CHAPTER - V

ECONOMIES AND DISECONOMIES OF THE LICI

The Life Insurance Corporation of India uses some conventional methods to adjudge its performance. The tools of such methods are the performance indicators in the respective area of operation. These indicators are technically known as the critical ratios. The critical ratios conventionally provide an index of the performance of the branch of the LICI in the respective areas. We shall choose two or three of such indicators in order to examine the aggregative performance of the LIC branches.

5.1 Performance in Marketing and Sales.

First of all we shall take 'contribution' as the indicator of marketing and sales activities of the LICI. The formula for arriving at the indicator is:

Contribution = (Total Premium Income) - (Total Management Expenses)

By using the formula we can easily compute the Contribution of LICI in a particular year by substracting the management expenses from the premium income of that particular year. From Appendix-III it may be seen that the contribution of the LICI has been increasing consistently over time. In 1971 the magnitude of contribution was Rs. 223.57 crore, in 1981 it increased to the height of Rs. 731.00 crore and attained to the height of Rs. 3419.06 crore in 1990. This implies that the rate of increase in premium income is higher than the rate of increase in management expenses. So, it may become indicative of return to scale of the LICI.

It may also be observed from Appendix-III that the rate of growth in Contribution was much more in the late 1980s and more particularly from 1985 onward. The probable underlying reasons for such galloping growth might be the outcome of the LICI's new dimension to its marketing mission and HRD philosophy that had been brought under effect from the early 1980s.

5.2 Performance Economy

Now, let us attempt to appraise the cost economy in performance of the LICI with the help of two critical ratios viz. the Renewal Expense Ratio (RER) and the Overall Expense Ratio (OER). These ratios have been designed to examine the performance of branch in the sphere of customer satisfaction and for determination of an economic level of expenditure. It may be assumed that the performance of the LICI as a whole is the aggregative performance of its all the branches. We shall deal first with the Renewal Expense Ratio. The formula for arriving at the ratio is :

$$RER = \frac{\text{Total Management Expenses} - (89.4\% \text{ of FYP} - 7.5\% \text{ of Sp})}{\text{Renewal Premium Income}} \times 100$$

$$\text{Or, } RER = \frac{A - B}{D} \times 100 = \frac{C}{D} \times 100$$

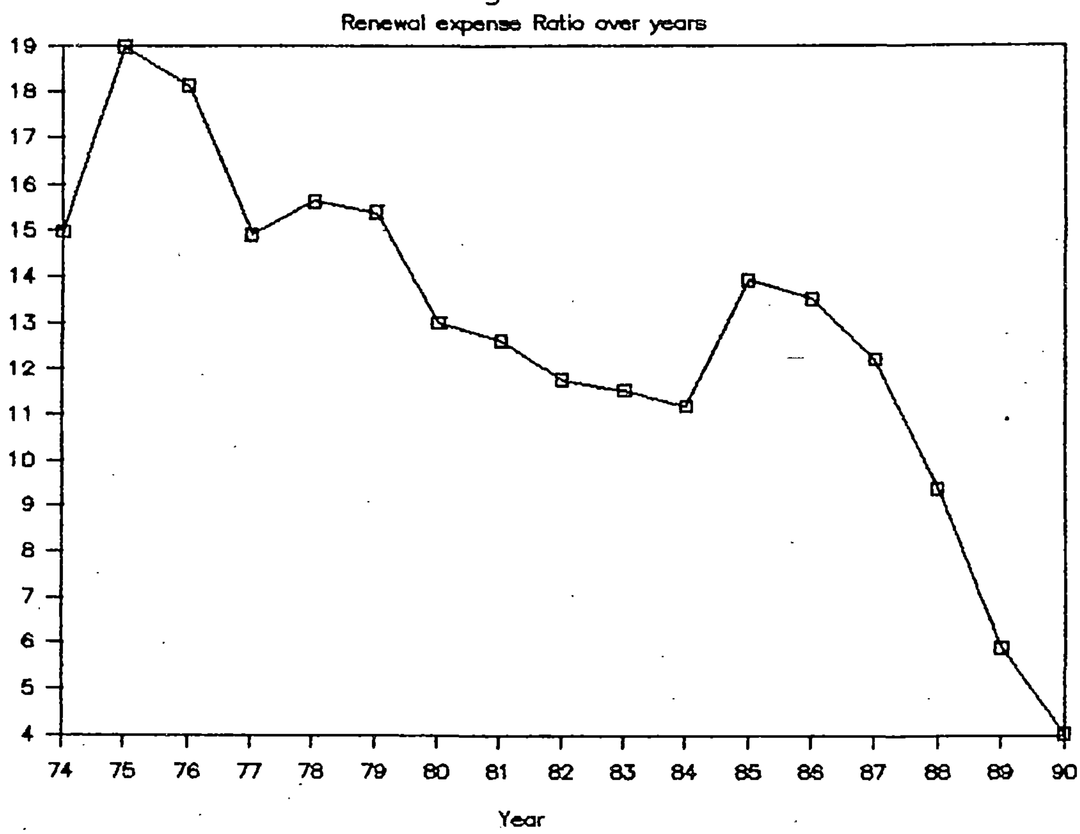
$$\text{Or, } RER = \frac{\text{Renewal Expenses}}{\text{Renewal Premium Income}} \times 100$$

Here, FYP stands for First year Premium, Sp for Single Premium (including consideration for annuities, 'A' for Total Management Expenses, 'B' for (89.4% of FYP - 7.5% of Sp) and D for Renewal Premium Income.

The Renewal Premium Income can be had from the difference of Total Premium Income and First Year Premium Income. That is, Renewal Prem. Income = (Total Prem. Income - First Year Prem. Income).

Thus, the RER varies with the changes in premium income and total expenses. The RERs over time are shown in Fig. 5.1 and fitted with a trend line. During the period of 1974-1990 it shows a downward trend with exceptions in 1975 and 1985. In 1974, it was 15.0% but in 1975, it rose to 19.0% for the probable reasons of deterioration in law and order situation and declaration of internal emergency, increase in the stationery and other expenses due to price-rise and announcement of 20-Point Programme which cast some financial obligations on the LICI (LICI, 1975). From 1975 to 1984 it shows a steady downward trend. But in 1985 the RER increased once again due to transition in transferring and

Fig. 5.1


Renewal expense Ratio over years
19
18
17
16
15
14
13
12
11
10
9
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6
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74
75
76
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78
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80
81
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86
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88
89
90
Year

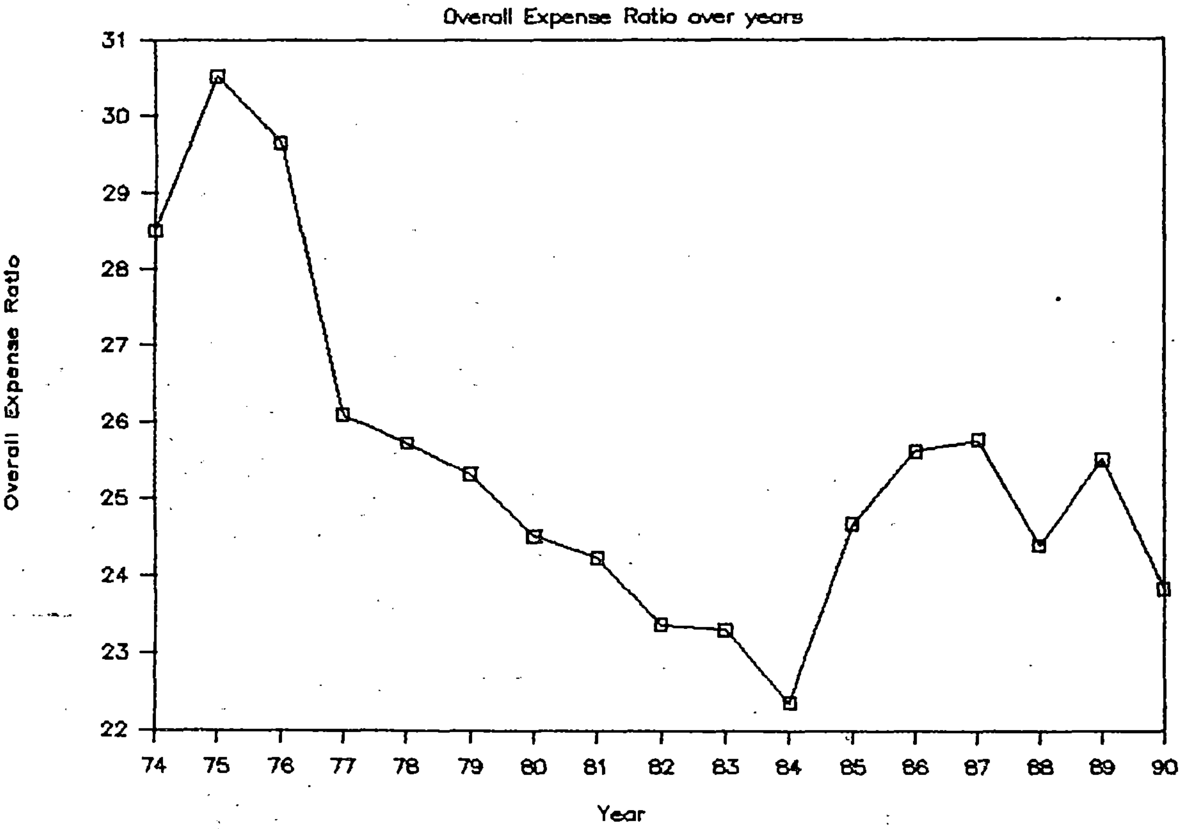
reallocating works and services among the LIC offices at various level under decentralisation, modernisation and technological development programmes of the Corporation. All these works at their transition gave rise to cost of services and hampered indirectly and temporarily the business procuration by the sales forces. It can be observed that the LICI has been performing business within the statutory limit of RER i.e. 15%. From the 30th anniversary year of the Corporation i.e. from 1986 it has been experiencing a sharp decline in the RER which came down to the ever lowest height of 3.04% in 1990. So it may be said that the LICI has been performing business with significant cost economy and can claim some efficiency in terms of RER.

Now, let us take another ratio viz. the Overall Expense Ratio (OER) for probing the economic level of expenditure of the LICI in respect of management expenses. To compute the ratio we may use the simple formula as follows:

$$OER = \frac{\text{Total Management Expenses}}{\text{Total Premium Income}} \times 100$$

The OERs over time have been shown in Appendix - III. The ratio can be had by dividing the total management expenses with the total premium income. It may be observed from the appendix that there was a declining trend in OER over the period from 1975 to 1983 and thereafter, an increasing trend subsisted over the period from 1984 to 1987. In rest of the years there was no definite trend but fluctuations. For further elaboration of our study the components of the ratio may be obtained from Tables 3.1 and 3.2. The annual management expenses can be had from Table 3.2 and the corresponding premium income from Table 3.1. From Table 3.2, the mean value and coefficient of variation of management expenses over time are found to be Rs. 319.57 crore and 83.60 respectively. Similarly, from Table 3.1, the average value and coefficient of variation in respect of premium income over time can be found to be Rs. 1312.61 crore and 82.64. So, the ratio of the two averages, which is computed to be 24.35% may give us an aggregative idea of the economic level of management expenses of the LICI. It may also be seen from the coefficients of variation that the overall variation in both the scores took place more or less in the same rate. However, by using Fig. 5.2 we may have a more comprehensive idea of changes in OERs over time. It can be visually observed from Fig. 5.2 that from 1977 to 1984, there was a sharply declining trend and thereafter a rising trend upto 1990 with some exceptions in 1988 and 1990. These represent that the LICI experienced more economy in this respect during the period from 1977 to 1984 and less economy in the next phase upto 1990. The probable causes of increase in OER to its maximum level in 1975 might have been those mentioned in connection with RER, such as, to repeat once again, the deterioration of law and order situation in the country and declaration of internal emergency, increase in stationery expenses due to inflated price and the announcement of the 20-Point Programme

Fig. 5.2


Overall Expense Ratio over years
31
30
29
28
27
26
25
24
23
22
Overall Expense Ratio
74
75
76
77
78
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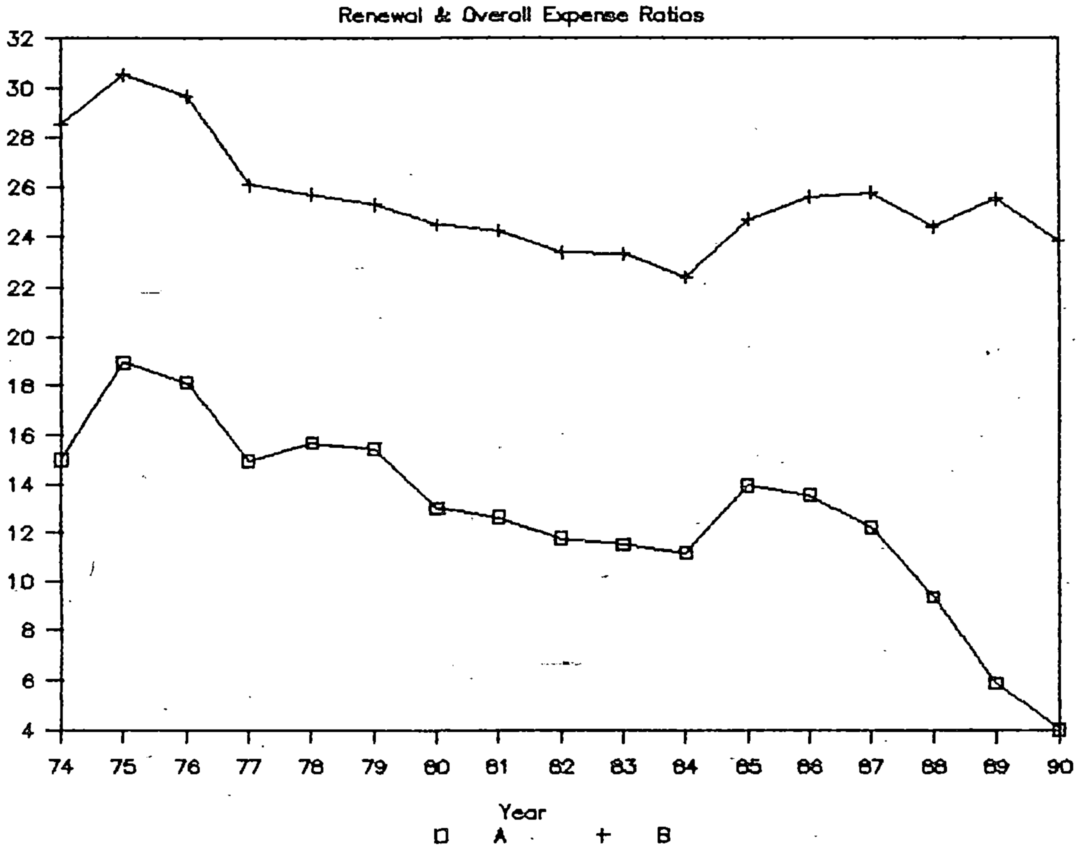
81
82
83
84
85
86
87
88
89
90
Year

by the then Prime Minister casting certain obligation on the LICI too. All these might have caused to the increase in management expenses and a comparatively slow growth in business. But the almost vertical decline in OER in 1977 might have been influenced by the Corporation's stricter measures for economy, downward revision in dearness allowance due to fall in price-index, and abrogation to Article 31 Clause (2) of the Constitution relating to bonus applicable to Classes III & IV employees (LICI, 1977 & 1978). The likely causes of the rise in OER from 1984 to 1987 might be the initial expenses incurred in connection with upgradation of technology and modernisation works, the severe drought of 1987 and other concomitant factors affecting the LICI's expenses and business.

In Fig. 5.3 both the RER and OER Trends are compared. Apparently, both the ratios over time show a more or less similar tendency. When OERs fall, RERs respond in the same way and vice-versa. But OER is always higher than RER. This is, because, OER represents the ratio of total management expenses to total premium income, while RER represents the ratio of renewal expenses to renewal premium income. The total management expenses is much higher than the renewal expenses. On the other hand, total premium income is not very much higher than the renewal premium income. The average of the three years' (1971, 1981 & 1990) percentages of the management expenses to total outgo may be computed from Appendix-III to be 33.7%, while the average of the percentages

Fig. 5.3



A - Renewal Expense Ratio

B - Overall Expense Ratio

of the renewal expenses to total outgo of those corresponding years may be computed to be 9.7%. So, it is obvious that management expenses are always higher than renewal expenses. Similarly, those three years' average of the percentages of first year premium to total premium may be calculated to be 17.8% while the same in respect of renewal premium is computed as 76.7%. So, naturally, the RER is lower than OER. Thus, based on these conventional expense ratios it seems that the performance of the LICI has been satisfactory.

5.3 Analysis on Scale Economies

Apart from the conventional measures discussed in the previous section some probing into the economies of scale are necessary for regulatory and management decisions. This is, perhaps, more so, in the context of the current trend of restructuring of the financial sector (Report, Malhotra Committee, 1994) of the Indian economy. Because of its structure, the LICI as a vital component of the financial industry in India provides us with some relevant source of data for measuring the cost function. Since the findings of any analysis are in a large measure function of the purpose for which the analysis is undertaken, it is useful to begin with this section of our study by considering the questions that a study of scale economies of financial institutions like the LICI might seek to answer.

The questions to which economies of scale are usually related may be grouped under three headings (Benston, 1972).

(1) Regulatory : Entry, merger, branching and some prices in the finance industry are regulated, requiring regulators to estimate the cost consequences of their decisions.

(2) Importance to the finance industry: If firms understand their costs better, they may be more efficiently managed and make decisions more rationally and (3) Economic understanding: Knowledge of the relationship between cost and output is basic to micro-economics, industrial organisations etc. and a study of finance industry should provide emperical estimates that are relevant to theory. These issues will surface when we situate our query regarding the economies of scale of the LICI.

Regulation: Entry, merger and expansion in any financial intermediary like LICI is normally subject to Government control. By law the regulatory agencies (e.g. in the case of LICI, the Controller of Insurance, Ministry of Finance etc.) are charged with determining the structure and composition of the industry that best serves the public and national need. Estimates of the production and cost functions of the financial institutions are part of the data required by the regulatory authorities to implement rules which are normally somewhat vague in nature. If the industry is subject to economies of scale, larger institutions would be more efficient and could provide services at lower cost, ceteris paribus. The regulatory authorities need to know whether economies or diseconomies of scale exist, but also whether they are stable, whether they apply to particular types of services etc. and what the magnitudes are.

Importance to the industry: Estimates of economies of scale would provide a financial institution with information that would help them make better decisions. This information is more helpful for the financial industry, since the industry's cost and output affect most other industries and sometimes may affect some aspect of monetary policy (Benston, 1972).

Studies related to cost and economies of scale are useful if these provide management with data to evaluate the efficiency of their operations and estimate the cost to their institutions by expanding, increasing or decreasing specific type of services and other portfolio decisions.

Economic Understanding: The nature of the cost function and the prevalence of economies of scale are important considerations for economic theories. The 'Cost' recorded by accountant rarely reflect the opportunity cost about which economists are more concerned. Measurement of this is difficult. Time series studies of a particular institution are complicated by changes in factor prices and production techniques, joint production, partial adjustment of cost to change in the rate of output, insufficient number of observations etc. Cross-section studies suffer from inconsistent definition of output among units, differences among units in accounting cost. Again, a single equation may not provic and estimate of a cost curve unless output is exogenously determined and firms minimise cost (Benston, 1972).

However, financial institutions, in a way, offer a better opportunity to estimate the cost function, because they normally provide data and conditions that can allow study to meet most of the problems outlined above. The LICI, in our present study, records its cost and output more or less uniformly across time. However, because of different time sequence, we could not utilise some recent innovations in products. Thus our analysis is somewhat limited by the omission of multi-product cost considerations.

<u>Nature and Form of the Cost Function</u>: Benston (1972) proposes a general cost function, for which output and other variables must be specified as:

$$C = f(Q, H, P, U) \qquad \ldots (5.1)$$

where,

C $\Rightarrow$ Operating costs per period (usually a year),

Q $\Rightarrow$ rate of output per period.

H $\Rightarrow$ Output homogeneity variables that account for the fact that Q is not a homogeneous measure.

P $\Rightarrow$ difference in factor prices, organisational structure, and management ability of firms.

U $\Rightarrow$ other unspecified factors.

The issue of scale economies of financial intermediaries has a rich history, particularly in the field of banking. The applicability of production function approach though has gained near unanimity among researchers, there persists a difference among them in respect of the form of the cost function, the model specification, measurement of variables and estimation techniques.

Early studies used to estimate scale economies by postulating a linear production relationship. But lack of any sound theoretical or strong emperical support for such a relationship subsequently induced researchers to adopt conventional or generalised Cobb-Douglas production function with exogenous input prices (Benston, 1972). In addition to its emperical advantage it provides certain estimation facilities because of the duality it possesses between cost and production parameters and also because of its convertibility in log-linear form. The use of Cobb-Douglas production function facilitates the estimation of the output elasticity of cost. However, there does not appear to be any other reason, apriori for the assumption of a Cobb-Douglas production function with exogenous input prices. It is also incapable of recognising any variation in returns to scale at various production levels. Furthermore, if the assumption of a Cobb-Douglas form is inappropriate as a description of the production process of financial institution, estimates of output-elasticity may be biased. This led to the use of a generalised functional form by some analysts (Clark, 1984).

The limitations of Cobb-Douglas specification led to a number of recent studies employing a generalised (translog) cost function (Mullineaux, 1973 & 1983; Benston, Hanweck & Humphrey, 1982; Kim, 1986) developed by Christensen, Jorgenson and Lau

(Christensen, Jorgenson & Lau, 1973). Transcendental logerithmic (or translog) function is a very flexible form, capable of approximating a wide variety of functional forms (Johnston, 1985). As an illustration, following Johnston (1985), the production function for industrial sector of an economy is often specified as:

$$Q = f(K, L, E, M) \qquad \ldots (5.2)$$

where the inputs distinguished are Capital K, labour L, energy E and materials M. Assuming constant returns to scale plus exogenous factor prices P_K, P_L, P_E and P_M, and imposing symmetry on the second-order partial derivatives, give the translog cost function:

$$\begin{aligned} \ln C = {} & \alpha_o + \ln Q + \alpha_K \ln P_K + \alpha_L \ln P_L + \alpha_E \ln P_E \\ & + \alpha_M \ln P_M + \tfrac{1}{2}\beta_{KK}(\ln P_K)^2 + \beta_{KL}(\ln P_K)(\ln P_L) \\ & + \beta_{KE}(\ln P_K)(\ln P_E) + \beta_{KM}(\ln P_K)(\ln P_M) \\ & + \tfrac{1}{2}\beta_{LL}(\ln P_L)^2 + \beta_{LE}(\ln P_L)(\ln P_E) + \beta_{LM}(\ln P_L)(\ln P_M) \\ & + \tfrac{1}{2}\beta_{EE}(\ln P_E)^2 + \beta_{EM}(\ln P_E)(\ln P_M) + \tfrac{1}{2}\beta_{MM}(\ln P_M)^2 \end{aligned} \qquad \ldots (5.3)$$

Differentiating lnC with respect to the logs of the prices gives the cost share equations:

$$S_K = \alpha_K + \beta_{KK} \ln P_K + \beta_{KL} \ln P_L + \beta_{KE} \ln P_E + \beta_{KM} \ln P_M \qquad \ldots (5.4)$$

$$S_L = \alpha_L + \beta_{KL} \ln P_K + \beta_{LL} \ln P_L + \beta_{LE} \ln P_E + \beta_{LM} \ln P_M \qquad \ldots (5.5)$$

$$S_E = \alpha_E + \beta_{KE} \ln P_K + \beta_{LE} \ln P_L + \beta_{EE} \ln P_E + \beta_{EM} \ln P_M \quad \ldots (5.6)$$

$$S_M = \alpha_M + \beta_{KM} \ln P_K + \beta_{LM} \ln P_L + \beta_{EM} \ln P_E + \beta_{MM} \ln P_M \quad \ldots (5.7)$$

Since the shares must sum to unity,

$$\alpha_K + \alpha_L + \alpha_E + \alpha_M = 1 \quad \ldots (5.8)$$

and the β's sum to zero in each column (and row). Imposing the row-wise β constraints on the first three share equations gives the system,

$$S_K = \alpha_K + \beta_{KK} \ln \left(\frac{P_K}{P_M}\right) + \beta_{KL} \ln\left(\frac{P_L}{P_M}\right) + \beta_{KE} \ln \left(\frac{P_E}{P_M}\right) \quad \ldots (5.9)$$

$$S_L = \alpha_L + \beta_{KL} \ln \left(\frac{P_K}{P_M}\right) + \beta_{LL} \ln\left(\frac{P_L}{P_M}\right) + \beta_{LE} \ln \left(\frac{P_E}{P_M}\right) \quad \ldots (5.10)$$

$$S_E = \alpha_E + \beta_{KE} \ln \left(\frac{P_K}{P_M}\right) + \beta_{LE} \ln \left(\frac{P_L}{P_M}\right) + \beta_{EE} \ln\left(\frac{P_E}{P_M}\right) \quad \ldots (5.11)$$

Because of the symmetry in the β's there are just nine independent parameters in the system. Estimation of these, in conjunction with the summation conditions on the α's and β's, will yield estimates of all the coefficients of the cost function except α_0.

The translog cost function permits the estimation of 'U' shaped average cost curve and the derivation of scale economies for a financial institution like the LICI. However, as suggested by Johnston (1985, pp. 336-37), a word of caution is required. A basic assumption underlying the derivation of the share equations above is that "in each observation period in the sample there has been a full and complete adjustment of the input-mix to the factor prices ruling in that period so that the minimum cost level C^* is achieved. This is an implausible assumption for many production processes..... The assumption of instantaneous adjustment is likely to produce seriously biased estimate of the various elasticities". However, in our study we directly estimate the cost equation (5.3) as has been done by many others.

It has been almost conventional to use Cross-Section data for most of the studies relating to bank cost. In our knowledge there is no such study on LICI cost using either Cross-Section or time series data. The convention to use Cross-Section study is mainly for the sake of avoiding accounting variations that may occur overtime and to repeat the exercise for consecutive years for ensuring temporal stability of results. Ours is an exercise based on time series data pertaining to LICI. We have not found any significant accounting variation during the period considered.

5.4 Cost in Financial Institutions:

'Cost' should refer to economic or opportunity cost (private and social) of operating a firm during a time period at a given rate of output. Presence of externalities which are difficult to quantify vitiates measurement of 'cost'. Correspondence between the accounting data recorded by firms and opportunity cost is rare. However, for a financial institution like LICI these problems are less severe compared to any other industry. Production of financial services involve relatively few externalities (e.g. no smoke pollutes the air). Furthermore, since LICI has more or less extensive branch offices the opportunity cost of convenience, trouble etc. is not likely to be significant.

The accounting data recorded by the LICI reflect the present value of resources given up by it as a result of the production of its services. Salaries to employees, and Commission to agents are the major types of expenditure in the LICI. These are the valid measures of opportunity cost when annual data are used (Benston, 1972). Depreciation and occupancy expenses can present a problem. Depreciation is not generally considered as a good measure of the decline in the present value from using or holding assets. Occupany expenses of LICI are relatively small. While it rents in some quarters, it also owns and rents out a portion of its owned buildings.

Capital costs as generally recorded seem to suffer from meaningful economic interpretation. To use the recorded amounts as estimates of capital invested in the LICI is likely to over-estimate. However, the capital employed is not a very significant fraction of the inputs of this institution (around 1%) and it seems that this fraction does not vary substantially over the period of time. So, it is not likely to vitiate our results significantly.

Type of costs that is excluded from our consideration is the opportunity cost of different reserve requirements (e.g. creation of provision against payments to policy-holders etc). These costs are excluded because they do not vary much due to operations.

Another problem for cost studies is association of cost with output. This problem is related to allocating costs among time periods and products — when output is produced in one period and the cost of production is recorded in another. For this reason probably most cost studies have used annual, cross-sectional data to reduce time period allocation problem. The shorter the time period, the greater the problem is likely to be. However, in our study we make use of data spanning over twenty years (1970-71 to 1989-90) and as such may not hamper a meaningful statistical analysis.

5.5 Input & Output of the LICI:

Studies of scale economies differ more with respect to the output used than with any other respect. One reason for this is the unique nature of the financial industry: financial institutions produce services rather than identifiable physical product and it is not clear how one might measure the output of services (Fuches, 1969). A related problem which complicates it further is how to define output for a multi-service institution. In the ultimate analysis it is the availability of data which has forced some researchers to use a pragmatic definition of output.

For the banking sector Benston (1968) and (Bell & Murphy, 1968) have defined output in terms of what banks do that cause them to incur operating costs. The major output in terms of the number of deposit accounts and loans produced. These numbers are computed as the average number serviced per year. Greenbaum (Greenbaum, 1967) and Powers (Powers, 1969) use and estimate 'real value' of output in their analyses of commercial banking. They measure it with the gross operating income. Its usefulness has been questioned by Benston (1972). Harvitz (Harvitz, 1963) and Schweiger and McGee (Schweiger and McGee, 1961) used total deposit whereas Gramley (Gramley, 1962) uses total assets as a proxy for bank output. There is also the use of the amount of deposit and loan as measures of bank output (e.g. Langer, 1973). Langer in a later contribution (1980) argues that since operational costs are primarily related to number of documents handled, average number of deposits and loan accounts per year would be a better proxy for bank output. These apart there are uses of Divisa index (e.g. Hanweck and Humphrey, 1982 and Mullineanux, 1983) and the yield index of different earning assets (Bell et al, 1968).

The definition of the output of the commercial banks and for that matter of any financial institution continues to be a controversial subject, because of its potential importance in the estimation of economies of scale. No general consensus seems to persist regarding the appropriate definition. This lack of consensus is reflected in a diversity of measures of output employed in the economies of scale literature.

In our present study following Murray and White (Murray and White, 1983) we assume that the economic output of a financial institution like LICI is best measured by the rupee value of earning assets. The LICI output is represented by the variable Y_3, the total loans plus total investments. Additional run was made by substituting for Y_3, rupee value of total assets (Y_4) as an alternative measure of economic output.

Total costs, 'C', include all labour and real capital expenses. It also includes interest, dividend and rents paid.

Input categories are identified as : labour services (services of employees as well as Commissioned agents), fixed capital and material. Again, following Murray and White (Murray and White, 1983) a crude unit price of capital 'W_1' is obtained by taking the aggregate of major capital expenditure (as reported by the LICI) and dividing that by the rupee value of premium paid in each year. The Unit cost of labour 'W_2' is a yearly rate obtained by dividing the yearly total salaries to employees plus yearly Commission paid to the Commissioned agents by the total number of employees and Commissioned agents in a year. Since there is no well defined part-time workers we make no adjustment to reflect wage differences between full-time and part-time workers.

5.6 The Model for the LICI:

LIC is assumed to minimise the costs associated with a given level of output.

$$\text{Min} \quad C = \sum_{j=1}^{m} w_j x_j \qquad \ldots (5.12)$$

subject to a production constraint

$$F(y_1, \ldots, y_n; x_1, \ldots, x_m) = 0 \qquad \ldots (5.13)$$

where,

C = total cost of real capital, labour services, deposits and shares;

w_j = unit price of jth factor input;

x_j = quantity of jth factor input; and

y_i = quantity of ith output (loans plus investments and total assets).

Studies analysing the production characteristics of financial institutions has traditionally imposed a specific functional form on F (the product transformation function) and they would solve for the implied reduced form of cost equation,

$$\text{Min } C^* (y,w)^1$$

The production functions they imposed on F using this primal approach are, as we have already stated, very restrictive (e.g. the Cobb-Douglas and CES). The production functions are assumed to be homogeneous with a constant or unitary elasticity of substitution. Since, in such models returns to scale are forced to remain constant across all output levels it may present a biased picture of the production/cost relationship at extreme point of the output range.

The translog cost function avoids these problems by not forcing us to treat homogeneity and a constant elasticity of substitution as maintained hypotheses (Murray & White, 1983). In its most general form, the translog function provides a second order approximation to any twice differentiable function. There is no need to assume a particular production function relationship a priori and then impose it on the cost function. One can directly proceed to a general representation of the cost function and use it to extract information about the true production function.

The translog cost function that we use in our analysis is essentially a Taylor series expansion in output quantities and input prices, and for the two alternatives y_3 and y_4 they can be written as follows:

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1. Note: See for example Bell Murphy (1968) and Benston, (1972).

$$\begin{aligned}\ln C = \alpha_o &+ \alpha_3 \ln y_3 + \beta_1 \ln w_1 + \beta_2 \ln w_2 \\ &+ \tfrac{1}{2}\beta_{33}(\ln y_3)^2 + \beta_{13}(\ln w_1)(\ln y_3) \\ &+ \beta_{23}(\ln w_2)(\ln y_3) + \tfrac{1}{2}\beta_{11}(\ln w_1)^2 \\ &+ \beta_{12}(\ln w_1)(\ln w_2) + \tfrac{1}{2}\beta_{22}(\ln w_2)^2 \qquad \ldots (5.14)\end{aligned}$$

$$\begin{aligned}\text{and } \ln C = \rho_o &+ \rho_4 \ln y_4 + \gamma_1(\ln w_1) + \gamma_2(\ln w_2) \\ &+ \tfrac{1}{2}\gamma_{44}(\ln y_4)^2 + \gamma_{14}(\ln w_1)(\ln y_4) \\ &+ \gamma_{24}(\ln w_2)(\ln y_4) + \tfrac{1}{2}\gamma_{11}(\ln w_1)^2 \\ &+ \gamma_{12}(\ln w_1)(\ln w_2) + \tfrac{1}{2}\gamma_{22}(\ln w_2)^2 \qquad \ldots (5.15)\end{aligned}$$

The cost functions (5.14) & (5.15) should be linearly homogeneous in all input prices, concave in w_j and increasing in y_i and w_j. These equations are quadratic in logerithms and linear in the unknown parameters which permit us usual estimation. They can be reduced to some of the more popular restrictive technologies, e.g. the Cobb-Douglas and CES, by imposing zero restriction on selected parameters.

Following Panzar & Willig (Panzar & Willig, 1977) and Kim (Kim, 1986), a local measure of overall or aggregate scale economies 'SL' for the LICI is defined by the scale elasticity,

$$SL = \frac{C(y,w)}{Y_i\ MC_i} = \frac{1}{\eta_{cY_i}} \qquad \ldots (5.16)$$

where, MC_i is the marginal cost with respect to the ith output and $\eta_{cy_i} = \dfrac{\partial \ln C}{\partial \ln Y_i}$ is the cost elasticity of the ith output. This is so because

$$\begin{aligned}\eta_{cy_i} &= \frac{\partial c(.)}{\partial Y_i} \cdot \frac{Y_i}{C(.)} \qquad \ldots (5.17) \\ &= MC_i \cdot \frac{Y_i}{C(.)}\end{aligned}$$

The cost elasticity corresponding to the two output measures (y_3, y_4) obtained from the translog cost functions (5.14) and (5.15) can be expressed as:

$$\eta_{cy_3} = \alpha_3 + \beta_{33} \ln y_3 + \beta_{13} \ln w_1 + \beta_{23} \ln w_2 \quad \ldots (5.18)$$

and $$\eta_{cy_4} = \rho_4 + \gamma_{44} \ln y_4 + \gamma_{14} \ln w_1 + \gamma_{24} \ln w_2 \quad \ldots (5.19)$$

If η is greater than one (1), the LICI will experience decreasing returns to scale, as costs rise proportionately more than output. An η value equalto one (1), indicates constant returns to scale, and a value of less than one (1) indicates increasing returns to scale.

5.7 Emperical Results:

Equations (5.14) and (5.15) are linear in their unknown parameters and are, therefore, amenable to ordinary least squares (OLS) estimation. Though OLS fails to incorporate any extra information which might be extracted from a restricted system of cost equation (Murray & White, 1983, p. 893) we still utilise it because it provides a simple means of deriving unbiased estimates. The parameter-estimates of the two models and their relevant statistics are presented in Table 5.1.

TABLE - 5.1

Estimated Parameters and Relevant Statistics

Equation	R^2	F	DW	Parameter	Estimate	t-value
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.14	0.9996	2695*	2.088	α_o	-591.36	-1.7005****
				α_3	56.627	1.7379****
				β_1	-27.167	-1.0094
				β_2	-79.570	-1.9377***
				β_{11}	-2.1362	-2.3571**
				β_{12}	-0.6581	-0.4386
				β_{13}	1.2824	1.0203
				β_{22}	-5.9080	-3.1415**
				β_{23}	4.0330	2.0644***
				β_{33}	-2.4268	-2.5906**

Contd..

TABLE - 5.1 (Contd..)

Equation	R^2	F	DW	Parameter	Estimate	t-value
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.15	0.9998	3907*	1.9373	ρ_o	-208.88	-0.9858
				ρ_4	19.251	1.0064
				γ_1	-14.604	-0.6746
				γ_2	-27.149	-1.2044
				γ_{11}	-1 .8530	-1.8974***
				γ_{12}	.05574	.04976
				γ_{14}	0.6469	0. 6550
				γ_{22}	-2.2646	-2.4855**
				γ_{24}	1.4252	1.3714****
				γ_{44}	-0.6408	-1.3861***

*Significant at 1%; **Significant at 5%; ***Significant at 10%; and ****Significant at 20%.

The table shows that all estimated relationships yield high degree of association, R^2 being 0.9996 and 0.9998 respectively. Their calculated F-statistics are also significant at 1 per cent level. A goodness of fit is seen for both the equations under study. They also pass the Durbin-Watson 'd' statistics and as such the null hypothesis of no autocorrelation can be rejected. Low significant levels of some estimated parameters (as seen from 't' values) are probably mainly due to the presence of multicollinearity (though not perfect) among the arguments. This is often encountered in the estimation of translog function owing to the incorporation of each argument both in linear and squared forms. Some pioneering studies in this field have argued in favour of this reason[1].

Now, following Benston, et al (1982) we may put the geometric means of y_3, y_4, w_1 and w_2 in equations (5.18) and (5.19), and derive the scale economies with respect to y_3 and y_4 over the whole period of analysis. The geometric means of relevant variables are shown in Table 5.2.

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1. On this point please see Mullineaux (1983) and Benston et al (1982).

TABLE - 5.2

Geometric Mean of the Variables

Variable	G.M.
y_3	7961.9562
y_4	6571.1228
w_1	0.00626
w_2	0.00102

By using (5.18) and (5.19) we have estimated the scale elasticities with respect to each output of equations (5.14) and (5.15) at the geometric means. These are shown below:

TABLE - 5.3

Scale Economies

Equation	η_{cy_3}	η_{cy_4}
(5.14)	0.5403	-
(5.15)	-	0.5185

Table 5.3 shows the existence of scale economies/diseconomies with respect to y_3 and y_4. The values of the scale elasticities are seen to be 0.5403 in equation (5.14) and 0.5185 in equation (5.15). They imply that the proportionate escalations of total costs are respectively 54.03 and 51.85 per cents of proportionate increase in the LICI output y_3 and y_4 in the respective equations. Thus over the years the LICI produced an overall scale efficiency.

Using equations (5.18) and (5.19) we have also estimated the scale elasticities at different output levels over the years and present these in Table 5.4.

TABLE - 5.4

Scale Elasticities over the years

Year	η_{cy_3}	η_{cy_4}
1971	0.5940	0.1883
1972	0.6417	0.1754
1973	0.5514	0.1368
1974	0.1476	0.0480
1975	0.4540	0.3303
1976	0.6251	0.4059
1977	0.3889	0.3360
1978	0.6223	0.4619
1979	0.9817	0.6755
1980	0.8266	0.6023
1981	0.8126	0.6088
1982	0.7391	0.6107
1983	0.4169	0.5588
1984	0.6113	0.6717
1985	1.1227	0.8660
1986	1.0445	0.8746
1987	1.0273	0.8998
1988	1.0209	0.9441
1989	1.3113	1.0967
1990	0.7385	0.8773

The Table 5.4 gives evidence of the presence of scale economies throughout the period from 1971 to 1984 in equations 5.14 and 5.15 respectively with respect to y_3, (loans + investments) and y_4, (total assets). But the measures of scale elasticity become more than unity since 1985 (with the exception of 1990) in equation 5.14 and an increasing η_{cy_4} is discernable since 1985 in equation 5.15 and are thus indicative of its scale-diseconomies with respect to y_3 and a tendency towards scale dis-economies with respect to y_4 (which actually shows diseconomies in 1989). While in the case of equation 5.14 the range of scale elasticity is 0.1476–1.3113, in the case of equation 5.15 this range is 0.0480–1.0967. It, thus, seems that substantial scale economies in terms of y_3 as well as in terms of y_4 occurred till 1985 and from then on a cost increasing tendency is perceptible.

This exercise, thus indicates that operating economies tended to decrease as the activity of the LICI grew. This result conforms with the results we obtained in Sections 5.1 and 5.2 on the basis of some conventionally used critical ratios to understand the performance of branches of the LICI. Another point which needs to be examined but we have not, is the question of scope economies. Of late, the LICI has embarked on some multi-product business, (such as 'HFL' for housing finance loans, 'LIC-MF' for mutual fund business and 'LIC International (EC)' for procuring business in the gulf-countries) the impact of which needs to be analysed along with scale economies. However, on the basis of our exercise we may state that at least with regards to loans and investments (y_3) and total assets (y_4) there exists ground for economising in future years. Another point that needs to be stressed is that, we could not work out the outcomes of some other definitions of outputs (other than y_3 and y_4) and therefore, do not know the sensitivity of the elasticities with respect to those other alternative definitions. This, we must admit, is one of the limitations of our present exercise.