasticities and aggregate Scale economies during 1970-99 (With respect to Y1)

Year	η_{cy}	S_L
1970	3.29	0.303
1971	3.23	0.309
1972	-0.934	-1.07
1973	-0.296	-3.38
1974	3.14	0.317
1975	1.49	0.673
1976	1.30	0.770
1977	1.08	0.920
1978	0.453	2.20
1979	1.80	0.555
1980	3.09	0.323
1981	3.07	0.325
1982	2.45	0.407
1983	2.30	0.434
1984	1.87	0.533
1985	1.74	0.573
1986	0.964	1.03
1987	0.702	1.42
1988	0.586	1.70
1989	-0.511	-1.95
1990	0.552	1.81
1991	1.37	0.730
1992	0.889	1.12
1993	0.968	1.03
1994	0.640	1.56
1995	0.573	1.74
1996	0.764	1.30
1997	-0.245	-4.07
1998	-1.06	-0.939
1999	-1.84	-0.541

Table 4: Scale Elasticities and aggregate Scale economies during 1970-99, (With respect to Y_2)

Year	η_{cy}	S_L
1970	26.27	0.038
1971	25.16	0.39
1972	2.69	0.372
1973	2.49	0.401
1974	-1.85	-0.541
1975	-2.24	-0.447

1976	0.312	3.20
1977	0.431	2.31
1978	0.308	3.24
1979	-0.566	-1.76
1980	-0.398	-2.51
1981	-0.437	-2.28
1982	-0.230	-4.34
1983	1.264	0.791
1984	1.15	0.866
1985	0.829	1.20
1986	1.85	0.541
1987	1.84	0.544
1988	2.24	0.446
1989	2.22	0.450
1990	2.45	0.407
1991	2.82	0.353
1992	3.08	0.324
1993	3.30	0.302
1994	3.32	0.300
1995	3.22	0.309
1996	2.43	0.410
1997	2.61	0.383
1998	3.26	0.306
1999	3.39	0.294

Table 3 and 4 give the evidence of presence of scale diseconomies throughout the period under consideration. We observe that aggregate scale economies (S_L) with respect to Y_1 registered a huge scale diseconomies. During 1970 to 85 we observe that $S_L<1$ except the period 1978. $S_L>1$ for period 1986 – 96 except period 1989 and 1991. Out of 30 years of our study we observe that $S_L>1$ for 10 years only. Thus, at constant prices we observe that scale diseconomies are more pronounced. Fitting a linear trend equation for S_L during 1970 – 99, we see a positive trend growth rate of 0.004.With respect to Y_2 i.e. rupee value of loans and investments and physical assets, almost similar pattern is observed during the period under consideration. Out of 30 years of our study we observe that $S_L>1$ for 4 years only. Here except the period 1976-78 and 1985, there appear scale diseconomies all over the period. Thus, here scale diseconomies is more pronounced in the context of Y_2. Here a positive linear trend growth rate of 0.005 is observed over the period.

3. Conclusion

The exercise carried out in this paper indicates that operating economies tended to decline is more pronounced in constant price mechanism than that of current price mechanism as the LICI activities grew. This result is particularly important in the context of removal of entry restrictions of the private companies into the insurance business of India. It is interesting to note that as a monopoly corporation it enjoyed the most efficiency whereas in a competitive market environment it is not encountering the same efficiency. Further, research need to be undertaken on this score to see whether market structure has got to do anything with the scale efficiency of the LICI.

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