CHAPTER 2

2. LITERATURE ON PRODUCTIVITY MODELLING

Industrial Systems modelling has a wide scope and the development in this field is very well signalled by the various methods of modelling resulted from different approaches of many authors.

To evaluate productivity of an industry for any particular year the system approach comes in handy. An industry can be considered as a system with a set of input parameters resulting in a certain output in which the output and inputs can be correlated mathematically by a model. (Sumanth, 1981).

A model in the mathematical sense is an expression which gives a relationship between the various dynamic parameters viz input and output of the system considered. The immense complexity of the real economy makes it impossible for us to understand all the interrelationships at once; or for that matter it is difficult to decide whether all these interrelationships are equally important for the understanding of a particular economic phenomenon under study. The sensible procedure is therefore to pick out what appeals to our reason to be primary factors and relationships relevant to the problem and to focus the attention on it. Such a deliberately simplified analytical frame work is called an 'Economic Model' and it is a skeletal representation of the actual system. (Vogt et al 1975).

The term 'dynamics' as applied to economic analysis, refers to the type of evaluation in which the objective is either to trace and study the specific time paths of the variables or to determine whether, given sufficient time, these variables will tend to converge to certain equilibrium values. In a dynamic analysis the question of
‘attainability’ can be squarely faced, rather than being assumed. One salient feature of dynamic analysis is the dating of the variables, which introduces a consideration of ‘time’ into the picture. This can be done in two ways, the time can be considered either as a continuous variable or as a discrete variable. In the present work, the dynamic characteristics of industrial systems have been analysed on an year wise basis (discrete variables).

In this work it is proposed to analyse the performance of chemical, sugar, cement and paper industries during the nineties (1993-1998). The study is carried out at sectoral level. Again the data of the ‘some industries in each sector for the said years (1993 to 1998) were analysed year wise to evaluate the time dependency of these variables for forecasting.

2.1 SURVEY OF LITERATURE

Modelling of industrial systems is in vogue for quite some time. The developments in this field are very well defined by many authors who have approached it by many methods. Beisel et al (1973), Hodges, (1969), Laddha et al (1975)

Methods for modelling the steady state and dynamics of a single industry are better established and hence have been recorded more often. But methods for modelling of industrial system (sectoral analysis) were not so offen demonstrated and that too for a great advantage so far. It is better to say a standardisation is needed rather than saying standard methods are necessary.

To trace the history of system simulation, as early as 1961, Forrester, (1961) developed a sophisticated computer programme. The same technique was used by
Aldermeshian and Mickle (1973) to model the interaction of socio economic variables with the transportation system of various structures in urban USA.

A second method available is also equally sophisticated and depends upon the development of a transaction table for the particular system. This involves the solution of matrix equations which can be written in time dependent form to describe the production rates of each product of the system in terms of the supply rates, the demand rates, the matrix of time constant for the industries of the system and the information about the inventory dynamics for each industry. This method was suggested by Vogt et al (1975). Here, a complete description of each industry on the system is essential. Though potentially more powerful, the difficulty of acquiring the necessary data and the mathematical complexity of this method somewhat goes against its use at the present.

Beisel et al (1973) have proposed a single industry model. Its usefulness has been demonstrated in actual practice. They have modelled a soybean oil extraction plant in USA (Central Soya Company of Fort Wayne Indiana USA). Model equations were assumed and numerical results were obtained by programming the model equations on a computer.

The modelling techniques for the Indian industrial systems has been tried by Laddha et al (1975). A descriptive approach to the modelling of industries of south India was adopted by them as a first step. Data was developed on the following variables for selected industrial systems.

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<th>Sales</th>
<th>Operating costs</th>
<th>Productivity &amp;</th>
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<tr>
<td>Number of employees</td>
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<td>Profitability</td>
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Their effort was to obtain a model connecting the above variables and concentrated mainly on the plantations of South India and the process industries.

Data describing the performance of more than 50 plantations of South India for the period 1968 to 1974 were correlated assuming different forms involving the variables, Q - Productivity, K - Capital cost and L - the estate expenditure, \( \mu \)-capital.

The Models considered were:

\[
Q = A_1 K^b L^c \quad \text{and} \\
\frac{Q}{H} = A_2 \left(\frac{K}{H}\right)^{b_1} \left(\frac{L}{H}\right)^{c_1}
\]

and found to yield within confidence limit and high regression coefficients. Other forms consistently showed significantly poor goodness of fit. Specifically none of the systems studied may be described by the standard ‘isoquants’, that is by an equation of the general form. Though the results were not so successful, the technique provided an initiative for further study.