ANALYSIS OF RESOURCE USE EFFICIENCY OF THE SPINNING MILLS IN KERALA

Thesis submitted to the
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by

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CERTIFICATE

Certified that the thesis "**ANALYSIS OF RESOURCE USE EFFICIENCY OF THE SPINNING MILLS IN KERALA**" is the record of bona fide research carried out by **P.S. MOHANA KUMAR** under my supervision. The thesis is worth submitting for the degree of Doctor of Philosophy under the Faculty of Social Sciences.

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DECLARATION

I declare that this thesis is the record of bona fide research work carried out by me under the supervision of Dr.N.Chandrasekharan Pillai, Professor, School of Management Studies, Cochin University of Science and Technology, Cochin 682022. I further declare that this thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar title of recognition.

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GLOSSARY

Best Practice Techniques

Best practice techniques are defined as the techniques at each date which employ the most recent technical advances, and are economically appropriate to current factor prices. They correspond to the idea of the most up-to-data techniques currently available.

Counts

It indicates the degree of fineness of finished yarn. If a length of 840 yards of yarn, roving or sliver weights 1 lb. we call the yarn one hank or No.1 count. If 1680 (i.e. 2x840 yards) weigh 1 lb. there are two hanks or it is called Nc.2 counts etc. The formula for calculating count is

$$\text{Count} = \frac{\text{length in Hanks}}{\text{weight in lbs}}$$

Composite Mill

Mills where spinning and weaving operations are taking place simultaneously.

Efficiency Frontier

The locus of points characterised by the highest level of output per unit of input achieved within a sample of firms, different points on the frontier correspond to the use of inputs in different proportions.

Fibre Index Quality (FQI)

In order to decide the quality characteristics of the cotton required for spinning different counts with desired CSP (count lea strength product for different end uses) values, a single measure for the overall quality of cotton has been established by SITRA

$$\text{FQI} = \frac{\text{lusm}}{\text{f}}$$

where lu = product of 2.5% span length (l) in mm and uniformity ratio (u%) measured on digital fibrograph divided by 100.

s = Bundle strength in g/tex at 3 mm guage length (stelometer).

m = Maturity coefficient

f = Fibre fineness as determined on micronnaire and expressed as micronnaire value (micrograms/in.)

A higher FQI is indicative of better quality in cotton.

SITRA

South India Textile Research Association is a research institute located at Coimbatore, equipped with modern testing laboratory to help its member mills in South India.

Spindles ≤ 26,000

Mills whose spindleage is less than 26,000 installed spindles denoted as 'small mills'.

26,000 ≤ 50,000

Mills whose spindleage is between 26,000 to 50,000 spindles denoted as 'medium mills'.

Technical Efficiency

Measures the extent to which a firm fails to obtain the maximum output from its inputs i.e. how far its output-input ratio falls short of the most efficient firms that use factor in the same proportion as it does.

Twist Multiplier (TM)

Twist multiplier is a factor used in the textile industry to arrive at the optimum 'tpi' (twist per inch) or 'tpm' (turns per metre) to be inserted in the yarn, depending upon the linear density (count, tex) of the yarn, the quality of the mixing and the nature of the product

$$\text{tpi} = \text{TM}\sqrt{\text{count}}$$

$$\text{tpm} = \frac{100 \times \text{TF}}{\text{tex(t)}}$$

Twist factor (TF) is a term, similar (but not numerically equal) to TM. This is used when expressing the yarn number in 'tex' (direct system).

LIST OF ABBREVIATIONS

AIFCOSPIN	All India Federation of Co-operative Spinning Mills Ltd.
BIFR	Board for Industrial and Financial Reconstruction
BSS	Back Stuff Shortage
CD	Cobb-Douglas
CES	Constant Elasticity Substitution
CIC	Centre for Interfirm Comparison
COLS	Corrected Ordinary Least Squares
Co-op.	Co-operative
DEA	Data Envelopment Analysis
EBS	Empty Bobbin Shortage
ECP	Energy Conservation Programme
EM	Energy and Materials
FQI	Fibre Index Quality
GATT	General Agreements on Tariff and Trade
GPM	Gross Profit Margin
GPS	Gross Profit per Spindle
HVI	High Volume Instrument
IFC	Inter-firm Comparison
ITI	Industrial Training Institute
K/L	Capital Intensity i.e., Gross fixed capital (K) per unit of employee (L).
KP(Y/K)	Capital Productivity i.e., Value added (Y) divided by gross fixed capital (K)
KSTC	Kerala State Textile Corporation

$LP_1(Y/L)$	Labour Productivity i.e. Value added (Y) divided by total employees (L)
$LP_2(Y/S\&W)$	Labour Productivity i.e. Value added (Y) divided by salaries and wages (S&W)
MFA	Multi-Fibre Agreement
MLE	Maximum Likelihood Estimation
NCAER	National Council of Applied Economic Research
NDC	National Co-operative Development Corporation
NPC	National Productivity Council
NTC	National Textile Corporation
OAT	Operating Assets Turnover
PIAM	Perpetual Inventory Accumulation Method
PIM	Perpetual Inventory Method
R&D	Research and Development
ROA	Return on Assets
SITRA	South India Textile Research Association
SP(Y/S)	Spindle Productivity; Value added (Y) divided by number of installed/commissioned spindles
S&W	Salaries and Wages
TE	Technical Efficiency
TFP	Total Factor Productivity
TM	Twist Multiplier
TPI	Twist per Inch
TPM	Turns per Metre
TQM	Total Quality Management
UKG	Units per Kilogram of yarn

Chapter I

INTRODUCTION

1.0 THE CONTEXT OF THE STUDY

The textile industry has a glorious history in India. It reached its peak of excellence in the period between 10th and 17th centuries. The writings of Marco Polo and of Tavernier show the glory of Indian textiles. The fame of "Dacca Muslin" all over the world is a classic example for the superior position of India in this field. India has a long tradition in textiles. The origin of the textile mill started right from 1818 when the first cotton mill was established at Fort Gloster near Calcutta. Today the industry has grown to become the second biggest in the world.

Indian textile is known for the excellence of the craftsmanship, dexterity and skill and uniqueness in design, texture, and colour combination. Textile industry now plays a vital role in the national economy taking a share of 20 per cent of the country's industrial output and contributing nearly one-third of total foreign exchange earnings from exports. Thus the industry not only caters to clothing needs but also generates substantial foreign exchange. Next to food, clothing is one of the most important items of family expenditure in India accounting about 10 per cent (Sastry, 1984). Thus from the point of view of production, employment, export and consumption cotton textile industry is very important.

The cotton textile industry consists of organized mill sector and decentralized sector. The organized mill sectors are of generally two kinds, spinning mills which produce only yarn and composite mills which produce both yarn and cloth. The decentralized sector consists of handlooms, powerlooms and Khadi. The textile industry has got a complex structure comprising traditional hand-spun, hand-woven sector to sophisticated capital intensive, high-speed machine sector. A fast growing intermediate powerloom sector can also be witnessed along with a promising garment and hosiery industry.

The spinning sector of the textile industry has shown a phenomenal growth against heavy odds. The growth was more rapid and prominent after independence. The growth showed an accelerated increase during the 1980s when, on an average, one new spinning mill of 17,000 spindles was started every eight days (Ratnam, 1992).

The open-end rotor spinning system is gaining ascendency in India. Another development in recent years has been the growth of 100% Export Oriented Units (EOU) especially in the spinning sector. This is a green signal for positive development since most of the industrial nations are cutting own drastically their spinning capacity due to high labour cost. The industrialised nations are concentrating on weaving and knitting.

The industry as a whole provided employment to 133 lakh persons and annually earned Rs.35,000 crores from export of yarn, fabrics, made-ups and ready-made garments (National Textile Policy, 1985). In the international market, Indian textile goods occupied a unique place with its aesthetic qualities and durable nature. Currently (1990-91) the industry provided employment to 164.87 lakh people. The share of employment absorption of mill sector was 11 lakh people, Handoom sector was 96.87 lakh people and powerloom sector was 57 lakh people. In addition the garment industry and ancillary industries provided employment to as many as five million people.

Textile exports from just about Rs.130 crores in 1970 jumped into an enormous amount of Rs.12,843 crores in 1991-92. Textiles comprising garments, handlooms, cotton, synthetic yarn, wool and woollen garments were exported to almost all countires including EEC countries USA, Canada, Japan, Switzerland, Sweden and Australia. Out of the country's total foreign exchange earnings of Rs.43,828 crores in 1991-92, the contribution of textiles was about 30 per cent. Exports of textiles have an added significance because of the depleting foreign exchange reserves in relation to demand.

When disaggregated, the important items exported include mill-made fabrics, powerloom fabrics, handloom fabrics, hosiery fabrics, mill-made made-ups, powerloom made-ups, handloom made-ups, cotton yarn, sewing thread, woven garments, knitted garments, spun yarn, filament yarn, fibres, rayons etc. Of all these, cotton based items dominate the export earnings. Amongest these garments constituted the leading item followed by fabrics, made-ups and yarn including sewing thread as per 1991-92 statistics.

Market studies reveal that the promising export markets are found in Japan, South Korea, Hong Kong, Australia, Mauritius, canada, Saudi Arabia and Sri Lanka. More than 87 per cent of the yarn exports were counts in the range group upto 40s in 1992. It was nearly 82 per cent in the year 1990.[1]

The cotton spinning mills, producers of different counts of yarn are the main suppliers of yarn to handloom industry in Kerala and outside. The atmosphere in Kerala is highly conducive to the growth of spinning mills since there

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1. Statistical materials are taken from Spinner's Year Book 1993.

are about 95,000 handloom providing direct employment to 1.5 lakh persons (Economic Review, 1988). Also the spinning mills in Kerala supply yarn both to powerloom and handloom sectors which in turn provide employment to a large number of people.

The spinning mill sector is generally characterized by its very high linkage effects. These linkages can be used to generate the growth of other related industries especially in weaving and processing sectors. Yarn requirements of both handloom and powerloom sectors are met by spinning mills. Therefore, the spinning mills in Kerala are providing a boost to employment generation and also generate growth in other sectors.

In view of the closing down of spinning mills in European countries due to high labour cost, the prospect and growth of spinning mills is of much importance. But the export potential depends upon our ability to produce yarns of international quality. All this depends on the efficiency with which scarce resources are utilized by the spinning mills.

Modernization and technological upgradation are of paramount importance to meet the qualitative and quantitative requirements of yarn. The full potential of spinning sector is yet to be tapped. There is a great need to tap resources systematically and to use it most prudently so as to generate more employment and larger export market.

1.1 SIGNIFICANCE OF THE STUDY

The role of public sector and state owned industries has become a subject of discussion among statesmen, economists and academicians all over the world. There is a practice of selling down the assets of state owned industries partially or wholly to private sector along with a strong demand for denationalization even in essential sectors. Most of the discussions centre around the poor performance of state owned enterprises especially in terms of profitability, cost and productivity.

The Government of India assigned a key role to public sector enterprises right from the Industrial Policy Resolutions of 1948 and 1956. Sick Industrial Undertaking (nationalization) Acts were passed to take over sick units. As a result NTC under Government of India and KSTC under Government of Kerala took over the management of sick textile units in Kerala.

Textile units were also started in co-operative sector with the object of encouraging thrift, self-help and cooperation among persons along with business interest. Textile, especially spinning, is one of the very few industries/firms in Kerala where public, private and cooperative sectors co-exist. Hence, an objective assessment of its performance is of great importance. A critical analysis of public sector units will help to justify or not to justify nationalization of sick units.

The significance of the study increases in the context of a global trend among economists becoming more and more "Pro-Classicists".

Advocates of those who believe "small is beautiful" put forward the strong view that small enterprises are labour-intensive and labour intensity of production is advisable in an over populated and developing country like India in general and Kerala in particular where the backlog of unemployed educated labour force is amazingly high. Small industry promotion has been always a major objective of India's industrial policies and plans. As a result, government has been pursuing various programmes to help improve viability and accelerate growth of small industries. Hence a study regarding the relative resource use efficiency of small spinning mills versus medium spinning mills[1] is also of great

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1. By definition, the spinning mills in India consist of tiny, small medium and large spinning mills. But in Kerala tiny and large spinning mills are by and large absent.

importance to policy makers. "The changes in size and form of factory throw light upon the mechanical and scientific progress in production". Jewkes, (1952).

Hence an analysis of the performance of the existing spinning mills in Kerala is of paramount importance. The analysis is confined only to the spinning mills in Kerala.

It is in this context that this study discusses the factors which influence the productive and financial performance of the spinning mills in Kerala. The study will also help to assess the effect of ongoing reforms in the industrial sector in India. The main objective of the study is to identify and analyse the factors affecting the efficiency of the spinning mills. The unique feature of the study is that it compares the performance of private sector in relation to its public counterparts and also the performance of small sector in relation to medium sector.

The study which analyses and identifies the factors affecting the performance of spinning mills in Kerala in a unified framework of type of ownership and firm's size is first of its kind.

1.2 THE SCOPE OF THE FIELD

The textile industry involves in the manufacture of yarns and fabrics, such as spinning cotton, wool, silk or rayon fabrics into yarn; weaving or knitting yarn into cloth; finishing the fabric by dyeing, bleaching or printing; and other preparatory or finishing operations. The allied industries convert the fabrics into apparel are known as the 'garment' or 'needle trades'. Another group of allied industries purchase fabrics for conversion into non-apparel articles like draperies, awnings, tents, bags etc. The scope of the field (Alderfer and Michl, 1950) is shown in Figure 1.1.

The place of cloth in the family budget is so important that regardless of age, creed, colour, or wealth it satisfies the need of every customer. No article of consumption is so intimate and personal like clothing. "A person may emphasize his individuality not only by his selection of clothing but also by the manner in which he wears it, because identical garments may be worn by different people in ways which express individuality" (Alderfer and Michl, 1950).

The wide scope of this field, the different types of raw materials used, the wide variety of goods manufactured,

1. RAW MATERIALS

ANIMAL: WOOL, MOHAIR etc.

SILK

COTTON

VEGETABLE: WOOD PULP; FLAX, JUTE RAMIE ETC.

NON-CELLULOSIC

2. YARN MANUFACTURE

PHYSICAL PROCESSES

WOOL: Felt Mfg.; Woolen spun yarn (carded); Worsted spun yarn (carded)

Carpet and rug mfg.

SILK: Spun; Thrown

COTTON: Carded Yarn; Combed Yarn

CHEMICAL PROCESSES

RAYON: Stapel and waste; Rayon

NYLON: Staple; Yarn

3. CLOTH MANUFACTURE

WOVEN CLOTH

WOOL / NYLON, SILK AND RAYON: Piece goods; Blankets; Broad silks; Narrow Fabrics

KNITTED CLOTH

COTTON: Fine goods; Print cloths; Sheetings; Blankets; Other goods

4. MARKETS

FACTORY GARMENT MANUFACTURE

KNITTED GARMENTS: Underwear; Hosiery; Outer wear

CUT GARMENTS (NEEDLE TRADERS): Cutters of men's clothing; Cutters of Women's clothing

Furnishing traders etc.

Home dress making, custom tailoring etc.

House furnishing

Industrial users: Furn,mf'rs; Transportation Eq.mf'rs; Tire ,,; Misc. ,,

FIG.1.1 RELATION OF RAW MATERIALS, PROCESSES AND MARKETS

and many uses of which they are put, the high degree of linkage, the high employment nature are the characteristics which made this industry unique among other manufacturing industries in all over the world.

1.3 THE CONCEPT OF PERFORMANCE

The measurement of industry performance requires examination of a number of indicators. Only on the basis of all these, an overall judgement can be made, and there is no single universally accepted theory or criterion to measure performance. This is a major problem in performance-appraisal. The choice of measures of performance depends on the objectives of the study. Essentially performance measures the degree of success in attaining stated objectives. Economists rely on a large number of criteria to measure performance and to analyse relative or comparative position of firms.

According to Jones and Cockerill (1985) the important performance indicators to be analysed in the case of an industrial unit are: profitability, growth, productivity and investment. Attempts have also been made to use market models as indirect criteria for judging performance. Perfect competition model, though not a realistic market form itself, has been used as a base, for developing performance indicators. It is easier to construct indicators which are related to pre-conditions for satisfactory performance rather than related to performance itself.

Besides, economic performance industries also contribute indirectly to social welfare, environmental impact in terms of pollution, quality of life etc. In order to measure social performance the indicators chosen to measure performance should be related to attainment of socio-economic objectives.

Measures of performance are also viewed in terms of X-efficiency, allocative efficiency and technical efficiency.

Leibenstein originated the concept of X-efficiency which denote general managerial and technical efficiency. Firms generally operate within rather than on their production frontiers. Given the output, costs per unit are generally not minimized. Innovations are generally not introduced when it is optimal to do so. Hence, the comprehensive term, X-inefficiency is used. X-inefficiency is similar to technical inefficiency.

Allocative efficiency denotes the effectiveness with which (scarce) resources are apportioned between (alternative) uses. Another measure is named after Pareto (Pareto optimality); the allocative efficiency is not maximised if reallocation would make some people better off but no-one worse off. The analysis of allocative efficiency has been described as Welfare Economics.

"Technical inefficiency measures the extent to which a firm fails to obtain the maximum output from its inputs, as judged by how far its output-input ratio falls short of the most efficient of the firms in the sample that use factors in the same proportion as it does" (Cortes et al. 1987).

1.4 RELATIVE EFFICIENCY

Whether or not public enterprises or small scale enterprises should be protected or nurtured or promoted, depends, at least in part, on how efficiently they utilize resources. If small scale enterprises are using resources more efficiently than medium or large scale enterprises or if public enterprises are using resources more efficiently than private enterprises, there is strong economic justification for promoting such enterprises.

For the measurement of relative resource use efficiency both partial factor productivity and total factor productivity approaches are generally used in addition to different types of ratio analysis. The frontier production function approach and total factor productivity (TFP) approach are very useful techniques to measure relative efficiency. In the former, a frontier production function is estimated first, and then the requirements of labour and capital per unit of output in different firms or groups are compared to those on the frontier. In the latter, a weighted overage of partial productivity indices are taken, the weight being based on income shares of factors. Ho (1980) adopted TFP approach, Little et al. (1987) adopted frontier production function approach, Goldar (1985) adopted both the approaches. Most of the research studies in the relative efficiency adopt the tool of factor productivities, factor intensities and technical efficiency.

1.5 MEASURE OF PERFORMANCE ADOPTED IN THE STUDY

"The anatomy of performance is a highly complex phenomenon and generally attempts to describe it tend to get bogged down in a welter of theoretical morass" (Lakshmipathy, 1985). Performance also depends upon the fulfilment of objects or duties entrusted to an organization. Hence the choice of an appropriate criterion depends upon the approach adopted for measuring performance.

Meaningful measures of efficiency or productivity by ownership and size are not easy to construct. Ideally, efficiency comparisons by ownership are caught with certain limitations since the basic objective of private firms and non-private firms differs. The larger socio-economic objectives of public sector units are normally absent in the case of private sector units. A public enterprise is a productive entity or organization which is owned or controlled by public authorities where not less than 51% of the paid up capital is held by the Central Government or State Government or by both.

In most of the economies, public enterprises are used as counter-weights to enormous growth of private sector though recently there is a change in attitude in this view universally. Previously there had been a tendency of taking over the sick private sector industrial units by government under the guard of social obligation. But one of the major aims of private enterprises remains to profitability criterion only. Profitability is expressed in terms of money. Profitability criterion regards the excess of the price actually charged by the enterprises to the consumer over the average cost of production. But of late, the economic criterion is heavily applied in the case of public enterprises except in industries of strategic importance. The set of objectives are more or less same in private and public enterprises.

Ideally, efficiency comparisons by size of establishment should be restricted to firms that produce the same product, face the same market, so that they receive the same price for their output, and are vertically and horizontally integrated to the same degree. If data do not meet these conditions, efficiency measures are likely to be distorted. This is especially true when efficiency comparisons are made across different types of firms in an industry or between different firms in different industries. The present study overcome these limitations since the study concentrates on the spinning mills alone in Kerala which are vertically and horizontally integrated to the same degree.

Inter-sectoral comparisons in the present study are made in terms of the following important indicators of performance.

1. Technical efficiency
2. Productivity
3. Cost structure
4. Capacity utilization
5. Profitability
6. Technical change.

1.6 RESEARCH DESIGN

In todays context of liberalization, globalization and free market economy, countries are facing stiff competition to stay aflout in the world economy. Government and assisting agencies are currently reassessing their strategies, paying greater attention to the potential contribution of private firms, co-operatives and other non-governmental organizations. It would be desirable to ensure that surplus from public enterprises originates from an increase in productivity and a decrease in costs of production rather than from higher administered prices or through large doses of subsidy.

Credible structural reforms designed to improve the efficiency and productivity of resource use are an inescapable necessity. The relative efficiency of manufacturing firms has been a topic of considerable interest in the present context of new economic policy. Proponents and opponents have made conflicting claims regarding the efficiency of governmental and non-governmental firms. Supporters and critics of small and medium firm's also have drawn dissimilar views concerning the efficiency.

From a policy point of view, it is interesting to distinguish the inefficient firms from the efficient firms, and to determine whether inefficient firms share some common set of characteristics. The main objective of this study is to identify and analyze the factors affecting the productivity and efficiency of the spinning mills in Kerala. The relation between size and efficiency and type of ownership under which a firm operates and its efficiency are the principal research issues investigated.

1.7 RESEARCH ISSUES

The basic research questions are the following:

1. Do relative technical efficiency of firms vary according to change in size and ownership?

2. How do partial factor productivities behave when firm-size and ownership change?

3. How does capital intensity (K/L) vary according to firm-size and ownership pattern?

4. What are the reasons for capacity under-utilization in spinning mills?

5. Do firm-size and nature of ownership affect profitability?

6. What are the elements responsible for cost variations in different sectors in the industry?

1.8 OBJECTIVES OF THE STUDY

The objective of the study is to identify and analyse the relative performance of the Spinning Mills in Kerala by ownership and by firm's size. The specific objectives are the following:

1. To examine the extent of technical inefficiency (TE) ie., how far actual output is below potential output in different mills and in different sectors. This is to measure the extent to which actual total factor productivity (TFP) is below potential total factor productivity of any firm or group. Secondly to measure the extent to which TFP differs among individual firms. Thus the main objective is to compare relative as well as absolute levels of TFP firm-wise and sector-wise ie., inter-firm and inter-sectoral comparison.

2. To examine inter-sectoral differences in partial factor productivities viz., labour productivity, capital productivity and spindle productivity of the spinning mills.

3. To examine the movement of capital intensity (K/L) when firm-size and ownership differ.

4. To examine rate of capacity utilization and factors responsible for under-utilization.

5. To analyse structure of profitability in different sectors in the industry.

6. To examine inter-sectoral variations in cost and cost components over time.

1.9 HYPOTHESES

The present study examines the following hypotheses:

1. The larger the firm's size, the greater is the capital intensity and lower is the capital productivity and larger is the labour productivity.

2. Private enterprises use resources more efficiently than public sector firms.

3. There is a direct relationship between the productive efficiency of a firm and its size.

1.10 SCOPE AND COVERAGE

The study is carried out with reference to the relative performance of different sectors in the spinning mills in Kerala and to identify the sources of differences in performance. The study covers twenty one spinning mills in Kerala, of which ten are in the private sector, four under NTC, three under co-operative sector and four under KSTC. Measured in terms of firm-size fifteen belong to small size with a spindleage of less than 26,000 and six are in the medium size with a spindleage of 26,000 to 50,000.[1] The period of study is 1982-83 to 1991-92. Hence, only those companies, of which data of 10 years upto 1991-92 were available, were taken for study. Newly established mills and composite mills are excluded.

1.11 STRUCTURE OF THE SPINNING MILLS UNDER STUDY

The structure of the spinning mills under study is presented in Table 1.1. The main classification is on the basis of ownership and firm-size. Total number of mills in each category is also given in the table.

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1. As per the Blow Room capacity, formerly the engineering concept of a viable and economic unit was in favour of 12,000 spindles. A Blow Room could feed approximately 28 frames of 432 spindles thus totalling 12,096 (432x28) spindles. But today a modernized Blow Room feeds upto 58 frames of 432 spindles thus totalling 25,056 spindles. Hence, 25,000 spindles will be more viable and economical today. The present study hence treats mills with spindle size less than 26,000 spindles as small size mills and mills with spindle size ranging between 26,000 to 50,000 as medium size mills.

Table 1.1

Structural characteristics of spinning mills selected for the present study

Categories	Number of mills.
<u>OWNERSHIP</u>	
Private mills	10
NTC mills	4
Co-operative mills	3
KSTC mills	4
<u>FIRM-SIZE</u>	
Spindles ≤ 26,000	15
26,000 ≤ 50,000	6
High profit mills	5
Sick mills	4
<u>AGE-WISE</u>	
1 - 25	4
26 - 50	14
50 and above	3
Sophisticated mill	1

Five mills were earning net profit[1] for almost all the 10 years under study. These mills are categorised as high profit mills. Incidentally all these mills belong to private sector. There are four spinning mills in Kerala at present termed sick and referred to Board for Industrial and Financial Reconstruction (BIFR).[2] Three sick mills belong to private sector while one mill is under KSTC management. The presence of sick mills has an influence on the performance of respective mill groups.

Of all the three co-operative units under study, two units started trial production only during the year 1982-83 ie., during the beginning period of the present study. These mills have faced with all the problems of infancy. Another peculiarity is that KSTC took over sick mills[3] during the period 1982-83 while these mills were having very poor performance. Hence the year 1982-83 is peculiar in the case of KSTC and co-operative sectors and has got its impact on overall performance, which is reflected in various indicators selected for measuring performance.

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1. The operational definition used for net profit is profit gross minus interest and depreciation.
2. BIFR was set up in 1987 following the enactment of the Sick Industrial Companies Act (SICA) in 1986 to help in distinguishing the non-viable sick enterprises from the revivable ones and provide some effective solutions for the exit of non-viable units.
3. Malabar Spinning & Weaving Mills, Kottayam Textiles and Prabhuram Mills were taken over by KSTC with effect from 1.9.1983.

Age-wise analysis, where age is calculated on the basis of year of establishment, shows that there are four mills with less than 25 years of age while there are three old mills in age group 50 and above. All other mills belong to the age group 26 to 30.

There is only one mill using sophisticated technology of international standard. The mill (GTN) is recently accorded ISO: 9000 accreditation, the first of its kind in textile industry in Kerala.

1.12 PECULIARITY OF YEAR 1991-92

The year 1991-92 was an uncomfortable period to cotton textile industry as a whole. This is evident from the fact that the rising graph of all the variable showed a decline trend in 1991-92, incidentally the last year of the period of the study.

The set-back in 1991-92 was mainly due to the strident rise in cotton prices. In the previous years, the supply position was quite satisfactory and consequently prices were moderate. There was also a good demand for cotton yarn both from inside market and overseas market. But in the year 1991-92 the prices of various varieties registered a steep rise and even doubled in some cases. At the same time the demand for cotton yarn subdued and it was impossible for spinners to shift the price burden to weavers due to their stiff resistence. The spinning industry was constrained to bear the burden of loss which compelled it to curtail spindle activity and some marginal and weak units reduced production subsequently. The unstable cotton yarn export policy and the government policy to keep cotton prices under check also led to lower spindle utilization. All these led to poor overall efficiency in all sectors in the year 1991-92.

1.13 DATA REQUIREMENTS AND DATA SOURCE

The entire analysis of study is based on productivity, technical efficiency, capacity utilization, profitability, cost structure and technical change. The data required for all this analysis are mostly collected from cost audit reports, published annual reports of the companies and through structured and unstructured interviews conducted in the course of visits to mills.

The basic data required for the study relate to profit and loss accounts and balance sheet of the companies. Analysis of capacity utilization requires data on spindle shift worked and to be worked, which are collected from production records.

1.14 INTERVIEW TECHNIQUE

Interviews were carried out by technical experts in each mill right on the floor of the factory, supervising the working of the machine and observing the environment. The interviewers sought information, among other things, about the entrepreneurial characterists quality of raw materials purchased, sincerity and work ethics of worker, humidification, house-keeping and other prospects and constraints faced by the mills. Separate schedule was prepared to elicit information regarding technical change in mills (Appendix D-2).

Interviews lasted upto two to three hours. Assurance was also given to the respondents that the source of information will never be disclosed, hence, an atmosphere of confidence was created, which helped the researcher to elicit relevant information. Mis-statements were dropped after careful editing and re-assessment of quality of responses.

The floor interview was mainly focussed on the major technical and economic decision affecting yarn output. Responses were recorded regarding the functional relationship of spinning process.

$$Q = \frac{R}{T} \times e$$

The output per spindle hour for a given count of yarn, Q depends on the spindle speed R, at which spindle rotates per minute, the number of twists, T inserted per inch and hourly rate of spindle utilization'e'or machine efficiency (Pack, 1987). The interviews were specially focussed on these three important operating characterists--spindle efficiency, speed (breakage rate), twist per inch from each mill. The interviews also covered production engineering aspects like blending of raw fibre, quality control maintenance, desirable machine settings and conformed whether it was in tue with South India Textile Research Association (SITRA) standards. Detailed schedules prepared were used to collect these information both from middle management and top management, besides meeting workers' representatives (Appendix D-1).

1.15 REFINEMENT OF RAW DATA

The units surveyed were found following different accounting periods ending on 31st March, 30th June or 31st December. For majority of the companies, accounting periods were ending on 31st March and all the units have been following the same practice from 1989-90 onwards with April-March as accounting year. Hence data taken from balance sheet are reclassified and regrouped to make these figures comparable.

Employees

As total employees relate to a point of time, and it varies during different months of the year, employees on roll of each month was counted and its average was taken as the total employees during an year. The same practice was followed in the case of workers and other personnel.

1.16 ANALYTICAL FRAMEWORK AND STATISTICAL TOOLS[1]

The framework of analysis adopted to study inter-sectoral comparison of performance of spinning mills by ownership and by firm-size is as below. The following different aspects of comparisons are used for analysis.

a) Inter-sectoral growth rate comparisons[2]

The following different approaches are used for comparison:

i) Growth rate for terminal years of study ie., 1982-83 and 1991-92.

ii) The trend growth rate is computed by estimating B in $\ln Y = A + B_t + e$ where ln Y is the logarithm (to the base e) of the index of performance.

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1. Detailed Methodology is given in individual chapters.
2. Simple average annual growth rates for two sub-periods and for the entire period are also computed. The results are reported in Appendix C-5. It is to facilitate broad directional movement of growth rate.

iii) Rate of technological change is estimated using Cobb-Douglas production function. The model specified is as follows

$$\ln Y = \ln A + a\ln L + b\ln K + gT + u$$

The model allows for exponential technological progress at a constant annual rate of g.

b) <u>Panel data analysis</u>

Given the small number of observations, the study treats the subsequent period data of a mill as the data of a different mill of the same type. The cross-section and time series data so obtained are pooled together (panel data) for estimates. Pooling procedure also allows to have a much larger number of observations and hence many more degrees of freedom. This advantage is particularly useful while estimating multiple regression.[1]

Panel data is used to estimate partial factor productivities, rate of capacity utilization, profitability ratios, share of cost components to total cost, and regression analsyis.

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1. The procedure is followed in many recent studies. See Kumbhakar (1990), Ahluwalia (1991), Jha and Singh (1992).

c) Cross-section analysis

Cross-section data is used to estimate performance indicators of the beginning (1982-83), mid (1986-87) and end (1991-92) periods of study.

Inter-sectoral comparisons are made using the following methods:

1. By ownership-wise: ie., private, National Textile Corporation (NTC), Cooperative and Kerala State Textile Corporation (KSTC) mills.

2. By firm-size: ie., small firms in the spindle group 12,000 $\leq$ 26,000 and medium sized units with 26,000 $\leq$ 50,000 spindles.

3. Technical efficiency is analysed by using Cobb-Douglas frontier production function. Firms performing best practice have technical efficiency indexes of one (also called fronteir firms); those which are technically inefficient have indexes of less than one. The average efficiency level of each mill is obtained by using the efficiency indices computed for that mill for different years. Then the firms are grouped in ownership and size-wise and average efficiency level is computed for each group. The model would take the following form.

$$\ln Y = \ln A + a \ln L + b \ln K + gT - U$$

where $U \geq 0$

where Y = gross value added

L = labour, K = capital and T = time

4. Sources of variations in technical efficiency are examined by regressing firm-specific technical efficiency indexes on a number of enterprise characteristics. The dependent variable is logarithm of technical efficiency index.

5. Inter-sectoral differences in total factor productivity are also analysed with the help of dummy variables. The form of the model is:

$$\ln Y = \ln A + a \ln L + b \ln K + r D_1 + \delta D_2$$
$$\epsilon D_3 + \alpha S_1 + U_i$$

where D_1 = Cooperative mills

D_2 = KSTC mills

D_3 = NTC mils

S_1 = Small mills.

6. Partial factor productivity indices are taken as a ratio of gross value added to respective factors.

Labour productivity is measured as a ratio of gross value added at 1981-82 prices to total employment/total wage bill at constant prices.

Capital productivity is measured as the ratio of gross value added at 1981-82 prices to gross fixed assets at 1981-82 prices.

Spindle productivity is measured as a ratio of gross value added at 1981-82 prices to total commissioned (installed) spindles.[1]

The capital intensity is measured as a ratio of gross fixed assets at constant prices to total employment.

7. Estimates of inter-sectoral differences in capacity utilization are based on installed capacity. Kendall coefficient of concordance (W) is used to determine the degree of association among several sets of ranking. The value of w is computed using the formula.

$$W = \frac{2}{\frac{1}{12}k^2(N^3 - N)}$$

where $S = (Rj - R_{\bar{j}})^2$

K = number of sets of ranking

N = number of objects ranked.

1. Wherever all installed spindles were not commissioned, commissioned spindles were taken as the measure. The discrepancy was noted only in very few mills.

8. The structure of cost is analysed by decomposing total average cost into its constituents. The relative share of cost components to total cost is analysed in percentage terms.

9. Inter-sectoral comparisons of profitability are made using six measures. The emphasis is on measures based on gross profit margin (GPM) and operating assets turn over (OAT) ratios.

10. Wherever inter-sectoral comparisons are carried out by computing indices of performance, the base taken is 1982-83 (= 100).

11. The performance of high profit mills is compared with that of mills in other sectors. Firms earning net profit for almost all the ten years under study are taken as high profit mills.

12. Some descriptive statistics of best practice firms (frontier firms) are compared with the average of rest of firms and all firms under study in the industry.

13. Pair-wise Z-test is applied between the private and other ownership categories (and between the small size class and

other size class) to test the statistical significance of differences between mean values. The null hypothesis is that there is no significant difference in the mean levels between pairs.

14. Analysis of variance (ANOVA) technique is used to investigate the significance of the differences among several sample means simultaneously.

1.17 MEASUREMENT OF VARIABLES

Index of Output

The measure of output in the present study is gross value added at 1981-82 base prices. The gross value added is arrived at after deducting from the gross value of production the total value of intermediary inputs. The intermediary inputs include all direct manufacturing expenses viz., stores, spares, dyes and chemicals, packing materials, power and fuel, repair and maintenance of machinery and other electrical equipments, processing charges, freight handling inward and lab testing fee and raw materials consumed.

The gross value added by manufacture is given by the sale of output during the year with acretion/decretion to inventories of finished and semi-finished goods during the year minus purchase of inputs during the year with substractions from inventories of intermediate goods. If output prices and quantities be denoted by P's and Q's respectively and input prices and quantities be p's and q's then the gross value added in the i^{th} year is given by,

$$\sum P_{ij} Q_{ij} - \sum p_{ik} q_{ik}$$

Griliches and Ringstad (1971) advanced many arguments in favour of using value added measure.

The much used single deflation method is used to convert gross value added at current prices into its constant counter parts. Sastry (1981) favoured the use of single deflation since there is asymmetry in the treatment of excise duty between output and inputs in the basic source; while output is ex-factory and inputs are inclusive of it. For this reason double deflation[1] may not be appropriate. Goldar (1981) also used single deflation method because getting suitable deflators for 'materials' considering its severe heterogencity is a difficult task. The present study, therefore follows a single deflation procedure.

In between choice regarding 'net value added' and 'gross value added', Denison (1969) regarded both the measures

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1. Gross output and materials are deflated separately and materials are substrated from gross output.

as legitimate, though he favoured net measure. In Indian context, the figures on capital consumption (depreciation)[1] available are more an accounting entity governed by prevailing Income Tax Law. Hence, the present study uses gross value added and share the limitation with other studies.

Ex-factory value of products

It is taken as the value of product at factory and is exclusive of transport charges from the factory. For uniformity, value of products is estimated by adding sales during the year with closing stock at the end of the year less opening stock at the beginning of the year. The difficulty one encounters is that stock at the beginning and at the end of period is not valued at the same market price. The accounting practice is to value stock at market price or cost price whichever is lower. This constitute a limitation to the study.

Labour input[2]

Total employees are taken as measure of labour where 'employees' include workers, production managers, supervisors, technicains and clerks.

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1. Depreciation has been charged under straight line method in respect of plant and machinery and written down value method in respect of other assets or depreciation of all assets charged under written down value method at the rates specified in Schedule XIV of the Companies Act, 1956.
2. Details of measurement are given in chapter 4.

Capital input[1]

Gross fixed assets at constant prices have been taken as the measure of capital input. The standard practice of perpectual inventory method (PIM) which is based on the relationship between the capital stock at a point of time and investments upto that point, has been used to measure capital input.

1.18 PRICE AND PRICE INDICES

The price indices, which are used in order to deflate different variables, are obtained from different sources. To deflate wages and salaries, consumer price index of Kerala State is obtained from Bureau of Economics and Statistics. Other price indices are derived from the index number of whole sale prices in India.

All India wholesale price index (AIWPI) for fuel and power, textiles and machinery and machine tools are taken from the RBI monthly bulletin. Wherever price indices of the products are not available, those of similar substitutes are used as an approximation. The price indices given at source are with base 1981-82 (=100). This has been taken as the base of the study. Consumer price indices of Kerala state are

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1. Various methods of estimation and measurement of capital are given in chapter 4.

available with base 1970-71 (=100). The base period (1970-71) is recasted into new series based on 1981-82 new base period.

1.19 LIMITATIONS OF THE STUDY

* No attempt has been made to disaggregate capital and labour due to scanty information. Hence subject to problem of aggregation.

* Economic performance is not analysed in terms of price efficiency, and benefit-cost ratios.

* No attempt has been made to estimate a cost function and assess if different sectors are producing at minimum cost.

* No attempt has been made to compare deterministic frontier with composed error models. Translog production function (a recent development of neoclassical production theory), a more flexible function which avoids additivity, separability restrictions has also not been tried. These two are outside the scope of the present study.

* The usual practice of taking profits at current price has got some limitation on interpretation of results.

* An estimation and analysis of allocative efficiency have also not been attempted in the present study.

* Wide year to year variations in performance indices also place some limitation in interpreting trend growth rates.

* No attempt has been made to compare the performance of spinning mills in Kerala with that of mills in other states or with other industries.

The limitations of data and methodology will not seriously affect the conclusions and estimates of productivity. It is hoped that despite the limitations the study will benefit the management, and policy makers in re-vamping the style and structure of the spinning mills in Kerala. The study warrants further research by academicians in several specific areas.

1.20 CHAPTER SCHEME

The study is presented in nine chapters. The introductory chapter deals with scope, significance and analytical framework including statistical tools applied for analysis.

Chapter two reviews briefly the important studies focussing attention on productivity studies, studies related to cotton textiles, technical efficiency, capacity utilization, and relative efficiency studies.

Chapter three is devoted to the discussion on origin, growth and structure of cotton textile industry with special attention to the situation in Kerala.

Chapter four analyses the partial productivity indices viz., capital, labour, and capital intensity and surrogates to capital and labour. Along with inter-sectoral differences productivity trends are also analysed.

Chapter five analyses technical efficiency and economic performance of the spinning mills ownership-wise, size-wise and firm-wise. Reasons for differences are also traced along with a brief description of technical changes.

Chapter six empirically analyses the inter-sectoral differences in capacity utilization and examines the important causes of under-utilization.

Chapter seven is devoted to profitability analysis. In order to analyse financial performance important financial ratios are employed.

Chapter eight is devoted to examine cost component and its share in relation to total cost. The last chapter summaries the principal findings of the study along with arriving conclusions relevant to policy makers.

Chapter II

LITERATURE SURVEY

2.0 The objective of the present study is to analyse the important aspects namely productivity, technical efficiency, capacity utilization and overall relative efficiency by ownership and by firm-size of the spinning mills in Kerala. This chapter is devoted to review the literature related to the areas consistent with the objectives.

Cotton textile industry is the subject which received considerable attention from academicians, statesman and researchers, considering its importance. Hence a large amount of literature is available regarding its historical, institutional and analytical aspects. Detailed study regarding model, size, location, employment absorption, technical change, productivity, production function relations were attempted by many scholars. Other areas which received attention were quality of yarn both cotton yarn and blended yarn, cotton ginning, cleaning and baling, cotton spinning, weaving, shrinking, sanforizing and finishing, printing, dyeing and bleaching.

Production function studies were conducted in factor substitution, constant returns to scale and technical efficiency. Research studies were conducted on the measures to be adopted to produce high quality yarns, cotton selection, process optimisation, quality control, machinery maintenance and audit, house-keeping and materials handling and labour training. Other aspects which received attention were capacity utilization, wage productivity relationship, trend in exports of cotton textiles, determinants of investment, and profitability criterion, technical change, market structure and demand. Economies of higher spindle speed, machine utilization, replacement of machinery components, economics with generators are new areas which received researchers' attention. This chapter is organised to review literature on following areas and to identify research gaps.

1. Cotton Textile Industry
2. Production Function Studies
3. Technical Efficiency
4. Relative Efficiency Studies
5. Capacity Utilization
6. Research Gaps

2.1 COTTON TEXTILE INDUSTRY

One of the earliest studies relating to cotton textile industry is that of Mehta, M.M. (1949). The study analysed the trends in the size of cotton spinning and weaving mills of Bombay, Ahmedabad, Madras and the rest of India for a period ranging from 1905 to 1944. The unit used to measure the size was number of spindles installed in the case of spinning mills and number of looms installed in the case of weaving mills. The study revealed that mills in Bombay were comparatively bigger than mills in Ahmedabad in terms of size. A high correlation was noted between rate of profit and size of mills.

Antony and Pillai (1972) examined the organization and management, financial position, wages, workload, productivity, industrial relations and marketing problems of textile mills in Kerala and suggested concrete steps to resolve the crisis and problems faced by the industry. The study valued for its technical and analytical-cum-historical approach formed the basis for a long term textile policy both by the State Government and Kerala State Textile Corporation.

A comprehensive analysis about the cotton mill industry in India probing into different aspects was conducted by Sastry (1981). The study analysed structure and growth of cotton mills, capacity utilization taking into account six alternative measure of capacity utilization. The most important factor influencing capacity utilization was found to be the availability of raw materials. Productivity of mills in Maharashtra, Tamil Nadu and all India levels were compared using both partial and total factor productivity indices. TFP indices selected were Kendrick and Solow, and Domar and it showed a general uptrend both in Maharashtra and Tamil Nadu, and for all India. Variability is greater in Tamil Nadu. The estimates of elasticity of substitution between capital and labour were 1.22 for all-India, 0.95 for Maharashtra and 1.05 for Tamil Nadu which were not statistically different from unity. This also provides some justification for estimating Cobb-Douglas production function. Three alternate variants of capital measure (gross fixed capital and two surrogates to capital viz., electricity consumption and total energy consumption) had been used in estimating production function.

The choice of industrial technology in the production of cloth is of paramount importance. Pickett and Robson (1981) examined in deep the technology choices in developing countries with respect to the production of cloth. Beyond confirming the availability of many choices, the results of the enquiry underlined the importance of choosing and using modern technologies, taking into account the labour absorption nature also. The gains from improved efficiency and also gains from improved technology were other interesting areas which the study covered.

The Government is discriminating in taxation and licensing against large mills and subsidies small industries though Khadi and Village Industries Commission and through co-operatives. Desai, A.V. (1983) viewed that these policies had little success in changing the technology mix but they have had a strong influence on the firm size composition. The small, new spinning mills and even smaller weaving sheds created a demand for high-draft systems, carding engines and finishing machines.

Pack (1984) analysed past choices of technology and present levels of productivity in the Philippines' cotton spinning and weaving industries. He analysed the detailed engineering and economic information to estimate levels of productivity relative to international standards. The study also analysed the sources of productivity short-falls. Lack of sufficient firm level specialization among product varieties and deficient firm-level technolcgical capabilities were found the major sources of productivity short-falls.

Chandrasekhar (1984) analysed the growth and technical change in Indian cotton mill industry. The study revealed that after a period of good performance in the fifties and early sixties, the industry entered a phase of 'crisis' in the mid-sixties characterized by a decrease in the growth of output as well as investment. Deceleration in the growth of demand for the products and technical backwardness ie., the use of outdated techniques including machinery that had long crossed its normal life-span were other striking features of the industry. The study attempted to relate all these factors along with the co-existence of firms with widely varying levels of productivity and technical advance.

Kevin (1989) analysed the performance of cotton spinning and weaving mills in Kerala on the basis of profitability and financial position and found the performance not satisfactory. The study also examined the cost structure, productivity, asset structure, financial structure, and working capital management for the period 1980-85. Analysis had been done using financial ratios, correlation, index numbers and fund flow analysis. The results obtained were compared with that of other registered mills of SITRA in Tamil Nadu.

Technical change and competitiveness in the Indian Textile Industry had been analysed by Khanna (1989). He argued that many of the recent innovations were not suitable to Indian conditions, and the technical change in the advanced countries had only marginal relevance to Indian conditions. It was argued that the 'failure' of the Indian textile industry to modernize had to be attributed to the inappropriate techniques available from advanced countries and to inefficiency of the Indian capital goods sector. As per the analysis, the root cause of crisis was not with supply of inputs but lay entirely on demand side ie., the inability of the consumer to spend greater proportions of their income on cloth.

Goswami (1990) examined sickness in most of the composite mills during the period from 1971 to 1987. The number of working looms during the period decreased at a trend 0.65 per cent per annum. Hence the decline in production of mill cloth was at the rate of 1.5 per cent. The conclusion drawn was that there was very little hope for most of the composite mills, especially the nationalized ones, in the face of competition from powerlooms. Rationalization of labour force was an option suggested.

"Cotton Textile Industry: An Appraisal" a scholarly analysis by Gupta (1991) gives a vivid and lucid picture of cotton textile industry in India. Among various other things, the study measured partial productivity ratios/indices based on output and gross value added versions. A decline in capital productivity and an increase in labour productivity, were the major results obtained from various segments of industry in general.

Production function estimates had been obtained at two levels:

i) By pooling cross-section and time series using state level observations.

ii) By using disaggregated industry level observations over the period 1980-87.

The evidence revealed the relevance of estimating cobb-Douglas production function parameters. The results also reveal presence of technical progress.

Ratnam (1992) had undertaken a study to assess the internal causes of sickness in spinning mills. The contribution to the losses by internal causes had been assessed in selected cross-section of 30 spinning mills in public, co-operative and private sectors. The study examined in length the inter-relationships between modernization, productivity and sickness and the symptoms of sickness had also been identified. The study sponsored by SITRA besides examining technical aspects, laid down standard to be maintained to keep up productivity. Also the study suggested both short-term and long-term measures that can be taken by the mills to improve their working and cut down losses.

Ratnam and Seshadri (1992) conducted a highly technical and scholarly analysis and suggested very important measures to improve machine productivity in spinning mills. The level of machine utilization and its impact on profit, economics of higher spindle speed, measures to achieve higher rates of production in ring frames, reels and cone winders, yarn quality and speeds, costs and profits for different spindle speeds etc. which were dealt within the most scientific manner are highly useful to mill owners. SITRA norms for production (Appendix C-2) per spindle along with spindle speed (rpm), twist multiple, machine efficiency percentage and production per spindle per 8 hours (g)[1] were also given.

Energy cost is accounting for 7 to 10% of the yarn selling price and it constitutes highest component of conversion cost next to wages. Hence a need for energy conservation programme (ECP) and energy audit is highly

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1. 100% production per spindle per 8 hours = $\frac{7.2 \text{ x spindle speed}}{\text{tpi x count}}$

where tpi = Twist Multiplier $\sqrt{\text{Count}}$

important. A procedure to work out the power cost for different counts and types of yarn was analysed by Ratnam and Rajamanickam (1992). According to them a modern mill that spins carded counts and achieves the standard production rate of 88.8 g, UKG (units/kg) figure of 3.56 adjusted to 40s count can be considered to be reasonable. It is found that the power cost as a percentage of yarn sales shows a steady and steep increase with the count from about 6% in 20s to 13% in 100s for carded counts. But in combed counts, the power cost is lower by one-tenth than that in carded counts.

The criteria of capital investment ie., 'will it pay or not' had been examined by Ratnam and Indra Doraiswamy (1992) considering into account the recovery of capital to be invested and interest on investment, tax considerations covering development rebate, depreciation and capitalization vs. treating as stores expenditure and replacement costs. Different methods with illustrative examples were narrated for easy references and adoption. Instead of resorting to wholesale modernization resulting in huge labour replcement, the study suggested a planned continuous modernization processes, so that timely changes in building or lay-out of machines can also be done. As a broad guideline, the study suggested 3 to 4% of the sales revenue as annual investment on modernization and the mills should ensure that they get a return of not less than 25% of the investment. The study also dealt with in detail the symptoms to forewarn sickness in spinning mills and turn around strategy for recovery from sickness.

2.2 PRODUCTION FUNCTION STUDIES

A lot of literature is available regarding the production function studies of the Indian industries. Most of the studies were mainly aimed at analysing the contributory factors of output growth, returns to scale, partial and total productivity indices, technical progress, elasticity of factor substitution etc. using Cobb-Douglas, (CD) Constant Elasticity Substitution(CES), and Variable Elasticity Substitution (VES). Research works are mostly based on Cobb-Douglas and CES models. Recently some other functional forms have also been proposed. Of these, the transcendental logarithmic functional form (translog production function) proposed by Christensen, Jorgenson and Lau (1973) is widely applied. The transcendental logarithmic functional form represents the production frontier by functions that is quadratic in the logarithms of the quantities of inputs and outputs. A thorough review of literature regarding production function studies of Indian industries by Somayajulu and Jacob George (1983) and a review of literature regarding translog production (TL) function by Chakrabarty (1983) give profound insight into the various applications of these production function theories.

One of the early studies on production function is that of Dutta (1955) which shows that Indian industry enjoyed constant returns to scale in the study based on cross-section data during the year 1946-47.

Murti and Sastry (1957) in their production function study of the industrial sector in aggregate, along with some selected industries, estimated Cobb-Douglas production function for the year 1951 and 1952. The study observed constant returns to scale in all cases except in Jute textiles. Reddy and Rao (1962) analyzed the technical progress in Indian industries during the period from 1946 to 1957 and found the existence of neutral technical progress using Solow method.

Hajra (1965) compared partial productivity ratios between large and small scale units and found that both labour and capital productivities were low in small scale industries. The study took employment to measure the size of industries. Findings of Hajra were similar to that of the findings of Sandesara.

Dutta Majumdar (1966) on the basis of a time series analysis of Indian industries during the period from 1951 to 1961, found constant returns to scale.

Singh (1966) analysed productivity trends and wages in Indian industries and came to the conclusion that labour productivity increased considerably, but total factor productivity (TFP) did not rise appreciably. There had been a significant fall in capital productivity due to over expansion of capital input. Thus increase in labour productivity was due to capital deepening.

Diwan (1967) in the study on "Returns to scale in Indian Industry" also prcvides evidence of increasing returns to scale during the period 1953-1958.

Yeong-Her Yeh (1966) examined the production function relationships of the Indian manufacturing industries using Cobb-Douglas function. The study argued that economies of scale may exist for many industries in India.

Venketa Swamy (1968) examined technical progress in twenty-eight Indian industries during the period from 1948 to 1967 using ordinary least square fitted both CES and Cobb-Douglas production function. The study showed that technical change was relatively higher in new industries than in old industries.

Shivamaggi et al. (1968) examined wage trend in seven selected Indian industries in the period 1951 and 1961 and compared them with trends in labour productivity and cost of production. Their findings agree with that of Singh (1966) that increase in labour productivity was due to capital deepening.

Raj Krishna and Mehta (1968) examined the productivity trends in large-scale industries. The study also showed that gains in labour productivity was due to increase in capital input. But total factor productivity (TFP) steadily decreased during the period of study ie., from 1946 to 1964.

Diwan and Gujarati (1968) in their Constant Elasticity Substitution (CES) production function studies of twenty-eight Indian industries during the period 1946-1958, showed high economies of scale, and found employment elasticity of output was also quite low. The study also showed that the elasticity of capital-labour substitution was quite low.

'Capital labour ratio rises with size and output-capital ratio falls with size' was the major findings of Mehta (1969) when he compared capital-labour, output-capital ratios of small, medium and large factories. The size was measured in terms of fixed assets unlike in the studies of Dhar and Lydell and Hajra and Sandesara.

Sankar (1970) examined elasticities of substitution and returns to scale in Indian manufacturing industries using CES production function and found evidence of economies of scale. The study also noted positive/neutral technical progress in six industries and negative in two industries.

Banerjee, A (1971) calculated both labour productivity and capital productivity for the period 1946-1958. The study showed increasing trend for labour productivity and decreasing trend for capital productivity. Banerjee was in agreement with other studies that increase in labour productivity was due to capital deepening. TFP was computed using Solow and Kendrick indices and observed a steady decline in the total productivity for the period.

Hashim and Dadi (1973) also found evidence of constant returns to scale in Indian industries. Their estimates based on production elasticities of factor inputs and the time rate of shifts in production function (Cobb-Douglas) found that technological change was an important source of output growth in Indian manufacturing. The period of study was 1946 to 1964.

Asher and Krishnakumar (1973) compared the growth performance of countries characterized pre-dominantly by centralized socialist economic planning vs. countries with a pre-dominant private sector. The study revealed considerable difference in economic performance of the manufacturing sector in various countries. The American manufacturing was found out performing its Russian counterpart. The production model adopted in the study was CES with Hicks neutral technical progress and constant returns to scale.

Narasimham and Fabrycy (1974) in their production function study of 28 Indian industries using Cobb-Douglas, CES and Homothetic Isoquant shared evidence of constant returns to scale in all the industries separately and together, though there were variations between different industries.

Banerjee, A. (1975) using Cobb-Douglas production function observed technical progress in five Indian industries. But traditional industries like cotton and jute textiles had not shown any significant technical progress. The study registered constant returns to scale in these industries. TFP was computed using Solow and Kendrick indices.

Banerji, R. (1978) investigated capital intensity and average size of plants in manufacturing by size classes of employment, across countries. The study observed, "Empirical evidence is likely to reveal that the average size of plant is associated with the level of development, apart from that with capital intensity". The Comparative overview revealed that the average size of plants in low and middle income countries tend to be much smaller than in developed countries.

Kazi (1978) estimated elasticity of substitution in nine Indian industries for the period 1960-62 using CES and VES production function. The result showed that there was an upward bias in the estimate of σ by the CES method, and the VES production function showed that 75 per cent of them were below unity.

Kazi (1980) using cross-section data estimated VES production function of Indian Manufacturing Industries during the period from 1973 to 1975. The estimate of σ obtained by the CES method and VES method varies between industries.

Mehta (1980) studied productivity, production function and technical change of some Indian industries during the period from 1953 to 1965. The study analysed partial productivity of capital and labour and total factor productivity using Solow and Kendrick indices. According to him, total productivity was declined during the period. Labour productivity and capital productivity showed varying trend in different industries.

Goldar (1981) examined and analysed the productivity trends and technological progress in Indian manufacturing industry for the period 1951-78. Goldar presented the productivity analysis at the aggregate industry level using Kendrick, Solow and Translog indices and compared the results with that of Banerjee (1975) and Hashim and Dadi (1973). The estimates indicated a rising trend in labour productivity and capital intensity and a falling trend in capital productivity. Growth in TFP seemed to have been rather sluggish and substitution of labour by capital was found to be the main feature of industrial growth. Cobb-Douglas production function estimation seemed to favour the assumption of constant returns to scale.

For estimation purpose the following two regression equations were used.

$$\log(V/L) = A_o + b \log(K/L) + gt + u$$

$$\log(V/L) = A_o + b \log(K/L) + m \log(L) + gt + u$$

Gupta (1984) analysed total factor productivity of Basic Metal Industries in India during the period from 1948 to 1970 using Kendrick and Solow indices. The study showed an average annual rate of growth between 0.7 and 0.8 per cent during the period from 1948 to 1958. In the rest of the period it showed an average rate of decline between 3 and 4 per cent. The study also showed that there was a divergence between total factor productivity growth emerging from total factor productivity indices and the coefficient of 't' in the production function.

Joseph (1984) examined the growth and development problems of chemical industry in the state of Kerala. The Cobb-Douglas production function and the CES production function were estimated to analyse the problems of productive efficiency. The study also examined the input-output linkage between the different chemical units. Increasing labour productivity and capital intensity were seen in different sub-groups of the industry and wage rates were found to be lower than the labour productivity indices. A trend of accumulating losses was also reported in the case of public sector chemical units.

Ghosh (1984) examined some efficiency parameters of the steel, cement and sugar industries in order to focus attention on the problem of inefficiency in Indian manufacturing industry. It highlighted the reasons of the low productivity observed in a few key or important industries. Existing low productivity stemmed from inefficient management and not mainly due to technological reasons. "The major lacuna in Indian industry today is management", says the author, "workers' efficiency and productivity depend to a large extent on management practices. All internal problems of factory operations are linked to management efficiency". The study also underlined the need for workers' participation, workers' discipline, the work ethos and work environment.

Ahluwalia (1985) calculated total factor productivity growth (TFPG) of organized manufacturing for the use-based and input-based classification groups and for twenty two digit level industry groups. Ahluwalia had found that in more than half of the twenty digit industry groups, the growth of TFP was negative. These industries account for about 60 per cent of the value added in organized manufacturing. The decline in TFP was more than 3 per cent per annum in industries accounting for about 50 per cent of the value added.

Agarwal (1986) estimated coefficients of labour, capital and raw material and efficiency parameters using Cobb-Douglas production function in twenty industries (into two groups) covering two period ie., 1967-71 and 1975-80. The marginal productivity of inputs and factor shares had also been computed.

Dabir-Alai (1987) examined the productivities of capital and labour and total factor productivity growth during the period from 1973-74 to 1978-79 across the large-scale manufacturing industries of India. The study presented the results of value added production function estimates of TFP growth rates using Solow and Kendrick indices. The result was indicative of an overall improved production efficiency. The findings run contrary to the analyses of Ahluwalia (1985) and Balasubramanyam (1984) who held the view that there had been a decline in the rate of productivity growth of manufacturing sectors of India over a period of the 1970s.

Bhatnagar (1988) examined the relationship between wage and productivity in selected Indian industries for the period 1960-80. No significant relationship was seen between wage trends and productivity trends, but there was some direct relationship between wages and productivity. Capital intensity had been seen to influence productivity to a large extent. The study observed that Capital intensity was positively correlated with both wage rate and labour productivity and was negatively correlated with productivity of capital. It also observed that wage had not acted as a motivating force of productivity increase.

Radhakrishnan (1989) analysed the productivity trends in the organized manufacturing sector of Kerala as a whole and its selected industry groups. The growth of industrial productivity, measured mainly in terms of labour, capital and total factor productivity had been found declining since 1970s. The analysis of total factor productivity growth was carried out in terms of three indices viz., Domar, Solow and Translog. The study concluded that the overall declining productive efficiency coupled with region specific and industry specific factors conspired against the industrial development of Kerala.

Nair and Barman (1990) analysed the performance and productivity of the food processing sector during the period from 1973-74 to 1985-86. The study adopted the Solow method of measuring total factor productivity. An increase in TFP at the rate of about 2.3 per cent per annum was noticed upto 1979-80 followed by a significant fall in 1980-81. After that a remarkable improvement was noticed. On the basis of trend rates of growth in labour productivity, capital productivity and capital intensity, the industry groups were classified as 'High growth', 'Moderate growth', 'Zero or negligible growth' and 'negative growth'. The study revealed that the industry could not achieve any rapid strides during the past forty years inspite of so many favourable factors. A smaller size of the market, higher cost of production, high taxes and levies were quoted as major growth constraints.

Ahluwalia (1991) analysed how trends in productivity growth had influenced the organized manufacturing sector in India over the period 1960 to 1985. It established that there was a prolonged phase of stagnation in industrial productivity in the manufacturing sector in the first two decades which was followed by a distinct turnaround in the eighties. The measure of total factor productivity growth (TFPG) in this study was mainly Translog production function. It was an indicator of change in efficiency in factor use. Production functions were also estimated pooling cross-section and time-series data. The estimates of Translog production function were compared with those of Cobb-Douglas production function.

2.3 TECHNICAL EFFICIENCY

The use of frontier models is widely accepted because it is consistent with the underlying economic theory of optimizing behaviour and deviations from a frontier is a measure of technical inefficiency and finally informations about the structure of frontiers have many policy implications.

Aigner, Lovell and Schmidt (1977) proposed a new approach to the estimation of parametric frontier production functions. Previous work on the estimation of parametric frontier production functions as characterized by the work of Aigner and Chu (1968), Afriat (1972) and Richmond (1974) began by assuming a function giving maximum possible output as a function of certain inputs.

$$Y_i = (X_i ; \beta)$$

Schmidt (1976) added a one-sided disturbance to the above model. Thus,

$$Y_i = f(X_i ; \beta) + \varepsilon_i, \quad i = 1 \ldots N$$

$$\text{where } \varepsilon_i \leq 0$$

The study added two error terms

$$\varepsilon_i = V_i + U_i \qquad i = 1 \ldots N$$

They provided an appropriate specification, by defining the disturbance term as the sum of symmetric normal and (negative) half-normal random variables. The specification of the error term is made up of two components, one normal and the other from a one-sided distribution. The study described a linear model with an error specification that is considered appropriate for the estimation of an industry production function using cross-section data.

Tyler (1979) estimated firm specific indexes of technical efficiency for the Brazilian plastics and steel industries, using two dissimilar procedures--the Farrel index and an index developed from the concept of a non-stochastic frontier Cobb-Douglas production function. The results suggested that small firms tend to be less efficient and relative efficiency of the firms in the two industries was not seen to be significantly related to firm-ownership (foreign or government). But here again a tilt was in favour of larger firms, to be closer to the frontier than smaller firms.

The latest development in estimating frontier production function has been the introduction of a composed error structure in the production function. It allows simultaneously systematic efficiency differences between production units and random differences. Broek et al. (1980) compared the results obtained with this specification and previously developed techniques. The efficiency measures were computed for 28 Swedish dairy plants using cross-section data and pooled data-set. The results showed systematic pattern of differences in both type of analyses.

Page, Jr. (1980) explored the relationship between choice of technique, technical efficiency and economic performance of three industries from Ghana ie., Logging, Saw Milling and Furniture Manufacturing. Frontier production function of each industry fitting Cobb-Douglas form using the linear programming technique was estimated. Sources of technical efficiency were also analysed using a multiple regression framework of all the three industries taking four different explanatory variables.

Pitt and Lee (1981) investigated the sources of technical efficiency in the Indonesian weaving industry. Three firm-attributes were identified as being potentially related to firm's efficiency in their study. They were firm's ownership, age and size. To test whether inefficiency of firms was time variant or time invariant, pooled data analysis was also used. Maximum likelihood estimates of a model with a time invariant efficiency component demonstrated mean efficiency of the Indonesian weaving industry between 60 and 70 per cent. An alternative specification which relaxes the assumption of a time invariant efficiency component but which permits some inefficiency to persist over time was also estimated.

Page Jr. (1984) analysed the relationship between relative technical efficiency and firm's size in four Indian manufacturing industries. A frontier translog production function was used to derive measures of technical inefficiency. In the study, firm's size was found to be positively associated with relative productive efficiency in only one of the four industries. The production function specified was transcendental logarithmic (TL) form. Sources of technical efficiency was also analysed taking logarithm of the Farrell index as dependent variables and seven independent variables were tested for their contribution to the level of technical efficiency.

Schmidt and Sickles (1984) suggested a standard form of using panel data for estimating a stochastic production frontier model. The model is written as:

$$Y_{jt} = \alpha + X_{jt}\beta + V_{jt} - U_i$$

where j = 1,... N indexes firms and

t = 1,... T indexes time

X_{jt} = is a vector of inputs

V_{jt} = a symmetric error term and

$U_i \geqslant 0$

The advantage of using panel data is that one can choose whether to assume particular distribution of V and U or whether to assume that technical inefficiency is uncorrelated with the inputs and that therefore, these assumptions are testable.

Goldar (1985) estimated partial factor productivities, total factor productivity (TFP) and relative technical efficiency of small scale washing soap industry in India. The study paid attention to variations in size and efficiency using total factor productivity approach developing an index as used by Ho (1980), which was based on a linear homogeneous Cobb-Douglas production function. Another approach used in the study to measure relative efficiency was a Cobb-Douglas deterministic frontier production function. Both the estimates showed that tiny washing soap units were quite inefficient as compared with relatively bigger units. Inter-firm differences in technical efficiency were analysed using a multiple regression framework.

In most of the studies, econometric frontier functions had been carried out for a single output with multiple inputs. Kalirajan (1986) measured firm-specific technical efficiencies of each observation in a sample, by estimating a system of production frontiers representing multiple outputs. This methodology is applicable to more general cases of production, in which levels of outputs are interdependent. The study described the theoretical conception of the stochastic production frontier for multiple output firms.

Cortes et al. (1987) assessed the levels of economic efficiency and the determinants of productivity and growth of small and medium-scale enterprises in Colombia. The economic performance was analysed by using three benefit-cost ratios: the entrepreneurial (EBC), the private (PBC) and the social (SBC) and technical efficiency indices (TCI). Technical efficiency indices were calculated using the linear programming estimate of a non-stochastic production function. The study also estimated firm's TEIs using Farrells' methodology. The two approaches produced similar TE indices, with correlation coefficients for four product categories above 0.95 and for two other product categories of 0.83 and 0.73.

Seiford and Thrall (1990) discussed the mathematical programming approach to frontier estimation known as Data Envelopment Analysis (DEA). They examined the effect of model orientation on the efficient frontier and the effect of convexity requirements on returns to scale. Methodological extensions and alternate models that had been proposed were reviewed and the advantages and limitations of DEA approach were also presented.

Kopp and Mullahy (1990) assessed the implications of relaxing some of the distributional assumptions especially the assumption regarding the iid normal character of the noise component in composed error models. Eventhough composed error model was superior to non-stochastic models originally developed by Aigner and Chu (1968) and Timmer (1971) it suffered from the severity of the distributional assumptions giving rise to composed error. An excellent study was done by Kopp and Mullahy, in their paper.

Greene (1990) modified the stochastic frontier model of Aigner, Lovell and Schmidt to allow the one-sided part of the disturbance to have a two-parameter Gamma distribution rather than the less flexible half-normal distribution. In the context of the deterministic frontier, the Gamma frontier model was also proposed by Greene (1980). The salient features were its one-sided disturbance, and the useful features of the Gamma distribution. The paper discussed various methods and its usefulness in detail. The conclusion derived was that the Gamma model offers a promising alternative to half-normal and exponential models for the stochastic frontier.

Bjurek, Hjalmarsson and Forsund (1990) analysed productive efficiency in about 400 local social insurance offices of the Swedish social insurance system for the period 1974-84. The analysis was based on parametric and non-parametric deterministic frontiers. The following three different approaches were used.

i) a Cobb-Douglas (CD) deterministic frontier production function

ii) a Quadratic (QD) deterministic frontier production function

iii) deterministic non-parametric frontier or data envelopment analysis (DEA)

The general results were that the efficiency was around 0.8 and that the differences between the approaches were surprisingly small.

Kumbhakar (1990) used a panel-data framework and models firm-specific technical inefficiency which was allowed to vary over time. The specification was flexible enough to accommodate increasing, decreasing and time-invariant behaviour of technical inefficiency. Time-varying firm and input-specific allocative inefficiency were also incorporated. The technical efficiency was allowed to vary across firms and over time.

Cornwell, Schmidt and Sickles (1990) considered the efficient instrumental variables estimation of a panel data model (production forntiers with cross-sectional and time-series variations in efficiency levels) with heterogeneity in slopes as well as intercepts, using a panel of U.S. airlines. The approach allowed to estimate time-varying efficiency levels of individual firms without invoking strong distributional assumptions of technical efficiency or random noise.

Technical efficiency of the top 100 engineering firms had been analysed using a three inputs frontier production function estimated by ordinary least square method by Goldar and Agarwal (1992). The study applied a deterministic frontier production function and the assumption made about the probability distribution of the error terms was Gamma distribution. They had modified Greenes' (1980) method and took the average of five largest error term to derive consistent estimate of the intercept term. Result showed that technical efficiency of public sector firms was lower than that of private sector firms, and found that size was positively related with the efficiency of a firm. Investigation regarding the determinants of efficiency revealed that size of the firm, research and development intensity, retention ratio and intensities of foreign trade were major determinants.

A detailed study of the cost structure, technical and allocative efficiency of ten major industries in India including efficiency of cotton textile industry was attempted by Jha and Sahni (1993). The study estimated a three input translog cost function with biased technical progress and calculated elasticity of cost with respect to output and found the presence of economies of scale in the industry. The important conclusions were the following:

1. Allocative efficiency had increased over time.

2. Production was characterized by significant economies of scale. Hence, policy makers were advised to expand output so as to reduce average cost.

3. It was found that capital and labour were complements as were capital and EM (energy and materials). However, labour and EM were substitutes. Additions to output need not required massive use of energy and materials--more labour could instead be used.

4. Technical progress was biased toward the use of capital and against the use of labour and EM.

The study suggested that subsidies on capital should be removed and the power of trade unions to extract large wage concessions be curtailed besides allowing the expansion of larger mills. And imbalances should be corrected by encouraging both the unorganized sector and mill sector unlike the present policy of actively encouraging the unorganized sector.

Ramaswamy (1993) analysed deeply the technical efficiency of four Indian small scale industries viz., motor vehicle parts, agriculture machinery and parts, machine tools and parts and plastic products. The study applied four sets of estimates of technical efficiency. Two of them based on deterministic frontiers were obtained using the method of linear programming (LP) and Corrected Ordinary Least Squares (COLS). The method of COLS and Maximum Likelihood Estimation (MLE) were used to obtain two alternative estimates of statistical frontier based technical efficiency. The study also tried three functional forms; namely the Cobb-Douglas, the Constant Elasticity Substitution (CES) and the Translog Production Function. Empirical evidence suggested that functional specification had a small impact on estimated efficiency.

The main conclusion of the above study showed that there was substantially lower intra-industry variations in technical efficiency, which is consistent with the observation that small-scale firms operated in a strong competitive environment. Hence the study suggested that the scope for output gains with existing input qualities and combinations is rather limited. Measures to shift frontier itself through investment in modernization is crucial for growth.

Keshari and Paul (1994) examined the relative efficiency of foreign and domestic banks using a three input Cobb-Douglas form of stochastic fronteir production function. To compute bankwise technical efficiency Jondrow et al.'s (1982) formula was used. The result showed that foreign banks as a group was one per cent less efficient than domestic banks while the standard deviation of technical efficiency of foreign banks as a group was one per cent less efficient than domestic banks while the standard deviation of technical efficiency of foreign banks was slightly higher than that of domestic banks. But the labour productivity and profitability were found higher in foreign banks. It was attributed to their particular operational characteristics and strategies and preferential treatment rendered to them by the Government.

2.4 RELATIVE EFFICIENCY STUDIES

The prevalent belief is that small units as compared with larger establishments possess employment creating and capital saving characteristics. There are a large number of studies which examine the relative efficiency of small scale units compared to their medium or large scale counterparts.

Dhar and Lydall (1961) conducted a study on relative efficiency of small-scale industries in India. Output-capital ratios were compared in a number of industry groups. The study revealed that modern small scale units were in general more capital using than large scale units. In general the most capital-intensive type of manufacturing establishment was the small factory using modern machinery and employing upto 50 workers.

Rao (1965) in the study on 'Small Scale Industries and Planned Economy' strongly favoured the development of cottage and small industries for rural industrialization. The study also discussed various aspects of small industries and its relevance particularly to India's economic development.

Sandesara (1966) analysed capital labour ratio and output-capital ratio by size and found that small-scale units were at a disadvantageous state when compared to large-scale units in terms of employment and output. Findings of Dhar and Lydall and that of Hajra and Sandesara are opposed to each other.

Total factor productivity (TFP) approach had been used by Dholakia (1978) to study relative performance of public and private manufacturing enterprises in India. The performance of public enterprises were quite remarkable compared to that of private enterprises, selecting TFP growth as the criterion rather than net profitability.

The index of TFP is useful to measure the extent of increase or decrease in the overall efficiency of factor inputs used in any production process. The methodology adopted was based on the theoretical framework provided by the well-known neo-classical theory of economic growth.

$$Y_t = F(K_t, L_t, A_t)$$

According to this framework, the growth of output (Y_t) depends on growth of capital input (K_t), the growth of labour input (L_t) and the increase in the efficiency of factor inputs (A_t).

Jalan (1978) presented analytical data on employment, output and capital output ratios of sixteen selected industries in which small scale sector and the large scale sector competed with each other. Of the industries selected for analysis it was found that most of the units in the textile industry were in the tiny sector about 50 per cent of the factories contributing 25 per cent of the gross output contribution in the industry. Capital-output ratio was found highly in favour of tiny textile units (0.29). But capital-output ratio was almost same in large scale units and small scale units while large scale sector absorbed 33.4 per cent of the total employees and small-scale sector absorbed 38.5 per cent in the year 1975-76. The study made similar critical analysis of the rest of fifteen industries also for the year 1975-76 compiling data from the Annual Survey of Industries.

Bhavani (1980) examined the relationship between the scale of operation, technology, capital intensity and relative efficiency of 46 three-digit industries of National Industrial classification, drawing data from ASI and census of small scale industrial units (CSSI). It was seen that in large number of small scale industries both capital and labour productivities were lower than those in large scale units.

Ho (1980) had taken Total Factor Productivity (TFP) approach for assessing the relative efficiency of small scale industries in Korea and Taiwan. In the study, Korean data revealed more useful information since Korean data were disaggregated into more and finer size categories. The results showed that in Korea, the most productive size was the "small medium" size category of 50-59 workers. Small establishments were found to be efficient in only a few industries, and the few industries, where small establishments were efficient did not absorb large number of workers. In most industries not dominated by small industries, the most productive establishments were those with 100 + workers.

Subramaniam (1987) analysed a sample of twenty eight paper mills and reached the conclusion that small mills had higher costs of production relative to large mills. The author computed cost of production of large and small mills during the period from 1983-84 to 1985-86 and concluded that "small is not beautiful". The article points out that there is little justification for subsidizing small vis-a-vis large firms if the former fails to lower their cost of production.

Goldar (1988) analysed relative labour productivity, relative capital productivity and relative efficiency of small scale industries. Small scale units were found relatively inefficient in a fairly large part of the industries covered, if not in most of them. The conclusion does not agree with the findings of Page (1984). Goldar concluded that even if small scale units were inferior in terms of technical efficiency, they might be far superior in allocative efficiency so that the economic efficiency of small scale units might be as high as that of large scale units.

Raghunathan (1989) claimed that "small is beautiful" while discussing the role and performance of small-scale industries in the national economy of India. The author also mentioned the case of industries including textile where there was low investment and abnormally high turnover and industries where turnover was comparatively low. "Therefore, an inescapable duty of all concerned is to spot out products no longer within the technological or investment competence of the small-scale sector," the study comments.

Gupta, Meena (1989) evaluated the relative performance of the different sectors in the fertilizer industry in India and identified the sources of differences in performance. Performance was evaluated in terms of four different measures, namely, capacity utilization, profitability, productivity and the structure of operating costs. Intersectoral comparisons of performance were attempted on an year to year basis and for the entire period of study. Estimates of Cobb-Douglas function revealed a lower productivity in the public sector--the value of coefficient of sectoral dummy was

-0.434 with a standard error of 0.082. Though the productivity of labour as well as of capital had declined in both the sectors, there was a relative improvement in the public sector in relation to the private sector. Overall analysis of performance in terms of capacity utilization, productivity, profitability and the structure of operating costs and capital indicated a poorer performance of the public sector in relation to the rest of the industry.

2.5 CAPACITY UTILIZATION

The problem of under-utilization of capacity received attention during the Second plan period when large scale investment programme was started. But the problem received much attention only during the later part of Third plan. The Fourth Five-Year Plan was launched with an objective to bring about conditions, within which maximum utilization of capacity already built-up was achieved.

In the past, a number of studies had been conducted to assess the capacity utilization in Indian industry. The studies by Lobel and Das (1955), Morris Budin and Samuel Paul (1961) are some of the earlier studies on capacity utilization. Another important study is that of National Council of Applied Economic Research (1966). A survey was conducted by NCAER on 129 units by collecting information through a questionnaire. The Reserve Bank of India conducted a study in 1970 which examined the problem of under-utilization in chemical, metal and engineering industries.

Sing (1975) analysed the problem of under utilization of capacity in Indian industries during the period from 1969 to 1973. The study analysed the constraints in the process of effective utilization and in the light of this exercise focus a perspective look in the near future.

Gupta and Thavaraj (1975) analysed the capacity utilization and profitability of fertilizer units in India. Capacity utilization had its impact not only on productivity of labour and capital but also on costs and profits. The study revealed that technical defects in installation, non-availability of materials of requisite quality, shortages in power supply, unscheduled breakdowns, disturbances in industrial peace and so on had contributed to under-utilization of capacity in different fertilizer units in India. This has accounted for a significant increase in cost of production and reduction in profitability.

Different approaches to measure capacity utilization of cotton textile industry in India was attempted by D.U.Sastry (1981). Six alternative measures of capacity utilization had been estimated. They were (1) the Wharton Index of capacity utilization; (2) the RBI Index of Potential utilization; (3) the maximum output per spindle/loom; (4) the measure based on two shifts; (5) the minimum capital output ratio measure and (6) the National Productivity Council (NPC) measure based on machine hours. The estimate suggested that capacity utilization vary according to the measures employed. The range of variation between estimates was 50 to 70 per cent and above. The most important factor influencing capacity utilization was the availability of raw material as per the study. And the demand factor appeared to have much less influence on capacity utilization.

Rao and Gupta (1987) studied the level of capacity utilization in NTC group of mills and identified the reasons for poor capacity utilization. It was found that NTC subsidiaries were showing better capacity utilization performance as compared to private sector textile units, public sector consumer goods group and public enterprises (PEs) in India. The study concluded that, inspite of better position, there was every scope for improvement. The main reasons for under-utilization of capacity were identified as follows:

1. Old and obsolete machinery
2. Crisis of raw cotton and power shortage

3. Demand constraints
4. Strained employer--employee relations
5. Multiplicity of products
6. Sickness of unit,

Nanda Mohan (1989) analysed capacity utilization in manufacturing sectors of Kerala during the later seventies and early eighties. The study established the fact that the traditional and small scale industries of the state kept capacity grossly underutilized and the under-utilization became highly significant in the eighties. The regression analysis also made explicit the negative association of capital intensity of an industry and its utilization. The most significant determinant of capacity utilization was found maintenance expenditure. Capital was found not properly maintained in the state.

Goldar and Renganathan (1991) analysed the influence of market structure and government policies on capacity utilization using cross industry multiple regression technique. The study showed a positive relationship between demand pressure and capacity utilization and also between market concentration and capacity utilization. The study identified 39 industries with less than 60 per cent capacity utilization and 14 industries with more than 75 per cent in most of the years of the period from 1974 to 1984 and a linear probability model was estimated. The growth rate of production (GQ) and the growth of number of factories (GF) during 1974-84 were taken as the explanatory variables. The estimated equation is,

$$D = 0.282 + 0.0147\ GQ - 0.0118\ GF$$

$n = 43$

$R^2 = 0.28$

D is a dummy variable taking value zero for industries in which capacity utilization has been low and 1 for industries in which it has been high. The estimated equation indicates that a high growth rate on production (demand pressure) improves capacity utilization, while a higher growth rate in the number of firms in the industry depresses capacity utilization.

2.6 RESEARCH GAPS

Several studies have evaluated the performance of cotton mill industry in India and in different states. But there are a number of gaps in these studies. For example, a comprehensive study bringing both the type of ownership and firm size into a unified framework has not been attempted so far and the performance in terms of technical efficiency has been ignored especially at state level studies. The usefulness of capital surrogates and labour surrogates to get rid of measurement problems of capital and labour has also received little attention. A simultaneous analysis of financial performance and productive performance has not been dealt in detail especially about the mills in Kerala.

Most of the studies at regional and all India levels are based on ASI data which grossly disterts measurement of capital, due to inherent measurement problems. In the present liberalised free-market economy, the productive efficiency by type of ownership and by firm-size analysing all these aspects is of great importance. And internally Kerala is locked in a fierce but healthy competition to attract maximum investment. Kerala, like all other states, cannot afford to miss the current industrial wave that is sweeping the country. All these necessitates for an assessment of resource use efficiency of enterprises. Hence, need to take a fresh look at the factors affecting productivity and efficiency of spinning mills, a major industry in the factory sector of Kerala.

Chapter III

ORIGIN, GROWTH AND STRUCTURE OF COTTON TEXTILE INDUSTRY

3.0 This chapter traces the origin of cotton textiles and examines the production process, composition and structure of textile industry in India and Kerala. The growth of textile industry over the period 1982 to 1992 is also traced.

The pattern of ownership and firm-size of spinning mills in Kerala and India are also analysed. The structural characteristics of cotton mills in Kerala are also examined with the help of selected statistics.

3.1 ORIGIN

The word "textile" stems from the Latin word "texere" which means "to weave". Another widely used word for textiles is "fabrics". Thousands of years ago people used animal skins to cover their body. The 'Stone Age' man used animal skin to give protection from bad weather.

The art of textile making began in the old Stone Age. The earliest known textiles made from yarn were fishing nets. "Research has disclosed that the weaving of linen and wool is at least 5000 years old, that cotton was grown and made into cloth by 3000 B.C. and that silk was widespread in China by the 12th century B.C." (The New Book of Knowledge, 1971).

Archaeologists digging the ruins in Pakistan had found traces of cotton fabrics and cotton string dating back to 3000 B.C. Excavations in Peru had uncovered cotton cloth dating back to 2500 B.C. Cotton fabrics were described by the Greek historian Herodotus in 500 B.C. (New Standard Encyclopedia, 1987). Nearly all of the clothes that we wear are made from textiles. Textiles are used for clothing, interior furnishings like draperies, upholstery, towels, beddings, military and sport equipments like tents, parachutes, balloons, sails, flags, handicraft supplies like artists' canvases, embroidery bases, and industrial products like conveyor belts, gunny sacks, tarpaulin etc.

Textile consists of thousands of fine thread like 'fabrics'. About 43,000,000,000 (billion) pounds of fibres are produced every year. About half of this is cotton, about a fifth man-made fibres, and a tenth wool. The rest is mostly rather coarse vegetable fibres (The New Book of Knowledge, 1971).

Textile fibres come from many different sources. Many come from plants and animals; others are made by chemical processes. The former is called natural fibres and the latter is called man-made fibres (mmf) or synthetic fibres. The important man made fibres are acetate, rayon, fibreglass, nylon, polyester, acrylic, modacrylic, olefin, and spandex. Commercial production of artificial silk was started in 1889 though the first patent was granted in 1855 in England to a Swiss chemist, George Audemars (Spinner's Year Book, 1993).

The major natural fibres are cotton (from the cotton plant) flex (from the flex plant) wool from sheep and silk from cocoons of the silkworm moth.

The natural fibres consist of three classes based on chemical structure.

1) protein (animal) of which wool and silk are best known

2) cellulose (vegetable) of which cotton, linen and jute are most widely used

3) mineral of which asbestos is the only fibre.

Cotton fibre consists of slender, one-celled hairs that grow on the seed. The fibre varies in length from 2.5 cm to 5 cm is called fibre length. When referring to fibre length the term 'staple' is used as 'long staple' and 'short staple'. Long staple is being considered fine and desirable.

The fibre received from the seed by the process of ginning is called 'lint cotton'. After separating lint cotton from the seed, it is pressed and bailed. It is sold in bale forms. This raw lint cotton is made into yarn at a spinning mill and woven into cloth at a weaving mill. Lint cotton passes through different manufacturing processes at the spinning level.

Textiles consist of thousands of fine, thread like fibres. These fibres are twisted together to make a strong thread, and is called yarn. The yarn is again woven to make textiles. These textiles are called cloth.

Different counts of yarn/hanks are produced in a spinning mill. In measuring yarn, the number or count is based on the relationship of the length of the yarn to a unit of weight. In measuring cotton, the English system is generally used.

The terms Hanks and Counts have the same meaning and are measured on the same basis. They indicate the degree of fineness of the cotton as it passes through the various process in the cotton mill. "Hanks" is the term applied generally to cotton in the preparing process whilst "counts" is used to indicate the finished yarn.

3.2 INDIA'S POSITION

Cotton was used in India as long ago as 3000 B.C. Indian cotton was taken from wild cotton plants. By about 1000 B.C. the plants were being cultivated. "The Dacca Muslin" known all over the world for its superior quality shows India's position in this field.

Cotton textile technology has essentially three stages viz., (1) cotton preparation, (2) spinning and (3) weaving.

Preparation entails cleaning, straightening and alignment of the fibres. Some mills purchase kapas directly and get them ginned by hiring ginneries. Since pre-cleaning and post-cleaning take place in the mill itself, they can avoid foreign matter like immature bolls, green motes, seed coat fragments, jute fibres, cloth rags etc.

Spinning[1] involves drawing out and twisting of plant,

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1. During early days in England, Spinning was the usual task of the unmarried women of the household who came to be known as 'Spinsters'.

animal or man-made fibres into a thread of desired quality.

Weaving consists of the stretching of the thread and their arrangement to make cloths.

There are two types of mills - those that only spin yarn - the spinning mill - and those that weave it as well - the composite mill.

In a more disaggregated form, the cotton textile industry as a whole can be grouped as follows:

(i) Cotton ginning, cleaning and bailing.

(ii) Cotton spinning, weaving and finishing of cotton textiles.

(iii) Printing, dyeing and bleaching of cotton textiles.

(iv) Weaving and finishing of cotton textiles in power-looms.

(v) Cotton spinning other than mills (Charkha).

(vi) Weaving and finishing of cotton textiles in hand-loom other than khadi.

3.3 PRODUCTION PROCESS

The production of yarn involves several preparatory process. The production process are opening and cleaning, the formation of laps of clean cotton, carding, drawing and roving. Spinning process sequence are explained in Fig.3.1.

The process of manufacture decomposed into different stages is detailed below.

1. Mixing

The raw material, cotton received in the form of highly pressed bales of different varieties are opened and mixed in the desired proportions in the mixing department. A textile mill wisely mixes more than one variety of cotton as raw material to manufacture different counts of yarn. The shrewd Spinning Master on the basis of trial and error method adopts the mix ratio so as to minimize the cost of yarn, ensuring the required quality of yarn.

Mixing is the most important and crucial factor which determines the ultimate quality of yarn. Thus the selection of cotton assumes very importance in spinning. All the major fibre properties influence substantially in bringing forth good quality yarn.

COTTON SPINNING PROCESS SEQUENCE

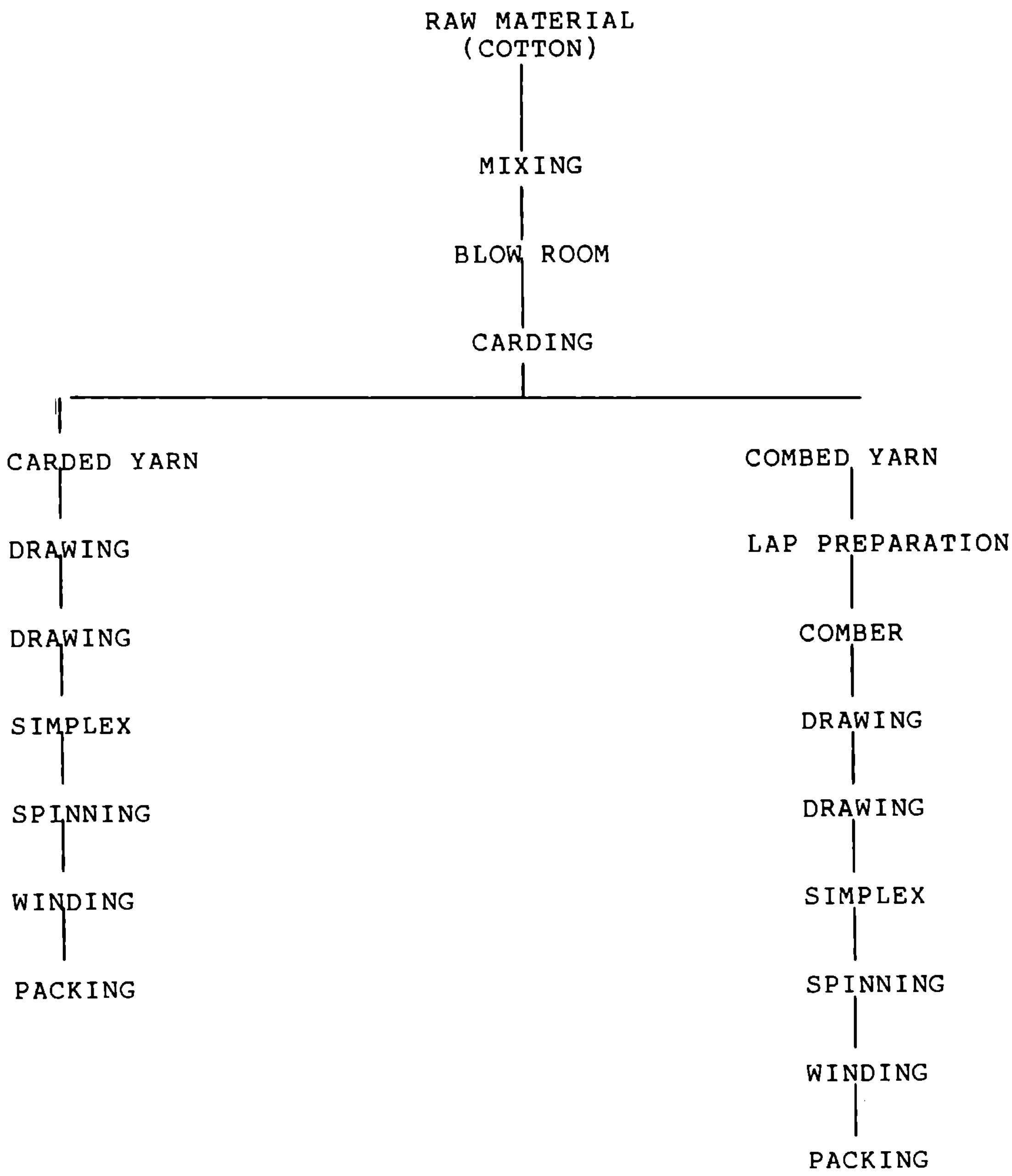

Fig. 3.1

Asaithambi (1989) constructed a Linear Programming model to decide the proportion of each cotton that is mixed to get a certain count of yarn with specified quality levels in such a way that the mixing cost is minimum possible. Better mixing of different varieties of cotton reduces cost of cotton and increases profit. Linear programming is a mathematical technique. It is well suited to the analysis of rational behaviour since programming is concerned with the determination of the optimal solutions to the problems.

2. Blow Room

Opening and cleaning take place in the blow room and involve a range of four or five machines. They comprise an opener, mixing and cleaning machines and a scutcher. The cotton is passed through a series of peners and beaters and finally through the scutchers in the Blow room and here the cotton becomes pure; free from seeds, leaf and other foreign matters, before it is converted into lap form. The slower the cotton is processed, the better it is cleaned and less damage to the fibre. The optimum speed is a compromise between this objective and high output. As a result of technical progress the 'optimum speed' has increased compared to previous levels.

3. Carding

The lap of cotton that goes to the carding still may contain dirt and partially unopened fibres. The carding machine removes the remaining dirt and excessively short or immature fibres.

The laps received from the Blow room are passed through the carding department and here they are converted into sliver form after short fibres are removed. In carding also, the lower the speed the higher the quality. Most of the mills are using a combination of low speed, semi-high speed and high speed cards whose range of r.p.m is 8 to 30. High efficiency is maintained using larger cans when compared to smaller cans used in the case of low speed cards. Reduction in labour requirement is also possible by using large cans.

4. Drawing

The carding slivers are passed through two heads of Draw Frames to ensure uniformity and also to parallel the fibres. The fibres arranged in a roughly parallel disentangled form called sliver is the real input for drawing. Slivers drawn from cards are further straightened and reduces the sliver size by passing it between successive sets of rollers. The suitably spaced pairs of rollers attenuate the fibres without causing them to break.

5. Simplex (Roving)

The object of the roving frame is further to attenuate and even the sliver. Thus the roving process makes it thinner by the same means of employing increasingly fast rollers. In order to give strength, the sliver is twisted slightly, and bobbins are used to wind it thus making suitable for spinning, which is the last step of production.

6. Spinning

The complex slivers are drafted and spun into yarn of desired counts in the spinning department. Two different types of spinning are generally used: ring spinning and open-end (OE) or break spinning. In open-end, roving process can be completely skipped and yarn formation proceeds at much greater speed than in ring spinning.

Spinning is done with the help of spinning frames, each of which has an average of 432 spindles,[1] though the number of spindles in each frames may vary. In ring spinning, bobbins of roving are placed on the upper part of the ring frame.

These bobbins are fed downwards through drafting

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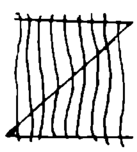
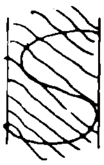
1. The usual practice of measuring the size of a spinning mill is in terms of number of spindles installed and a weaving mill in terms of number of looms installed.

rollers to spindles which rotate at very high speed (called spindle speed). The yarn being spun is twisted as the spindle travels more quickly than the front roller. By adjusting the front roller, the twist per inch (t.p.i) can also be adjusted. Most plants use a standard "twist multiple" to determine the appropriate number of twists per inch.

Twist is defined as the spiral disposition of the components of the yarn, and is generally expressed as the number of turns per unit length (turn/ twist per inch-tpi or turns/twist per metre-tpm). Twist affects yarn's strength positively upto a limit and then negatively affects yarn's appearance and production. The direction of twists is expressed as either 'Z' twist or 'S' twist as shown below.





Two types of yarn are produced-warp and weft; the former is lengthwise yarn of a woven fabric, the latter is the crossing or filling yarns. A higher value of t.p.i. is usually used in warp yarns than in weft yarns because of greater stress induced by the former. The final stage of the processing is winding the yarn in cones/hanks.

7. Reeling, Doubling and Cone Winding

Depending on the requirements, the yarn from the spinning department is rented through the reeling, doubling and cone-winding departments before the final product is packed and despatched. Reeling is not a production point, it is merely a process of converting yarn package from one type to another i.e., yarn in cops to hank form.

3.4 COMPOSITION AND STRUCTURE

The textile industry consists of organized mill sector, and decentralized sectors, including powerlooms, handlooms and khadi. The mills are of two kinds, spinning mills which produce only yarn and composite mills which produce both yarn and cloth. The decentralized sector consists of handlooms, powerlooms and khadi. The decentralized sectors have been spread mostly in rural and semi-urban areas all over the country. Besides garment industry and hosiery industry have made phenomenal growth and are spreading their wings through the length and breadth of the country. The traditional hand-spun and hand woven sectors are mostly located in rural areas while sophisticated capital-intensive units with high-speed machines are mostly located in semi-urban and urban areas.

The organized weaving sector has been facing stagnation since 1960, while the spinning industry has been making steady and impressive progress during the last few decades.

The structure shows that there were 1117 mills in India in 1992 of which 846 were spinning mills and 271 were composite mills. The major concentration of the industry was in Tamil Nadu with 463 mills followed by Maharashtra with 136 mills. Spinning mills were concentrated in Tamil Nadu (440 mills) while Gujarat (89 mills) dominated in composite mills. Region-wise analysis shows that in Tamil Nadu, majority of the spinning mills were located in Coimbatore with 189 spinning mills and 14 composite mills (Table 3.1).

Category and Management-wise data reveal (Table 3.2) that out of the total 846 spinning mills in India private sector occupied 658 mills while there were 114 mills under co-operative sector and 32 mills belonging to state public sector and 42 mills under central public sector.

Licensed and installed capacity figure as revealed in Table 2.2 shows that on 31.03.1992 the licensed spindle capacity was 34142237 while installed capacity was 27821541. In Tamil Nadu alone licensed capacity was 10969625 while

Table 3.1

State-wise Number of Cotton Textiles as on 31-3-1992

States	Number of Textile Mills		
	Spinning	Composite	Total
1	2	3	4
1. Andhra Pradesh	70	2	72
2. Assam	4	1	5
3. Bihar	7	2	9
4. Goa	1	-	1
5. Gujarat	30	89	119
6. Haryana	14	2	16
7. Himachal Pradesh	7	-	7
8. Jammu & Kashmir	2	-	2
9. Karnataka	34	12	46
10. Kerala	25	5	30
11. Madhya Pradesh	15	16	31
12. Maharashtra	61	75	136
13. Manipur	1	--	1
14. Orissa	13	1	14
15. Punjab	24	1	25
16. Rajasthan	28	6	34
17. Tamil Nadu	440	23	463
18. Uttar Pradesh	42	14	56
19. West Bengal	23	16	39
Union Territories			
1. Delhi	--	3	3
2. Pondicherry	5	3	8
Grand Total	846	271	1117

Data presented in this table and subsequent tables in this chapter are compiled from Spinners' Year Book, 1993.

Table 3.2

Summary Statistics of Structure of Cotton Mill Industry in India as on 31-3-1992[1]

Particulars	Tamil Nadu	Maharashtra	Gujarat	Coimbatore	All India
1	2	3	4	5	6
Number of Mills					
Spinning	440	61	30	189	846
Composite	23	75	89	14	271
Total	463	136	119	203	1117
Category & Management-wise (Spinning)					
Central	10	2	1	6	42
State	1	1	-	-	32
Co-operative	19	35	4	2	114
Private	410	23	25	181	658
Licensed Capacity					
Spindles	10969625	6296987	4594591	4458277	34142237
Rotors	61916	13888	11144	25462	127895
Looms	9810	79085	64474	4446	210289

1. Statistics of important regions alone are included.

1	2	3	4	5	6
Installed Capacity					
Spindles	8395539	5042126	4055074	3630690	27821541
Rotors	48710	18612	9154	18254	112986
Looms	8242	57894	57267	3310	167299
Workers in Roll	174326	215386	190636	67294	1055020
Management-wise Installed Capacity (Spindles)					
Central Sector	464672	1328520	308170	369488	3960323
State Sector	13261	303124	552340	--	2078713
Co-operative Sector	473160	983932	173968	50100	3007860
Private Sector	7444466	2426550	3020596	3211101	18774645

installed capacity was 8395539. All India statistics shows that licensed rotor capacity was 127895 while installed capacity was 112986 and in the case of looms licensed capacity stood at 210289 while installed was 167299.

Labour-intensive cotton textile industry provided direct employment to 1055020 workers on all-India basis. The workers on roll shows that in Maharashtra the cotton textile industry absorbed 215386 workers followed by Gujarat (190636) and Tamil Nadu (174326). The figure includes workers on roll of cotton and man-made fibre textile mills. The mills of Maharashtra and Gujarath absorbed 20.42 per cent and 18.07 per cent of total workers while Tamil Nadu absorbed only 16.52 per cent of total workers.

The industry has its dominant installed spindle capacity in private sector as per the all-India and region-wise analysis. In India there were 18774645 installed spindles in the private sector. Central sector installed spindle capacity was much more than the co-operative and state sectors. In the private sector, Tamil Nadu has the largest number of installed spindles with 39.65 per cent of the total spindles installed in India in the private sector. Tamil Nadu was followed by Gujarath and Maharashtra in terms of spindles installed in the private sector. Inter-group analysis reveals that the private-sector has emerged relatively more important, followed by co-operative, central and state sectors respectively. The order is more or less the same in different States/Union Territories.

3.5 GROWTH OVER 1982-1992

The spinning segment shows an impressive progress in the last decade while organized weaving sector suffered a set back. Table 3.3 shows that the number of spinning mills increased nearly twice from 442 in 1982 to 862 in 1992. But the number of composite mills during the same period decreased from 291 to 271 which is an unsatisfactory development. The increase in number of spinning mills has facilitated more cotton production and has increased export. The export of fabric production increased from 38 metric tons in 1982 to 103.55 metric tons in 1987.

Spindle capacity also almost doubled from about 9.35 million to 16.43 millions in spinning alone. But taking composite mills, there was a decline in spindles installed from 12.43 million to 11.49 millions. In the case of loomage also there has been a fall but the number of automatic looms registered an increase. This can be taken as a measure of modernization. The growth of co-operative spinning mill is an important feature during this period. The number of co-

Table 3.3

Summary Characteristics of Indian Cotton Textile Industry

for the Period 1982, 1987 and 1992

	1982	1987	1992
1	2	3	4
Spinning Mills	442	741	862
Composite Mills	291	283	271
Total	733	1024	1133
Installed Spindles (millions)			
Spinning	9.35	13.69	16.43
Composite	12.43	12.33	11.49
Total	21.78	26.02	27.92
Installed Looms			
Ordinary	158	153	106
Automatic	52	55	63
Total	210	208	169
Co. of Co-operative Spinning Mills	63	N.A.	1133
Production of Cotton Fabric (000 metric tons)	N.A.	1277.86	1312.53
Export of Cotton Fabric (000 metric tons)	38.00	103.55	N.A.

operative spinning mills increased from 63 in 1982 to 113 in 1992. The first co-operative spinning mill was set up in Andhra Pradesh in 1954. The establishment of National Co-operative Development Corporation (NDC) and All India Federation of Co-operative Spinning Mills Ltd. (AIFCOSPIN) helped a great deal in the development of co-operative units. These units get financial, managerial and technical assistance and guidance from these institutions.

In the production of cotton fabric also it registered a remarkable growth from 1277.86 metric tons in 1987 to 1312.53 metric tons in 1992. The industry in its all sectors provided employment to 16.5 million people in the year 1990-91 (Table 3.4). When compared to the employment absorption of 14.6 million in the year 1988-89, it is a positive growth. But the organized mill sector shows a stagnation.

Capacity data reveal a mixed picture. Percentage capacity utilization shows an increasing trend from 1988-89 to 1990-91. The situation shows a reverse trend in 1991-92 calculated on the basis of daily average number of spindles worked in three shifts. The period 1991-92 witnessed a steep rise in cotton prices. The spinning industry as a whole suffered a set-back in 1991-92. This contributed to lower spindle activity, lower production and lower raw cotton

Table 3.4

Summary Statistics of Cotton Textile Industry for the Last 4 Years Under Study

	1988-89	1989-90	1990-91	1991-92
(1)	(2)	(3)	(4)	(5)
Employment (in lakh)				
Mill sector	11.04	11.60	11.00	--
Handlooms	84.25	88.64	96.87	--
Powerlooms	51.07	55.20	57.00	--
Total	146.36	155.44	164.87	--
Spindle Activity				
Daily average No.of spindles worked in three shifts	18.45	19.36	20.77	20.50
Percentage	70.00	73.00	78.00	76.00
Utilization in 3 shifts (spindleage)				
Capacity utilization (Loomage)	79.10	--	80.8	69.00
Raw cotton consumption ('000) tons)	1632.00	1690.00	1824.00	1761.00

(Contd...)

(1)	(2)	(3)	(4)	(5)
Yarn production (Million kg.)				
Cotton	1310.00	1372.00	1511.00	1451.00
Blended & 100% non-cotton	277.00	280.00	314.00	355.00
Total	1587.00	1652.00	1825.00	1806.00
Cloth production (in Million sq. metre)				
Cotton	13658.00	18936.00	15431.00	14647.00
Blended	2321.00	2118.00	2371.00	2712.00
100% non-cotton	4039.00	4544.00	5126.00	5229.00
Khadi/Wool/Silk	367.00	388.00	402.00	402.00
Total	20385.00	25986.00	23330.00	22990.00

consumption. This reflected on the percentage loomage utilization also. The Table 3.4 also reveals that cotton yarn production decreased while the production of synthetics increased rapidly. This may be due to the increased consumer preference for synthetics and their blends with cotton. Cloth production also maintained a similar pattern. It shows a growth trend till 1990-91 and a marginal fall in 1991-92.

As per Table 3.5 cloth production in the mill sector (organized sectors) shows a diminishing trend while in power loom and handloom a rising pattern is noticed. The production of cotton cloth taken alone shows an uptrend upto 1990-91. But the share of mill has been declining while a consistant growth pattern in cotton cloth production can be witnessed in powerloom sector. Handloom sector shows a mixed trend. It will be seen that the production of blended and non-cotton cloth shows a steady rise from 6391 million sq.mtr. in 1988-89 to 7941 million sq.mts. in 1991-92. Durability, finish and wash and wear properties are attractive features of belnded and non-cotton cloth and hence more consumer preference. Here also the share of powerloom sector increased while that of mill sector declined. The handlooms also share the experience of mill sector.

With the new liberalization policy, the industry may continue to grow at a fast speed. Several 100% Export

Table 3.5

Summary Statistics of Cloth Production in Cotton Textile Industry: 1988-89 to 1991-92

	1988-89	1989-90	1990-91	1991-92
Cloth Production (Million sq.mts.)				
Mills	2902	2667	2589	2376
Powerlooms/Hoisery	13123	14007	16044	16089
Handlooms	3993	3924	4295	4123
Total	20018	20598	22928	22588
Cotton Cloth Production (Million sq. mts.)				
Mill sector	2100	1957	1859	1651
Powerlooms/Hoisery	7647	8142	9335	8931
Handlooms	3911	3837	4237	4065
Total	13658	13936	15431	14647
Blended and non-cotton cloth production (Million sq. mts.)				
Mill sector	834	710	730	725
Powerlooms	5476	5865	6709	7158
Handlooms	82	87	58	58
Total	6392	6662	7497	7941

Oriented Units (EOU) were set up in various parts of the country to meet the growing demands especially from European Community which has become a unified market from January 1993. These EOUs also started programmes to acquire ISO 9000/ IS 14000. Two of the units in Kerala have already launched quality up-date schemes for obtaining ISO 9000/IS 14000 certification, so that it gives them a competitive edge in the domestic and international markets. These developments and the active support of promotional organizations like TEXPROCIL (Cotton Textiles Export Promotion Council) help the mills to capture international markets.

3.6 OWNERSHIP-WISE DISTRIBUTION OF SPINNING MILLS

In India spinning mills are scattered in public, co-operative and private sectors. In public sector again there are two sub-categories ie., mills fully owned by Central Government through National Textile Corporation and mills owned by State Governments. Of the total eight hundred and fortysix spinning mills as on 31.03.1992, forty two mills were owned by Central Government, thrity two mills were under State Governments; one hundred and fourteen mills were controlled by co-operative sector and the rest six hundred and fifty eight mills were under private sector. In percentage-wise, Central sector controls nearly 5 per cent, state sector controls nearly 4 per cent, co-operative sector controls 13.5 per cent and private sector controls nearly 77.5 per cent of the total spinning mills in India.

In the private sector, Tamil Nadu stands top with 410 private mills followed by Andhra Pradesh with 56 private mills and Gujarath with 25 private spinning mills. In co-operative sector, Maharashtra stands first with 35 co-operative spinning mills followed by Tamil Nadu with 19 co-operative mills and Uttar Pradesh with 11 co-operative mills. In the central sector again Tamil Nadu stands first with 10 mills followed by Uttar Pradesh with 6 mills and Andhra Pradesh with 5 mills. In the case of state government owned mills, Uttar Pradesh stands first with 13 mills followed by Kerala with 5 mills and Orissa and West Bengal sharing 3 mills each comes third in the list.

3.7 SIZE DISTRIBUTION OF SPINNING MILLS

There are marked regional differences in the size of cotton mills of India. Units are much smaller in size in the Southern Zone (covering Madras, Kerala and Mysore) and in the Eastern Zone (comprising West Bengal, Orissa, Assam and Bihar). The size of 'model units' in these regions ranges from 10 to 15 thousand spindles and 200 to 400 looms. In Uttar Pradesh, Madhya Pradesh, Andhra and rest of Bombay Presidency, the medium-sized units become prominent with 15 to thirty thousand spindles and 400 to 600 looms. In certain other areas units are of sufficiently big size ranging from 30 to 60 thousand spindles and 750 to 1500 looms (Kuchhal, 1969).

3.8 OPTIMUM SIZE OF A COTTON MILL

The nature of product also influences the size of a unit. One view is that if large quantities of standardized goods (say yarn of one count only or cloth of one variety) are produced, a large unit will be helpful and profitable. In the case of variety of goods of different qualities, a smaller unit will be more suited.

"The technical optimum size of a cotton mill is comparatively small because there is no operation in cotton textile manufacturing which must be conducted on a large scale from considerations of technical efficiency. The tendency towards the formation of large plants, so far as production is concerned, has been chiefly the outgrowth of attempts to reduce the cost of management and nonmanufacturing operations over a larger volume of output" (Kuchhal, 1969).

He mentioned the reasons for divergence of the model size of mills in different parts of the country as follows:

1) The changes in overhead charges comprising the cost of power, taxes etc.

2) Methods of promoting and financing industry in different centres.

3) Locational effects such as nearness to port, export facility etc.

4) Local supply of cotton, capital and large consuming markets i.e. nearby markets for finished products thus avoiding railway freight charges etc.

5) Encouragement given to smaller units in the form of grant of free land, remission of customs duties, supply of electricity at concessional rate and immunity from income-tax provisions.

As per the statistics available, Mukesh Spinners, Coimbatore, Kalaivani Spinners P. Ltd., Coimbatore and Raja Rajeshwari Spinning Mills P. Ltd., Vadasandur, Anna are the smallest mills in India with a spindle size of 400 spindles and the mill with the highest spindle size is the Decan Co-operative Spinning Mills Ltd., Kolhapur (Maharashtra) with with 83,404 spindles and 336 rotors, followed by Kolhapur Zilla Shetkari Vinkari Sahsoot Girni Ltd. (Maharashtra) with 75,240 spindles.

The spindlewise distribution of spinning mills shows that nearly 75 per cent of the mills are with less than 26,000 spindles (spindles $\leq$ 26,000) and 21 per cent of the spinning mills are with more than 26,000 spindles but less than 50,000 spindles (26,000 $\leq$ 50,000) and only 4 per cent of the mills are having more than 50,000 spindles - an approximate estimate based on installed spindles capacity of mills published in Spinner's Year Book 1993. As per this estimate, small mills predominate over medium and large mills.

3.9 COMPOSITION AND STRUCTURE: KERALA

The first cotton textile mill was established in 1883 in Kallai near Kozhikode by P.S.Santhappa Chettiyar and A.K.T.K.M. Guptan Namboothiripad, known as Malabar Spinning and Weaving Mill (Rajan, 1987). The commercial production was started in 1887. Later in 1976, the mill was taken over by Government of Kerala and handed over to Kerala State Textile Corporation.

The second mill presently called "Parvathy Mills Ltd." was started in 1884 by James Darrag, an Englishman using 18 acres of land donated by the then Maharaja of Travancore. In 1888 the mill was sold to another British industrialist named A.T.Vin and in 1932 it became a public limited company.

In 1972 July 10, the management was taken over by Kerala State Textile Corporation. In April 1, 1974 the mill was nationalized under 'Sick Textile Undertakings (Nationalization) Act 1974' and was made a unit of National Textile Corporation (NTC) Limited, Bangalore which is a subsidiary of NTC, New Delhi, a Government of India undertaking.

Sitaram Textiles Ltd. another oldest mill was established in 1903 as a private limited company. It was started by Balarama Iyer. Later, due to mismanagement, and labour trouble, the company was liquidated in 1954. The factory was gutted down due to fire in 1959 and spinning production was completely stopped. The Government of Kerala purchased this unit as a result of liquidation and public auction in 1972.

With a modest start of these mills, the number of cotton textile mills rose to 31 at present. The Government of Kerala has announced in State Assembly on March 29, 1994, its willingness to start five more spinning mills one each at Kasargod, Kozhikode, Trissur, Kottayam and Malappuram along with commissioning of Co-operative Spinning Mill at Kareelakulangara at Alleppey with a spindle capacity of 6000 spindles.

The cotton textile industries are concentrated in the districts of Trichur and Palghat followed by Ernakulam and Cannanore. These four districts taken together accounts for nearly 3/4th of the mills in Kerala. The number of existing composite mills are quite low i.e., only four in number - and its growth during the last 10 years is nil. Due to the unprofitable nature of composite mill, Malabar Spinning and Weaving Mill discontinued its weaving operation and concentrates on spinning only. Calicut Modern Spinning mill once turned sick is now taken over by a financially sound third party and found earning profit during the last two years under study. The regional distribution of textils mills is given in Table 3.6. There are seven cotton textile mills in Trichur including one composite mill. Kottayam stands last in the list with only one state owned mill.

The textile mills in Kerala are managed by four different sectors namely private sector, public sector - both National Textile Corporation (NTC) and Kerala State Textile Corporation (KSTC), Kerala Government and Co-operative sectors. Two mills, Sitaram Textiles Ltd. (Composite Mill) and Trivandrum Spinning Mills were wholly under the Government of Kerala but now the management vests on KSTC. The distribution of cotton textile mills by nature of ownership is presented in Table 3.7.

Table 3.6

Regional Distribution of Textile Mills in Kerala

District	Spinning	Composite	Total
Trichur	6	1	7
Palghat	5	-	5
Ernakulam	3	1	4
Cannanore	3	1	4
Trivandrum	2	-	2
Quilon	1	1	2
Malappuram	2	-	2
Kozhikode	2	-	2
Alleppey	2	-	2
Kottayam	1	-	1
Grand Total	27	4	31

Table 3.7

Sector-wise (ownership Pattern) Distribution of Spinning Mills in Kerala

Ownership	No.of spinning mills	No.of total composite mills
Private	14	2
National Textile Corporation (NTC)	4	1
Kerala State Textile Corporation (KSTC)	4	1
Kerala Government	1	-
Co-operative	4	-
Grand Total	27	4

There are 16 private mills in Kerala, of which 14 are spinning mills and the rest two are composite mills. National Textile Corporation owns four spinning mills and one composite mill. Kerala State Textile Corporation has got under it four spinning mills and one composite mill. The co-operative sector owns only spinning mills.

In Kerala, the Trichur Co-operative Spinning Mills Ltd. with an installed spindle capacity of 12,000 spindles is the smallest mill followed by Kathayee Cotton Mills Ltd. with 14,860 spindles. The big size mills include Pre-cot Mills Ltd. with 51,283 spindles, Alagappa Textiles Cochin Ltd. with 49,564 spindles, and Kerala Lakshmi Mills with 41,328 spindles.

The mills in Kerala are of two sizes. The small unit varies from 12,000 to 26,000 spindles and medium-sized units have spindles above 26,000 to 50,000 spindles. There is only one unit in Kerala whose spindle size is above 50,000. The present study did not cover that mill due to the hesitant attitude of the management to provide data. In Kerala the units are much smaller when compared to very big units in other states. Mehta (1949) claimed that the model units in Kerala, Tamil Nadu and Mysore vary from 10,000 spindles to 15,000 spindles while the medium-sized units vary from 15,000 spindles to 30,000 spindles.

As per the Blow Room capacity, formerly the engineering concept of a viable unit was in favour of 12,000 spindles. But today, a modernized Blow Room feeds upto 25,056 spindles. Hence 25,000 spindles will be more viable and economical today. The size-wise distribution of spinning mills shows (Table 3.8) that there are twenty small mills and six medium mills and one large mill in Kerala.

The growth of textile mills in Kerala is far from satisfactory. In the public sector, only three mills were started after the year 1975 namely the Malappuram Co-operative Spinning Mills Ltd. and Quilon Co-operative Spinning Mills Ltd. and Edarikkad Textiles. Another co-operative mill, Alleppey Co-operative Spinning Mill at Kayamkulam is yet to be commissioned.

Under private sector also the growth is not satisfactory. The number of private mills registered after 1975 is only two - Balajai Spinners Ltd. and Pre-cot Mills Ltd. (Unit 'C'). These two units are open-end (OE) units with rotors. Another welcome feature is that a 100 per cent export oriented unit (EOU) Patspin India Ltd. will soon be starting commercial production at Palghat. These three units are located at Palghat near Tamil Nadu border. The reason for

Table 3.8

Size-wise (firm-size) Distribution of Spinning Mills in Kerala

Installed spindles	No. of Spinning Mills
1	2
12,000 ≤ 26,000	20
26,000 ≤ 50,000	6
50,000 and above	1
Grand Total	27

more increased concentration in Palghat district can be attributed to the availability of land at reasonably low rate, availability of cheap labour from Tamil Nadu and also availability of cheap power from Kerala. Another reason may be nearness to Coimbatore (Tamil Nadu) where textile machinery, spares and component factories are located profusely.

3.10 STRUCTURAL CHARACTERISTICS OF COTTON MILLS IN KERALA

The Government of Kerala as a part of its Annual Survey of Industries in 1985-86 published a broad picture of the pattern and growth of registered factory sector in Kerala. The industries were arranged according to their contribution as a percentage to total units (i.e. Ranking).

As per the report, there were 47 groups of industries with a fixed capital investment of 2 crores and above. Cotton textile with an investment of over four crores stood seventh in terms of fixed capital while its position in terms of working capital was fifteenth. For all other variables analyzed, its position varied from two to eight (Table 3.9). In terms of employment, cotton textile industry was fifth in Kerala providing direct employment to 13,068 people. The total emoluments paid by this sector was Rs.2,132.38 lakhs and stands second. The highest amount of emoluments paid to employees was in the generation and transmission of electric energy. The gross value of goods and services produced during the year 1985-86 was estimated to Rs.12,362.90 lakhs in cotton textiles. The net value added by manufacture during the period was Rs.4,364.59 lakhs and it showed a 7.34 per cent increase in 1985-86 compared to 1984-85.

Appendix C-1 presents the details of spinning mills in Kerala. The mills are grouped on the basis of ownership. Other informations given are year of establishment (age of the firm), its location, licensed spindle capacity and installed spindle capacity.

Table 3.9

Major Structural Characteristics of Cotton Textiles[1] Industry in Kerala: 1985-86

	Rs.in lakhs	% to total	Rank
a) Fixed capital	4352.34	2.76	7
b) Working capital	1015.87	1.58	15
c) Productive capital	5368.21	2.42	7
d) Invested capital	7229.71	3.26	6
e) Workers (Nos.)	11833	6.13	5
f) Employment (Nos.)	13068	5.50	5
g) Wages to workers	1696.96	9.51	2
h) Emoluments (wages + salaries + bonus + imputed values of benefits in kind)	2132.38	7.38	2
i) Input	7383.64	3.11	8
j) Output (gross value of goods & services)	12362.90	4.02	5
k) Net value added	4364.59	7.34	3

1. Cotton Spinning, Weaving and Finishing of Cotton Textiles.

Chapter IV

PRODUCTIVITY

4.0 The present chapter is devoted to an empirical analysis of partial factor productivity. The chapter starts with a historical analysis of productivity. Different alternative measures of partial factor productivity are analysed over the period 1982-83 to 1991-92 and for the entire period pooling cross section and time series data. Treatment of labour surrogate and capital surrogate are also attempted. An independent estimate of capital measurement is attempted due to non-availability of age profile and purchase price of capital input. Finally some selected statistical characteristics of high profit mills are compared with the average of all other mill groups in the sample.

4.1 PRODUCTIVITY: A HISTORICAL ANALYSIS

The term productivity first appeared in an article by Dr.Quesnay, the recognized founder of physiocracy and the physician to King Louis XIV. The physiocratic school as such developed the first seeds of productivity through which all further progress started.

The classical economists also dealt with production and the rate of production--the theory of production is the very foundation of classical economic theory. The evolution of process of production had undergone qualitative leaps and remarkable discontinuities. Like Quesnay, Ricardo postulated ideas on production. But the search for an "invariable standard of value" was never solved by Ricardo. A production schema close to Quesnay's "Tableau Economique" can be seen in Karl Marx's writing. The pure exchange model of the Marginalists was subsequently modified to include the process of production, and the marginal productivity theory was developed in the 1890s. The important ideas of marginal theory have formed the basis of subsequent theoretical development. The use of production coefficients and its importance were highlighted in Walrasian theory. It was Knut Wicksell who set out a model of production in which, in order to avoid various objections, he introduced numerous simplifications.[1] Knut Wicksell used the special production function

$$Y = CL^{1-\alpha}K^{\alpha}$$

where Y denotes net output

L labour and

K capital and 'C' add 'α' are constants. It later became known as the Cobb-Douglas production function after the

1. An excellent literature on production theory can be seen in Pasinetti (1978).

names of Cobb and Douglas. Professor Paul Douglas from empirical observations inferred its properties and Cobb, a mathematician inferred its mathematical aspects.

The recent formulations of the theory of production owe to Wassily Leontief and Piero Sraffa. Even today the word 'productivity' remains as one of the most elusive concepts in economic literature. Some of the important definitions of productivity if examined reveal more or less same content. "Productivity refers to a comparison between the quantity of goods or services produced and the quantity of resources employed in turning out these goods or services" (Fabricant, 1969).

4.2 PRODUCTIVITY: CONCEPTUAL FRAME-WORK

"Productivity, in economics is a measure of productive efficiency calculated as the ratio of what is produced to what is required to produce it. The inputs taken as the denominator of the ratio are usually the traditional factors of production--land, labour and capital--taken singly or in the aggregate. Productivity may be viewed as a measure of efficiency alone at a given moment in economic time, or it may be seen as an indicator of economic development, that is, as an index of growth" (New Encyclopaedia Britannica, 1985).

Kendrick (1961) observed, "the term productivity is generally used rather broadly to denote the ratio of output to any or all associated inputs, in real terms. Ratios of output to particular inputs may be termed 'partial productivity' measures, the most common of which is output per man-hour". In simple words Easterfield (1965) defined productivity as "a ratio of a measure of output to a measure of some or all of the resources used to produce this output".

According to Mantri (1977) "Productivity simply means that in order to produce a product or a service, either in the field, factories, offices, banks or any other place of economic activity, certain resources would have to be employed in the form of inputs to obtain output, and productivity takes into consideration both these aspects simultaneously".

Fenske (1968) defined productivity "as the average amount of goods and services produced by a unit of a productive factor in a specified period of time". Thus productivity is a measure of rate at which output flows from the use of given amounts of factors of production. In practice, productivity is usually measured by expressing output as a ratio to a selected input or a group of inputs.

Sardana and Prem Vrat (1984) presented an overview of the models of productivity measurement. The important productivity models are the following:

a) Production function models

b) Financial ratios as measure of productivity

c) Production based models

d) Production oriented models

e) Surrogate models

f) Economic utility models

g) Systems approach based models.

Teague and Eilon (1973) mentioned fourfold reasons for measuring productivity:

1. for strategic purposes, in order to compare the global performance of the firm with that of its competitors or related firms;

2. for tactical purposes, to enable management to control the performance of the firm via the performance of individual sectors of the firm, either functional or by product;

3. for planning purposes, to compare the relative benefits accruing from the use of different inputs or varying proportions of the same inputs, and

4. for internal management purposes, such as collective bargaining with trade unions, and hence several types of measure may be appropriate according to the function to be fulfilled.

4.3 PRODUCTIVITY AND PRODUCTION

Productivity should not be confused with production. Production in a manufacturing unit can be increased by employing more labourers, putting more materials in use regardless of the cost of production. But this increase in production does not necessarily signal increase in productivity though higher productivity leads to higher production. Production in two units may be equal but productivity may differ. Production means adding value to inputs and the efficiency with which value is added is the subject of productivity measurement. The concept of productivity signifies measurable input-output relationship.

It is a matter of common knowledge that higher productivity leads to a reduction in cost of production, which enables sales at competitive prices. The whole economic development of a country depends on the extent and measure of its production and productivity.

Production merely denotes to the volume of output. Productivity denotes output in relation to the resources employed. Productivity can be increased without increase in production, that is, using resources more efficiently--either by reducing labour or capital. If labour is reduced without affecting production, labour productivity increases. If capital is reduced without affecting total output, capital productivity increases, number of labourers remaining constant. Better human relationships, improved utilization of resources and innovations increase productivity.

4.4 PRODUCTIVITY AND EFFICIENCY

The term 'productivity' has been used in a wide variety of senses and it is very difficult to find out whether productivity is synonymous with efficiency. Productivity is the power to produce economic goods and services. The term productivity is ordinarily attached to the "power to produce". "Whereas 'efficiency' connotes inherent competence ie., capacity of a given input or production-unit to produce under given conditions the results intended or studied. 'Productivity' on the otherhand refers to the actual production-result shown by an input or production-line under given conditions during a given time at given costs. It is quite possible to increase the apparent productivity ie., the productivity achieved in association with the other co-operant inputs, of a given input without any improvement in its own efficiency" (Lal, 1965). Producing more and better output from given volume of resources or producing a target of output, from lesser or cheaper resource is the concept of productivity. It is the efficiency with which factors are used and combined determines productivity.

In sum, productive efficiency is indeed not the same thing as productivity, and it is not easy to gauge one thing from another. Inspite of all these definitions, if we consider deeply the terminology of 'productivity' and 'efficiency' the matter and substance is more or less same and hence used synonymously in ordinary literature. If one leaves aside the definitions and confines to the working of the industry, the term 'industrial efficiency' means 'productive efficiency' ie., the rate at which production is carried out in a given plant and efficiency with which it is being done. Hence for efficient working, production is to be kept maximum by the full utilization of plant and machinery and cost is to be kept at the minimum possible level.

4.5 INTER-FIRM COMPARISON

"An inter-firm comparison is an umbrella term referring to an organized form of voluntary pooling of data and their subsequent analysis to gain objective results useful for all" (Subramaniam, 1984). Inter-firm comparison (IFC) is usually taken to mean ratio analysis among participating companies, normally, belonging to same industry. Inter-firm comparison for productivity basically aims at evaluation of business effectiveness in comparison with that of the competitors in order to decide the business strategy.

The following models have been found to be practised for inter-firm comparison in different parts of the world.

1. The Discrete Accounting Ratio (DAR) sets
2. Arithmetically Related Profitability Ratio Structure (PYRM)
3. Profitability-cum-value Productivity Ratio Structure (PRYP)
4. Value Added Productivity Ratio Structure (VAP)
5. Production and Accounting Based Performance Ratio Structure (REALST)
6. Profit Impact of Market Strategy (PIMS) Data Base
7. Productivity Inter-firm Comparison (PIC) model
8. Benchmarking

4.6 VALUE ADDED PRODUCTIVITY RATIO STRUCTURE (VAP)

This structure takes either labour or capital productivity as an apex ratio, which is computed in terms of value added per employee or value added per unit of capital. The apex ratio is split into several other value added ratios. All the ratios are related arithmetically as shown in graph. The sales/capital and value added/sales ratios can be further broken down into various other ratios. The model expanded allows interlinkage of value added productivity with profitability (NPC-IFC, 1992). This has been being used in Japan since 1965.

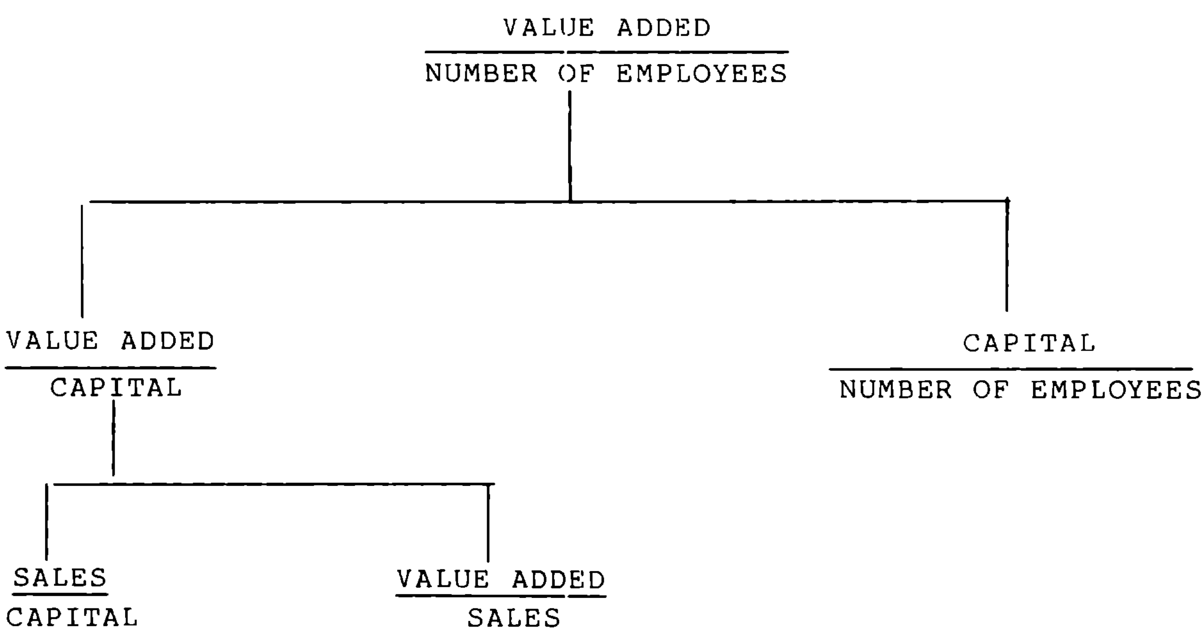


Fig.4.1 Value Added Productivity Ratio Structure.

To conclude, the framework of ratio hierarchy which is employed in value added productivity analysis is highly useful for the formulation of a tailor-made set of performance indicators to be used for inter-firm comparison for different kinds of business organization.

4.7 PARTIAL PRODUCTIVITY MEASURES

The ratio of output to an input is known as partial productivity ratio. There are as many partial productivity ratios as there factors of production. The following are the important partial factor productivity ratios used in the present study along with capital intensity.

1. Labour productivity (LP_1)
2. Labour productivity measured in terms of salaries and wages (LP_2): Labour surrogate.
3. Capital Productivity (KP)
4. Capital intensity (K/L)
5. Spindle productivity (SP): Capital surrogate.

Labour Productivity

Productivity concept includes many different kinds of productivity like labour productivity, capital productivity, power productivity, raw material productivity etc. or a combination of two or more of these factors. The word productivity has almost become a synonym of labour productivity since it is always understood to denote labour productivity unless otherwise stated.

Productivity is originally measured in terms of output per person or per man-hour. Productivity can also be expressed in terms of unit cost of material per machine or machine-hour, per unit of capital, per unit of energy consumed, per unit of capital, per unit of energy consumed, per unit of floor space etc. Labour productivity is the sum of product or material services per worker which is determined jointly by other factors of production.

Labour productivity alone had been taken as the main index of productivity measurement earlier. Output per man-hour is the accepted concept of labour productivity, inspite of its drawbacks. It fails to take into account the composition of quality of labour, levels of education, length of experience etc. By increasing the labour productivity, production costs can be decreased to a great extent leading to higher profit. Increasing productivity implies the full, proper and efficient utilization of not only labour but also other factors of production.

The increase in labour productivity may be due to efficiency of labour or due to capital deepening including rationalization or modernization. Better human relationship including attitude of managers and workers, improved utilization of resources and innovations also increase productivity. The other important determinants of labour productivity are:

1. Ergonomics: Ergonomics is concerned with the condition under which work is çarried.

2. Personal policies and relations also play a vital role in increasing productivity

3. Work ethics, wage, job satisfaction, due recognition of merit, physique of the worker and discipline of the worker

4. Technological improvement, rate of operation, machine efficiency, availability of quality raw materials, efficiency of management are other influencing factors.

5. Behavioural efficiency includes psychological efficiency, family improvement, welfare schemes, and social interaction.

6. Job experience, education to workers and learning process.

The learning process affects the quality of labour and education also exerts its effect in the average quality of labour. Learning curves had been estimated in a number of industries in different countries with a preponderance of values for the learning factor in the range 0.75 to 1.00. Some studies attempted to estimate directly education's contribution to growth. Education was also included as a separate input in the aggregate production function, with the interesting finding that the elasticity of output with respect to education was almost identical with the elasticity of output with respect to labour. The information on the distribution of the labour force by the amount of schooling was also incorporated in certain studies (Thirlwall, 1972).

The influences of all these factors are not measured in many of the studies. The present study also shares this limitation with other studies.

Eventhough labour productivity is commonly measured by gross output/value added per man-hour or per employee when output is composed of multiplicity of products, its money value is taken for measurement purpose.

Measurement of Labour Input

Labour input is measured in several ways. The following are the important types of measures used:

1. Total number of persons employed
2. Total number of workers employed
3. Total man-days worked for which man-hours worked have to be converted to man-days equivalent.
4. Wages and salaries bill.

Denison (1961) pointed out that reduction in man-hour per week leads to an increase in labour input per hour. Thus measuring labour by number of person is more satisfactory than man-hours because it gets adjusted for change in quality of one hour's work due to shortening of hours.

Following Krishna and Mehta (1968) and Goldar (1981) the present study adopts labour productivity index as the ratio of value added to the labour input. The number of employees is taken as the measure of labour input. This category includes employees like supervisors, technicians, managers, clerks and other similar types of employees.

$$\text{Labour productivity } (LP_1) = \frac{\text{Gross value added at 1981-82 prices (Y)}}{\text{Total employment (L)}}$$

Labour Productivity: Empirical Findings

Estimates of labour productivity (LP_1) and trend rates of growth are presented in Table 4.1. A comparison of terminal years 1982-83 and 1991-92 reveals an uptrend of labour productivity in all the six groups. The trend growth rate is also positive in all the groups. Co-operative sector with an index of 0.076 is the least efficient group in terms of labour productivity (LP_1) in 1982-83. However, this sector showing an increase of 125 per cent in its labour productivity index, between the terminal years, tops the list of sectors improved their labour productivity. In terms of trend growth rate co-operative sector rank first. In terms of trend growth rate co-operative sector is followed by NTC.

The sector with the next highest rate of growth of labour productivity with 95.83 per cent between the terminal years is KSTC. But comparison of terminal years growth rate between private and NTC sectors shows that private sector is above NTC sector. Private sector registered only less than five per cent trend growth rate, while co-operative sector had labour productivity growth rate of 12.53 per cent. Between size class the sector with the highest rate of trend growth rate and highest rate between terminal years is the medium size class. The trend growth rates are found statistically significant at the 5 per cent level in all sectors.

Table 4.1

Estimates of labour productivity (LP_1) by ownership and by firm size: 1982-83 to 1991-92

(LP_1 = Y/L) (Rupees in Lakhs)

Year	Ownership				Size	
	Private	NTC	Co-operative	KSTC	Spindles ≤ 26,000	26,000 ≤ 50,000
1982-83	0.187	0.157	0.076	0.120	0.142	0.178
1983-84	0.232	0.102	0.084	0.118	0.171	0.149
1984-85	0.252	0.137	0.085	0.133	0.176	0.202
1985-86	0.280	0.192	0.078	0.187	0.214	0.223
1986-87	0.242	0.176	0.120	0.142	0.187	0.202
1987-88	0.300	0.178	0.104	0.122	0.211	0.210
1988-89	0.245	0.213	0.125	0.130	0.176	0.258
1989-90	0.329	0.335	0.271	0.225	0.282	0.354
1990-91	0.348	0.328	0.207	0.268	0.285	0.369
1991-92	0.299	0.223	0.171	0.235	0.224	0.328
Growth Rates						
Terminal years	59.89	42.04	125.00	95.83	57.75	84.27
Trend growth rates	4.98** (0.013)	9.78** (0.025)	12.53** (0.026)	7.98** (0.024)	5.80** (0.016)	9.17** (0.015)

Note:-

Y = Gross value added at constant price
L = Total employees
Ln Y/L = A + B_t + e (Trend equation of labour productivity)

** significant at 5% probability level
* significant at 10% probability level
Figures in parentheses represent standard error.

There is considerable yearly fluctuations in productivity indices and there remains wide variations in growth rate indices also. But inspite of relatively poor performance of private sector in terms of growth rate indices, the private sector is found "most efficient" with an index of above 0.200 in almost all the years under study. The co-operative sector, with a high growth rate performance, is having labour productivity index of above 0.200 only in two years. The reason for variations can be attributed to the following factors:

1. Private sector showed a considerably better index during the beginning period of study ie., 1982-83. The scope for further improvement is comparatively lower.

2. Co-operative sector showed a very poor performance in terms of labour productivity during the year 1982-83. This is because two units out of the three units in Kerala started only trial production in the year 1982-83 and hence productivity was very low. Co-operative sector was able to improve in subsequent years but still behind private sector in terms of labour productivity index.

3. The Government of Kerala through KSTC took over the sick mills in Kerala during the year 1981-82. The mills being sick registered a very poor overall performance. Reasonable productivity increase was observed in subsequent years.

4. Hence, much reliance could not be placed on the trend growth rate as the computation is based on the assumption of a constant rate of change which does not hold good in the case of different sectors under study. This is well substantiated by the wide fluctuations in terminal year growth rates.

The observed productivity indices and rate of growth rates are highly influenced by the aforesaid facts. This holds good in the interpretation of all partial productivity growth rates and hence treated with caution.

An alternative estimate is also attempted to compare direction of growth rates. Simple average of annual growth rates (per cent per annum) for the entire period of study and for two sub-periods are estimated. A comparison between simple average and trend growth rates would help one to have a broad directional movement. It would be unrealistic to expect perfect agreement between the alternative estimates. The results of the estimates are presented in Appendix C-5.

Further productivity is analysed by pooling cross-section and time-series data. As mentioned, the pooling procedure is followed to overcome the limited number of observations. The mean value, standard deviation and number of cases are given in each type of analysis.

Estimates of labour productivity--pooling cross-section and time-series data of the years from 1982-83 to 1991-92 are presented in Table 4.2. Among ownership categories, the private sector stands highest in labour productivity with a mean productivity of 0.271 and a standard deviation of 0.171. The highest standard deviation can be attributed to the presence of large number of high profit mills and sick mills in the sector. Private sector is followed by NTC with a mean labour productivity of 0.204.

The labour productivity is lowest in the case of co-operative sector. The reason may be attributed to excess labour absorption in this sector. Estimates of workers per 1000 spindle show that there are 28.11 workers per 1000 spindle in co-operative sectors, while the industry average is only 23.67. But in KSTC mills low labour productivity can be attributed to low value addition. The worker spindle ratio is lowest in KSTC mills (Appendix C-6). The labour productivity

Table 4.2

Estimates of labour productivity (LP_1) by ownership and by firm-size: Pooled cross-section and time-series data from 1982-83 to 1991-92.

(Rupees in Lakhs)

Ownership/size	LP_1 (Y/L)	Std.Dev.	Cases
Private	0.271	0.171	100
NTC	0.204	0.741	40
Co-operative	0.127	0.073	30
KSTC	0.169	0.073	40
Spindles ≤ 26,000	0.206	0.139	150
26,000 ≤ 50,000	0.247	0.141	60
All units	0.218	0.141	210

of co-operative units and KSTC units are found much below industry average.

Labour productivity analysis among different size groups reveals trend favourable to medium sized mills compared to small mills. Medium units have a labour productivity of 0.247 while the estimated labour productivity of small mills is only 0.206.

The mean labour productivity (LP_1) of private sector is significantly above NTC, co-operative and KSTC sectors at the one per cent level. But the mean labour productivity of medium sized group is not significantly above (at the 5 per cent level) small size group. The graphical illustration of labour productivity (LP_1) is given in Fig.1 in Appendix B.

4.8 LABOUR SURROGATE AND LABOUR PRODUCTIVITY (LP_2)

The Latin word 'surrogatus' stands for substitute. The complexities of labour input measure is a common problem in productivity studies. Given the nature of data, it is not possible to measure heterogeneous labour using a single standard nor is to possible to get labour hours engaged for all the 10 years under study. In a productive unit like spinning mill the workers on roll are roughly 20 to 30 per cent higher than actually needed for production. They are kept on the roll to take care of weekly-off, absenteeism, and labour drop-outs due to unforeseen circumstances. Hence salaries and wages are taken as proxy for labour and denoted as LP_2. Salaries and wages constitute all personal expenses including salaries, wages and bonus, contribution to provident fund, welfare expenses and Managing Director's remuneration.

$$\text{Labour productivity } (LP_2) = \frac{\text{Gross value-added at 1981-82 prices}}{\text{Total salaries and wages at 1981-82 prices}}$$

Estimate of labour productivity (LP_2) and trends by ownership and by firm-size are presented in Table 4.3. Comparison of terminal years shows a rising trend in labour productivity in all the sectors except in the co-operative sector. An year to year analysis show that labour productivity remained highest throughout in private sector. This can be attributed to low share of salaries and wages. Among size categories medium sector stands top when terminal years growth rates are compared.

The trend growth rate is positive in all sectors and is found highest in KSTC followed by NTC among ownership categories. Between firm-size categories trend growth rate is found highest in medium sector along with highest growth rate between terminal years. The trend growth rates are significant at the 5 per cent level in the case of NTC, KSTC and medium sized mills.

Table 4.3

Estimates of labour productivity (LP_2) by ownership and by firm-size: 1982-83 to 1991-92

(LP_2 = Y/S&W) (Rupees in Lakhs)

Year	Ownership				Size	
	Private	NTC	Co-operative	KSTC	Spindles ≤ 26,000	26,000 ≤ 50,000
1982-83	2.21	1.66	1.84	1.29	1.86	1.92
1983-84	2.86	1.19	1.76	1.27	2.24	1.66
1984-85	2.45	1.24	1.18	1.29	1.82	1.80
1985-86	2.89	1.74	1.60	1.50	2.28	2.08
1986-87	2.30	1.65	2.24	1.22	2.01	2.01
1987-88	2.82	1.71	1.92	1.26	2.20	2.03
1988-89	2.44	1.82	2.09	1.17	1.93	2.30
1989-90	2.90	2.54	3.29	1.93	2.65	2.73
1990-91	3.18	2.26	2.48	2.15	2.67	2.80
1991-92	2.87	1.75	1.76	2.04	2.29	2.49
Growth Rates						
Terminal years	29.86	5.42	-4.34	58.13	23.12	29.69
Trend growth rates	2.20* (0.012)	5.28** (0.019)	4.71 (0.028)	5.52** (0.019)	2.76* (0.012)	5.08** (0.010)

Note:-

Y = Gross value added at constant price
S & W = Salaries and wages at constant price.
ln Y/S&W = A + B_t + e (Trend equation of labour productivity)

** significant at 5% probability level
* significant at 10% probability level
Figures in parentheses represent standard error.

Estimates of labour productivity (LP_2) by ownership and by firm-size, pooling cross-section and time-series data for the period 1982-83 to 1991-92, are presented in Table 4.4. Highest labour productivity is reported in the case of private mills followed by co-operative sectors. The private sector alone has a labour productivity above industry average of 2.189. All other three sectors are much below the industry average.

The labour productivity (LP_2) of private sector is significantly above to its public counterparts at the 5 per cent level. The reason for high labour productivity (LP_2) is the low salaries and wages share in relation to total cost. The salaries and wages share to total cost is highest in the case of KSTC mills and hence labour productivity (LP_2) is the lowest.

The estimated labour productivity is in perfect agreement with the share of salaries and wages to total cost (See table 8.1).

Size-wise analysis does not show much difference in labour productivity (LP_2). The reason may be that the size-wise classifications taken for analysis do not influence productivity much. Had a new group of mills with more than

Table 4.4

Estimates of labour productivity (LP_2) by ownership and by firm-size: Pooled cross-section and time series data: 1982-83 to 1991-92

(Rupees in Lakhs)

Ownership/size	LP_2 (Y/L)	Std.Dev.	Cases
Private	2.691	1.192	100
NTC	1.756	0.461	40
Co-operative	1.981	1.037	30
KSTC	1.517	0.552	40
Spindles $\leq$ 26,000	2.191	1.158	150
26,000 $\leq$ 50,000	2.181	0.865	60
All units	2.189	1.080	210

50,000 spindles existed, the study could have met with more interesting results. The difference in labour productivity between size class is not statistically significant at 5 per cent level. The graphical illustration is presented in Fig.2, Appendix B.

4.9 CAPITAL PRODUCTIVITY

Capital stock consists of all resources which contribute to the production of goods and services. The relationship between output and capital stock is an important aspect of the study of changes in productive efficiency. The national wealth includes both net tangible and intangible non-financial assets. Tangible assets include:

1. Reproducible tangible assets comprising fixed assets and stocks

2. Non-reproducible tangible assets comprising land, forests fisheries historical monuments and other resources.

Estimates of capital stock have attracted several researchers and the estimates of net capital stock of the Indian economy have been prepared using the benchmark estimates of capital stock and carrying forward these estimates by official estimates of net capital formation prepared by the Central Statistical Organization (CSO). The first comprehensive estimates of capital stock were prepared for the year ending 1949-50. Later, a series of estimates of capital stock at current prices and constant prices were prepared.

The estimates of capital stock have been prepared following the Perpectual Inventory Method (PIM) recommended in the "Guidelines on Statistics of Tangle Assets" issued by the United Nations Statistical Office in 1979.

Perpetual Inventory Method

The perpetual inventory method (PIM)[1] is based on the relationship between the capital stock at a point of time and investments upto that point. PIM necessitates the availability of reliable estimates of average age of various types of fixed assets in an industry. In India no life table of fixed assets is available. Katyal and Gupta (1984) prepared a table showing average life of 32 types of assets. Chaturvedi and Bagchi (1984) prepared average life of construction and machinery assets. The average life of certain assets was prepared by Central Statistical Organization (1988). The average life of manufacturing machinery is given as twenty years, while building and workshop shed of manufacturing sector is taken as 50 years.

The common method of making the estimates of written-down replacement cost for fixed capital stock is the PIM. These figures are based on the gross fixed capital formation

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1. The idea was originally developed by Goldsmith (1951) for preparing the time series of National Wealth in the United States.

of any year, classified on the basis of asset and year of acquisition. The assets of which whole life is over is assumed to have run out. The cost of purchase of each type of assets is adjusted to current gross replacement cost by an index of the average change in prices from the year of acquisition to the date in question; and allowance valued at current replacement cost, for accumulated depreciation between the two dates is deducted in order to arrive at its written-down current replacement cost. The perpetual inventory may be built year-by-year at the constant prices of a given year. Net capital formation during a given year at constant prices is added to written-down value of its accumulated net capital formation as at the beginning of the year at constant prices. The resulting constant price value of the net capital stock as of the beginning of the next year is converted to current replacement cost as of the later date.

The perpetual inventory method is also used to estimate the gross replacement value of fixed assets. In this case accumulated depreciation is not deducted for arriving at the initial estimates of the gross replacement cost of the capital stock and the value of the constant prices of gross rather than net fixed capital formation added year-by-year.

One major practical problem is the use of appropriate price index numbers on capital goods for deflation. Each type of machinery and equipment is unique in its features, may be indigenous or imported, and hence compilation of comparable series of price indices is very difficult. Another encounter is with accounting for quality changes. All these involve compilation and categorization of various data on different types of assets and its prices.

Denison (1957) proposed three important measures of capital viz.,

1. Measurement by cost
2. Measurement by the capacity of the system as a whole to produce output and
3. Measurement by the contribution of capital specifically makes production.

The amount of physical capital cannot be measured directly and hence it has to be measured in value. Denison preferred to value capital in terms of cost so that increase in the quality of capital would be reflected in the technical progress term rather than in the measure of the capital input. For productivity study, this approach is widely used. Another problem encountered is the treatment of capital stock and capital service. There is a strong view that it is not the stock but the service of capital is to be treated as the factor of production. The studies by Griliches and Jorgenson (1966), Christenson and Jorgenson (1969), dealt in detail to correct capital series by estimating capital service.

Another problem is with the measurement arising from heterogeneity, vintage, technical change and price deflation. Capital may vary in productivity because it is not of the same vintage. Economists also have reacted in different ways to the problem of aggregation. Samuelson (1962) offered a new tool of the surrogate ("as-if") production function and surrogate capital to solve aggregation problem.

Treatment of changes in capital utilization is yet another problem of measurement. Some studies have used the technique of reducing the capital stock by the percentage of the workforce employed. But this tends to under-estimate capital unutilized if labour is hoarded. If production is increased by utilizing unemployed capital than hiring new labour, this estimation will lead to over estimation of capital unutilized. It is interesting to note that in studies in which capital stock has been adjusted for changes in utilization, the sensitivity of output to capital appears considerably increased (Thirlwall, 1972).

Kendrick (1973) argued that capital stock series should not be adjusted for changes in rate of capacity utilization since capital goods are available for productive use at all times and involve a per annum cost regardless of the degree of use. Sastri (1981) estimated elasticity of capital with respect to energy consumption in cotton mill industry in India adjusting real fixed capital for capacity utilization. Separate regressions are framed taking real fixed capital stock adjusted for capacity utilization by Wharton measure and also by machine hours. Even after adjusting for capacity utilization, elasticities continue to be high.

Estimates of Capital

Most of the studies have used 'Perpetual Inventory Method' for estimating capital. The capital stock of a given year is traced to the stream of past investments at constant prices. Denoting I_t as investment at constant prices in year t, the capital stock at the end of year T can be written as

$$K_T = K_o + \sum I_t \tag{1}$$

where K_o is the benchmark capital stock

In investment I_t correction is made for discarding, assuming an annual rate of discarding r, we may refer the amount of assets discarded during year 't' as rk_{t-1}.

The studies of Hashim and Dadi (1973), Banerji (1975) and Goldar (1981), took gross fixed capital at constant prices based on the perpetual inventory method.

Hashim and Dadi (1973) calculated base year (1960) value from balance-sheets compiling gross-net ratios[1] for building and construction, plant and machinery and other assets separately. Using these ratios and book value of fixed assets, they derived gross fixed assets at purchase prices for the year 1960. The gross value of assets in a particular year is obtained as:

$$G = N(r)$$

where

G = Gross value

N = Net value or written down value

r = gross/net ratio.

Gross values of each year forward and backward are built up using the annual gross additions to capital stock.

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1. Ratios of purchase value to book value of fixed capital stock.

i.e.,

$$G = N(r) + A_t$$

where

$$A_t = N_t - N_{t-1} + d_t$$

where d_t is the depreciation allowed for the year.

The rate of discarding was taken as 4.47 per cent per annum for assets existing in 1945, and no discarding of assets acquired in 1946 and after.

Hashim and Dadi attempted to build a profile of age distribution of capital stock dividing 20 two digits industries into two groups. Since the age distribution of capital stock inherited from the past is not known, Banerji (1975) ignored the problem. For the manufacturing sector as a whole, Banerji assumed replacement cost to be approximately twice the book value of assets in 1946.

Hashim and Dadi argued out that there is no need to substract depreciation from gross capital stock since a large amount of expenditure is incurred by business firms on repair and maintenance. The main object of business firm is to keep the assets in more or less a similar productive capacity.

Depreciation figures unfortunately do not reflect actual consumption. Depreciation rates allowed by Income Tax authorities are seldom representative of true capital consumption. It is also extremely difficult to make a proper estimate of capital consumption. Sastry (1981), Goldar (1981), Radhakrishnan (1989) and others accordingly took gross measure.

Banerji's method can be expressed symbolically as

$$K_o = 2 \times B1946 \qquad (1)$$

$$I_t = (B_t - B_{t-1} + D_t)/P_t \qquad (2)$$

$$K_T = K_o + \sum I_t \qquad (3)$$

where

2 x B1946 = Twice the book value of 1946

B_t = Book value of fixed capital in year t

D_t = Depreciation allowance for year t

P_t = Price index for capital.

Measure of replacement value of fixed assets of 1946 had been taken as double the book value of 1946 at 1946 prices of capital assets. To this figure, yearly gross investment at 1946 prices had been added as given by equation (2). Datta

(1977) had also taken double the book value of fixed capital as replacement value of fixed assets for the benchmark year. Nandamohan (1989) had also taken double of book value for 1975-76 as replacement value of fixed capital stock for the benchmark year at 1975-76 prices.

Goldar (1981) had taken gross fixed assets at constant prices as the measure of capital input. Net fixed asset measurement was not taken since the reported figures on depreciation were not sufficiently representative of the true capital consumption. For estimation purpose Goldar also used perpetual inventory method.

There is no universally accepted method of measuring capital stock. There are also wide differences in the actual methodology used to build the estimates of capital stock.

4.10 CAPITAL MEASUREMENT: PRESENT METHODOLOGY

In the present study, fixed capital stock series are developed based on the perpetual inventory method. Gross fixed assets have been taken as a measure of capital input which includes land and building, plant and machinery and other assets.

Regarding the estimation of benchmark (1982-83) gross fixed assets, age profile of assets for each year is needed to convert gross fixed assets purchase price into that at replacement cost in constant prices. Information about the age structure of various assets acquired is not available from firms. An additional information, i.e., age of establishment is used to make an approximate estimate of age of gross fixed assets. The age is calculated on the basis of year of establishment of the firm.

The base year capital stock at purchase prices has been converted into that at replacement cost at constant prices using price inflator taking simple average of price indices of capital prior to 1982-83. The main problem is the estimate of assets acquired before 1982-83. The value of capital stock at the benchmark year is obtained by measuring the aggregate amount it would have cost to produce the actual stock of various types of capital goods.

Perpetual inventory method necessitates the availability of reliable estimates of average age of various types of fixed assets of the spinning mills in Kerala. However, no life table of fixed assets is currently available for this.

To adjust for age structure, it is assumed that the average life of assets is twenty years (CSO, 1988). Hence, for eleven firms established on or after 1962 the estimates of average price indices from the year of establishment to the date in question (1982-83) were taken as price inflator to obtain the gross value of fixed capital at replacement cost in constant prices (1981-82).

But for older firms, the age distribution of assets acquired in the past is not known. Firm level survey conducted shows that even in the oldest mill (age 110 years) majority of the assets was having average age of twenty to twentyfive years. i.e. only a negligible part of the asset was purchased before 1962. Old assets was either sold out or completely modernized so as to yield the return as that of new. In most of these firms, plants were scrapped before their efficiency was actually declined. The age profile of these group of firms was also assumed to be that of firms established in 1962. Accordingly adjustment is made using this information. This does not completely solve the problem. However, replacement cost so arrived can be taken as approximations to market value.

The investment figures were obtained using the formula:

$$I_t = (B_t - B_{t-1} + D_t)/R_t$$

where

B_t is the book value of fixed capital in the year t

D_t is the depreciation charges in the year t

R_t is the price index for capital in year t (Base 1981-82 = 100).

For deflating gross investment series, a composite price index of machinery and construction is used. The composite price index is based on relative share of land and building and plant and machinery in the total fixed capital. The average of 1982-83 and 1991-92 is taken as weights.[1]

The capital stock at any year is calculated using the perpetual Inventory Accumulation Method[2] as follows:

$$K_t = K_o + \sum_{t=1}^{T} I_t$$

where

I_t is investment in year t in 1981-82 prices

K_o is the capital stock in the bench mark year at 1981-82 prices.

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1. The weights are 74.80 for plant and machinery and 14.73 for land and building.
2. An excellent survey of capital measurement and PIAM is given in Hashim and Dadi (1973), Goldar (1981) and Radhakrishnan (1989).

The present study assumes zero rate of discarding in the measurement of capital since detailed information regarding age-structure is not available and also the age pattern of each type of assets varies intra-firm and inter-firm. Ahluwalia (1991) assumed annual rate of discarding of capital stock to be zero.

Goldar (1981) estimated TFP before and after adjusting capital series for rate of discarding to find out differences in result. No significant change in result was noticed even after corrections were made for rate of discarding.

The uniqueness of the present study is that the purchase price is directly taken from the balance sheets of the firm instead of applying a common gross net ratio. In the absence of information on the age structure of fixed assets, Hashim and Dadi (1973), found justification in using average gross net ratio for each industry from a good sample of the firms giving information about the purchase value of the assets and the written down value (wdv).

Analysis of the balance sheets of twentyone spinning mills in Kerala in the year 1982-83 shows a wide variation in gross net ratio i.e. from 1.20 to 4.74 (Appendix C-3). Wherever gross net ratio is not available, Goldar (1981) found some justification in using double the book value of fixed capital in line with Banerji (1975) and Datta (1977).

Following Kendrick (1975) and Goldar (1981) capital stock has not been corrected for capacity utilization. Instead, capacity utilization has been taken as a determinant of source of variation in technical efficiency (see chapter V).

Productivity of Capital: Findings

The productivity of capital is measured as a ratio of gross value added to gross fixed capital.

$$\text{Capital productivity (KP)} = \frac{\text{Gross value added at 1981-82 prices}}{\text{Gross fixed assets at 1981-82 prices}}$$

The concept of gross fixed capital includes plant and equipment and buildings and buildings under construction. Estimates of capital productivity and trend rates of growth are presented in Table 4.5.

There is no decidedly consistent upward or downward trend in capital productivity on an year to year basis. Comparison of the two terminal years 1982-83 and 1991-92 shows

Table 4.5

Estimates of capital productivity (KP) by ownership and by firm-size: 1982-83 to 1991-92

(KP = Y/K) (Rupees in Lakhs)

Year	Ownership				Size	
	Private	NTC	Co-operative	KSTC	Spindles ≤ 26,000	26,000 ≤ 50,000
1982-83	0.266	0.360	0.134	0.276	0.267	0.371
1983-84	0.309	0.232	0.155	0.272	0.262	0.211
1984-85	0.277	0.267	0.152	0.309	0.266	0.256
1985-86	0.311	0.340	0.143	0.414	0.316	0.284
1986-87	0.289	0.331	0.166	0.329	0.287	0.375
1987-88	0.302	0.327	0.158	0.262	0.267	0.258
1988-89	0.250	0.364	0.191	0.250	0.243	0.313
1989-90	0.339	0.546	0.299	0.416	0.363	0.420
1990-91	0.334	0.502	0.289	0.434	0.372	0.394
1991-92	0.232	0.321	0.248	0.343	0.264	0.297
Growth rates						
Terminal years	-12.78	-10.83	85.07	24.28	-1.12	-19.95
Trend growth rates	-0.19 (0.014)	4.93* (0.024)	8.55** (0.017)	3.01 (0.022)	1.85 (0.016)	2.89** (0.024

Note:-

Y = Gross value added at constant prices
K = Gross fixed capital at constant prices
$\ln Y/K = A + B_t + e$ (Trend equation of capital productivity)

** Significant at 5% probability level
* Significant at 10% probability level
Figures in parentheses represent standard error.

an upward trend only in the case of co-operative and KSTC sectors. The remaining sectors viz. private, NTC, small and medium registered a downward trend in their capital productivity indices. The lowest capital productivity in the year 1982-83 was reported in the case of co-operative sectors. The highest capital productivity in the year 1991-92 was found in the case of KSTC sector.

The trend growth rate of all sectors are positive except in the case of private sector. The highest trend growth rate among ownership categories is reported in the case of co-operative and among firm-size categories it is medium sector. The trend growth rate of co-operative and medium sectors are significant at the 5 per cent probability level.

Estimates of capital productivity (KP) by pooling cross-section and time-series data of different categories are presented in Table 4.6.

Highest capital productivity is reported in the case of NTC mills followed by co-operative mills. The capital productivity of private sector is significantly below NTC at the 5 per cent level and KSTC at the 10 per cent level. But the mean capital productivity of private sector is significantly above the co-operative sector at the one per cent level.

Table 4.6

Estimates of capital productivity (KP) by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92

(Rupees in Lakhs)

Ownership/size	KP (Y/K)	Std.Dev.	Cases
Private	0.291	0.109	100
NTC	0.359	0.157	40
Co-operative	0.194	0.103	30
KSTC	0.331	0.135	40
Spindles ≤ 26,000	0.290	0.124	150
26,000 ≤ 50,000	0.318	0.148	60
All units	0.298	0.131	210

Among size class the capital productivity of small size class is lower than that of medium size class. But the difference is not statistically significant. The decrease in capital productivity in private sectors can be attributed to capital deepening, while the decrease in co-operative sector may be due both to low gross-value addition and capital deepening. The graphical illustration of capital productivity is given in Fig.3 in Appendix B.

4.11 CAPITAL INTENSITY

Capital intensity is defined as the ratio of gross fixed assets to labour input. It is the ratio of capital per person.

$$\text{Capital per person} = K/L = \frac{\text{Capital}}{\text{Labour}}$$

The present study uses the following formula to estimate capital intensity.

$$K/L = \frac{\text{Gross fixed capital at 1981-82 prices}}{\text{Total number of employees}}$$

When capital intensity increases capital-output ratio increases and output-capital ratio declines indicating a fall in capital productivity. This supports the evidence of capital deepening. Singh (1966) found a significant fall in capital productivity due to overexpansion of capital input, and a high labour productivity due to capital deepening. Shivamaggi et al (1968), Raj Krishna and Mehta (1968) also agreed with the findings of Singh. Goldar (1981) also found the same trend in Indian industries.

Table 4.7 indicates the capital intensity indices and growth trends in capital intensity for the period 1982-83 to 1991-92 by ownership and by firm-size. The trend growth rates show that capital intensity increased in the case of all

Table 4.7

Estimates of capital intensity (K/L) by ownership and by firm-size: 1982-83 to 1991-92

Year	Ownership				Size	
	Private	NTC	Co-operative	KSTC	Spindles ≤ 26,000	26,000 ≤ 50,000
1982-83	0.76	0.46	1.39	0.47	0.76	0.67
1983-84	0.80	0.49	1.03	0.48	0.72	0.70
1984-85	0.88	0.55	0.66	0.49	0.70	0.75
1985-86	0.95	0.59	0.61	0.50	0.73	0.78
1986-87	0.99	0.59	0.62	0.51	0.78	0.72
1987-88	0.99	0.62	0.67	0.52	0.79	0.78
1988-89	1.05	0.65	0.74	0.56	0.84	0.82
1989-90	1.05	0.67	0.74	0.60	0.84	0.88
1990-91	1.12	0.72	0.75	0.68	0.88	0.97
1991-92	1.23	0.75	0.76	0.71	0.93	1.07
Growth rates						
Terminal years	61.84	63.04	-45.32	51.06	22.37	59.70
Trend growth rates	4.77** (0.004)	5.10** (0.003)	3.89 (0.026)	4.56** (0.006)	2.77** (0.005)	4.56** (0.006)

Note:-

K = Gross fixed capital at constant prices
L = Labour
$\ln K/L = A + B_t + e$ (Trend equation of capital intensity)

** Significant at 5% probability level
* Significant at 10% probability level
Figures in parentheses represent standard error.

sectors. The highest rate of trend growth rate is registered in the case of NTC mills followed by private mills. Among size categories medium size mills rank first both in terms of trend growth rate and rate of growth between terminal years. Terminal years growth rate show a declining trend only in the case of co-operative sector. The trend growth rate is statistically significant in all sectors at the 5 per cent probability level except in the case of co-operative sector.

Estimates of capital intensity by ownership and by firm-size pooling cross-section and time series data are presented in Table 4.8.

The capital intensity is found highest in the case of private mills. Private sector is followed by co-operative sectors in terms of capital intensity. The reported capital intensity is lowest in the case of KSTC sector. The mean capital intensity of private sector is significantly above NTC and KSTC sector at the one per cent level. There is no statistically significant difference between the mean values of private and co-operative sectors. The absence of a significant relationship between firm - size and capital intensity means that neither a positive nor a negative case can be made for small or medium firms on the grounds of employment efficiency.

Table 4.8

Estimates of capital intensity (K/L) by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92.

(Rupees in Lakhs)

Ownership/size	K/L	Std.Dev.	Cases
Private	0.98	0.546	100
NTC	0.61	0.180	40
Co-operative	0.80	0.849	30
KSTC	0.55	0.203	40
Spindles ≤ 26,000	0.80	0.321	150
26,000 ≤ 50,000	0.81	0.216	60
All units	0.80	0.267	210

When capital intensity increases this is usually followed by a decreasing capital productivity (output-capital ratio). Increase in capital intensity in private and co-operative sector is followed by a decrease in capital productivity. The graphical illustration is presented in Fig.4 in Appendix B.

4.12 CAPITAL SURROGATE AND CAPITAL PRODUCTIVITY

The complexities of capital measurement - problems in the calculation of depreciation, adjustment for capital losses, use of appropriate price deflators, lack of data on age distribution of capital assets and other problems explained earlier, have led scholars to think of using surrogates to capital stock such as horse power rating of electric motors, electricity consumption and machine hours. The inherent advantages of such proxies are:

1. Physical measure like power consumption is relatively more homogeneous and devoid of price deflation;

2. it is well free from aggregation problem.

To overcome many problems of capital measurement, the present study employs spindles installed as a proxy to gross fixed capital. Spindle is a mechanism for spinning yarn, usually ring spinning, and consisting of delivery rollers, a tapered length of steel which can be rotated at a high speed and a ring and traveller for inserting twist and winding the yarn on to a bobbin. Spindles installed being a physical measure, problems of price deflation are not present. It is also free from aggregation problem since it is relatively more homogeneous. But spindles are not absolutely homogeneous. Spindle efficiency varies from mill to mill based on its age and quality. Spindle efficiency is reflected in spindle speed. It varies from 12,000 rpm to 25,000 rpm. Another problem with this measure is installed spindles may remain idle due to so many inherent constraints common to mills.

Despite these limitations, it may be worthwhile to try these surrogates in order to get round some of the problems of capital measurement. Table 4.9 presents the estimated value of spindle productivity by ownership and by firm-size for the period from 1982-83 to 1991-92. Comparison of the terminal years 1982-83 and 1991-92 alone reveals an upward trend for spindle productivity index in all six categories of mills. Private sector with a terminal growth rate of 143.48 represents 'most efficient' group.

The lowest trend growth rate in spindle productivity is recorded in KSTC mills among ownership categories and small mills in firm-size categories. The highest trend growth rate is recorded in co-operative sector followed by NTC sector among ownership categories. Among size categories medium group of mills registered a trend growth rate of nearly 10 per cent while in the case of medium sector, it is nearly 7

Table 4.9

Estimates of spindle productivity (SP) by ownership and by firm-size: 1982-83 to 1991-92

(SP = Y/S) (Rupees in Lakhs)

Year	Ownership				Size	
	Private	NTC	Co-operative	KSTC	Spindles ≤ 26,000	26,000 ≤ 50,000
1982-83	0.46	0.39	0.26	0.28	0.37	0.42
1983-84	0.55	0.25	0.31	0.27	0.43	0.35
1984-85	0.60	0.31	0.29	0.29	0.44	0.45
1985-86	0.65	0.43	0.28	0.40	0.51	0.50
1986-87	0.54	0.41	0.34	0.31	0.42	0.50
1987-88	0.66	0.40	0.30	0.25	0.45	0.51
1988-89	0.55	0.46	0.36	0.26	0.38	0.62
1989-90	0.78	0.70	0.74	0.46	0.64	0.82
1990-91	0.84	0.66	0.57	0.53	0.65	0.86
1991-92	1.12	0.47	0.49	0.45	0.78	0.78
Growth Rates						
Terminal years	143.48	20.51	88.46	60.71	110.81	85.71
Trend growth rates	7.26** (0.016)	7.71** (0.023)	9.26** (0.024)	5.93** (0.024)	6.46** (0.019)	9.41 (0.126)

Note:-

Y = Gross value added at constant price
S = Total number of commissioned spindles.
$\ln Y/S = A + B_t + e$ (Trend equation of spindle productivity)

** significant at 5% probability level
* significant at 10% probability level
Figures in parentheses represent standard error.

per cent. The trend growth rates are statistically significant at the 5 per cent probability level in all sectors except in medium sized mills.

The estimates of spindle productivity by ownership and by firm-size using panel data are presented in Table 4.10. The spindle productivity is found highest in the case of private mills. Private sector is followed by NTC. The lowest spindle productivity is in the case of KSTC mills. The findings are not in agreement with the estimates of capital

Table 4.10

Estimates of spindle productivity (Y/S) by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92.

(Rs. '000)

Ownership/size	SP (Y/S)	Std.Dev.	Cases
Private	0.68	0.54	100
NTC	0.45	0.14	40
Co-operative	0.38	0.20	30
KSTC	0.35	0.13	40
Spindles ≤ 26,000	0.51	0.44	150
26,000 ≤ 50,000	0.58	0.33	60
All units	0.53	0.42	210

productivity. The estimated capital productivity is highest in the case of NTC mills.

There is a statistically significant difference between the spindle productivity of private sector and those of public sectors. It is significantly (at the 5 per cent level) below those for NTC, co-operative and KSTC sectors. Within size-group there is no significant difference (at the 5 per cent level) between mean spindle productivity, eventhough the estimated spindle productivity is higher in medium size group. The graphical illustration is given in Fig.5 in Appendix B.

4.13 CHARACTERISTICS OF HIGH PROFIT MILLS

Table 4.11 provides some distinctive characteristics of high profit mills and compares them with the average of all other groups and also with industry average.

In all measures except capital productivity the high-profit mills are well high above other groups as per the estimates presented in Table 4.11. The high profit mills were earning net profit for almost all the ten years under study. There were only five such mills and these five mills belong to private sector. In terms of technical efficiency four out of

Table 4.11

Estimates of selected statistical characteristics of high profit mills

Mill groups	Mean values				
	LP_1	LP_2	KP	SP	K/L
High profit mills	0.37	3.11	0.31	0.78	1.50
Private	0.27	2.69	0.29	0.68	0.98
NTC	0.20	1.75	0.36	0.45	0.61
Co-operative	0.13	1.98	0.19	0.38	0.80
KSTC	0.17	1.52	0.33	0.35	0.55
Spindles $\leq$ 26,000	0.21	2.19	0.29	0.51	0.80
26,000 $\leq$ 50,000	0.25	2.18	0.32	0.58	0.81
All units	0.22	2.19	0.30	0.53	0.80

these five mills are having efficiency index of one (100% efficient) and the other mill is 99% efficient.

The reason for low capital productivity (KP) and high labour productivity (LP_1) of high profit mills is also due to capital deepening. The capital intensity index of high profit mills is 87.5 per cent higher than industry average. Partial factor productivities were estimated by age-wise in both categories. Age of the firm was calculated from the year of its establishment to the final year of the period of study. The age of the enterprise was included as a test for the presence of learning by doing. Three groups - old, new and intermediate - were seggregated. But no definite relations could be traced due to small number of observations in each group. This area leaves scope for further research.

4.14 ESTIMATES OF THE RATE OF TECHNOLOGICAL CHANGE

An attempt is made here to measure the technological change through Cobb-Douglas production function. To capture technological progress, a time trend variable is introduced in the specified production relationship and the trend coefficient is explicitly estimated along with the other parameters of the production function. Then the Cobb-Douglas function may be specified as

$$y = Ae^{gT} L^a K^b e^u$$

where y is the gross value added, L is the total number of employees, K is the gross fixed capital, T is the time variable and u is the error term with usual assumptions. The function can be simplified as follows.

Denote T as T_{1983}, T_{1984}, T_{1985} etc., by T_1, T_2, T_3 etc. Then.

$$y = \ln A + a \ln L + b \ln K + gT + u.$$

The equation was estimated for different groups using OLS method. Cross-section and time-series data were pooled together to have larger number of observations and many more degrees of freedom. The results of the rate of technological change for each group and for the mills as a whole are presented in Table 4.12.

The estimated trend coefficient is statistically significant at the 5 per cent level in the case of NTC, KSTC and medium mills. In the case of co-operative mills the growth rate is statistically significant only at the 10 per cent level eventhough its growth rate is 8.12 per cent per annum.

Table 4.12

Estimates of rate of technological change (in percentages)

Ownership/size	Cases	Growth rate	Computed t-value	Significant at 5%	Significant at 10%
Private	100	-1.47	0.79	No	No
NTC	40	5.01	2.67	Yes	Yes
Co-operative	30	8.12	2.27	No	Yes
KSTC	40	4.26	2.91	Yes	Yes
Spindles ≤ 26,000	150	3.07	2.24	No	Yes
26,000 ≤ 50,000	60	4.17	3.01	Yes	Yes
All units	210	3.78	2.88	Yes	Yes

The estimated growth rate of -1.47 per cent per annum in the case of private mill is not statistically significant. The trend coefficient of small mills is statistically significant only at the 10% probability level.

A significant positive trend coefficient in the case of spinning mills as a whole is a welcome feature. This indicates the presence of technological progress in the spinning mills in Kerala.

Chapter V

TECHNICAL EFFICIENCY AND ECONOMIC PERFORMANCE

5.0 The preceding chapter explored the relationship between firm-size/ownership pattern and partial factor productivities of the spinning mills in Kerala. This chapter examines the relationship between firm-size/ownership and technical efficiency in production using a two factor frontier Cobb-Douglas production function to measure technical efficiency in six categories of spinning mills. Inter-sectoral differences in total factor productivity are also analysed with the help of dummy variables.

An investigation into the sources of technical efficiency differentials among firms in the sample is also done. The important explanatory variables selected are capacity utilization, wage rate and presence of well equipped research and development (R&D) department.

5.1 THE CONCEPTUAL FRAMEWORK

Neo-classical economics characterized by micro economic theoretical systems assumes the working of a firm in a perfectly competitive and riskless environment and maximise profit. But in real practice, the efficiency varies greatly among firms as against neo-classical assumption. Micro-economic studies usually distinguish between allocative efficiency, and technical efficiency. Technical inefficiency arises due to a firm's failure to maximise output from a given set of inputs.

Production, in the broadest sense may be defined as any activity the net result of which is to increase the degree of compliance between the quantity, quality and distribution of commodities and a given preference pattern (Heathfield and Soren, 1987). Production process is the means of transforming inputs into outputs. Production function is the set of possible efficient relations between inputs and outputs given the current state of technological knowledge.

$$y = g\ (r_1,\ r_2,\ \ldots\ldots,\ r_m)$$

which states that 'Y' is the maximum amount of commodity Y which the firm can produce if it uses exactly r_1 units of inputs 1, r_2 units of inputs 2 etc. Knowledge of such a functional relationship presupposes that a set of optionality calculations has already been carried out, explicitly or implicitly, by the firm's engineers or production managers.

The existence of embodied technological progress has led to the introduction of frontier production functions. The frontier production function represents the best technology ie., the most modern. It is called 'frontier' function because it represents the efficiency frontier of the industry. It is also called 'best practice' functions or 'ex-ante' production functions. The introduction of frontier production has inspired the studies of efficiency in an industry.

5.2 MEASUREMENT OF PRODUCTIVE EFFICIENCY

Best practice studies started with a study in 1948 by A.P.Groose on open hearth steel furnaces. In this and later on in Salter (1960) the term was reserved for a specific 'technique' rather than for whole production function. The first to use of a best practice function as an empirical concept was in 1957 by Farrell (Heath field and Soren 1987). Most of the best practice, or frontier production studies are related to the analysis of productive efficiency/inefficiency. The concept of frontier and best practice relations are due respectively to Farrel and Salter. Farrel (1957) introduced the concept of technical efficiency along with that of frontier or best practice production function, which defines for a set of observations the maximum output attainable from a given vector of measured inputs.

Before the emergence of best practice concept, efficiency measurement by average productivity of labour or capital or total factor productivity index was thought to be adequate. The former indices are simply the average products of labour or capital while total factor productivity, often referred to as the 'residual' or the 'index of technical progress' is defined as ratio of output to weighted sum of all factors. Symbolically these indices are:

Partial indices: (a) $AP_L = Q/L$,

(b) $AP_K = Q/K$

Total productivity index: $A = Q/(aL + bK)$

where Q, L and K are respectively, the aggregate level of output, labour and capital inputs; 'a' and 'b' are some appropriate weights.

Keshrai and Thomas (1994) summarize the disadvantages of these measures:

1. An average productivity measure ignores the contribution of other factors in production.

2. Although an index of total factor productivity (TFP) can take into account all the factors of production, in construction of index one faces the usual index number problems while aggregating inputs.

3. Measures of TFP are deduced from explicitly or implicitly defined average production function but the production function by definition are frontier functions.

Thus the total factor productivity index should be constructed on the basis of a frontier production function: Farrel's measure of efficiency avoids the aforementioned problems - one which takes into account all inputs and yet avoids index number problems. The measure developed is applicable to any productive organization from a workshop to a whole economy.

Farrel has proposed two measures of technical efficiency. First measure is based on the ratio of best practice input usage to actual usage, holding the output constant. It is called input based measure. The second measure is based on ratio of actual output obtained from a given vector of inputs to maximum possible output achievable from the same input vector. Farrel's input based measure of productive efficiency can be illustrated with the help of a diagram.

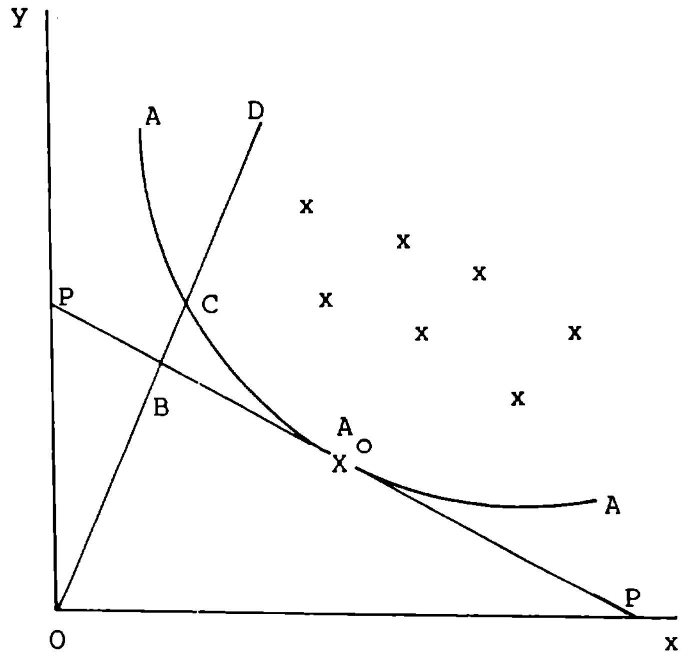

Fig.5.1 **Measurement of Technical Efficiency**

The point D in the diagram represents the inputs of the two factors, per unit of output, that the firm is observed to use. The isoquent AA denotes the frontier production function for various combinations of two factors to produce unit output. The crosses denote observable input coefficients of the firms in the industry. Each cross is a per unit of output coefficient.

Let C be a specific firm. It represents an efficient firm using the two factors in the same ratio as D. Firm C produces the same output as D using only OC/OD as much of each factor. Thus OC/OD is defined as the technical efficiency (TE) of firm D.

This ratio has the properties that a measure of efficiency obviously needs. It takes the value of 1 (or 100 per cent) for a perfectly efficient firm. Since AA has a negative slope, an increase in the input per unit of output of one factor implies lower technical efficiency ceteris paribus. The technical efficiency has the range $0 \longrightarrow 1$.

However, point C does not represent the most profitable factor combination eventhough it is technically efficient. Both firm C and A_o represent 100 per cent technical efficiency, but firm C is not resorting to optimal method of production. Since PP has a slope equal to the ratio of the prices of the two factors of the firm, A_o is restoring to optimal method of production. Thus firm D has also a price inefficiency. The price efficiency (PE) of firm D is OB/OC.

Further, if the observed firms were to change the proportions of its inputs until they were the same as those represented by A_o, while keeping its TE constant, its cost would be reduced by a factor OB/OC, so long as factor prices did not change. If the observed firms were perfectly efficient both technically and in respect of prices, its cost would be a fraction of OB/OD of what they in fact were. Farrel defined this as the overall efficiency (OE) of the firm. Thus OE = TE x PE = OB/OD.

Farrel's efficiency measures are relative in the sense the performance of the individual firms are compared with the best performer in a peer group. Farrel also proposed an output-based measure of technical efficiency that could be derived by estimating a frontier production function with a specific functional form. A frontier production function is defined as the locus of output achievable from the given input vectors.

Technical efficiency is the ratio of actual output to the corresponding level of output shown by the production frontier, i.e. ratio of actual to maximum potential output. Technical inefficiency is defined as the amount by which the actual output falls short of the maximum possible output on the frontier. It measures the extent to which a firm fails to obtain the maximum output from its inputs, as judged by how far its output-input ratio falls short of the most efficient of the firms in the sample that use factors in the same proportions as they do.

"The TFP differential between actual and potential (or best practice) output is defined conventionally as technical inefficiency" (Little et al., 1987). The concept of technical efficiency is closely related to that of total factor productivity (TFP). Nishimizu and Page (1982) rightly pointed out that the amount by which actual output is less than potential output is formally equivalent to the difference between total factor productivity based on best practice and that based on actual practice. Since differences in technical efficiency between firms are equivalent to the differences in TFP, the production frontier provides a useful tool for analyzing the relative productive efficiency of individual economic units. Deviations from best practice are ascribed to technical inefficiency.

Farrel did not follow up his own suggestion of estimating a frontier production function. Non-parametric approaches for the estimation of the efficiency frontier were popular after Farrel's work. However, techniques have been developed to estimate a parametric frontier by imposing a functional form. Early efforts at specifying frontiers were done by Aigner and Chu (1968), Timmer (1971), Afriat (1972), Richmond (1974) and Schmidt (1976). Beginning with the pioneering work of Aigner and Chu (1968), substantial econometric effort has been focused on developing frontier production functions. They specified a homogeneous Cobb-Douglas production frontier and required all observations to be on or beneath the frontier. Their model may be written

$$\ln Y = \ln f(x) - u$$

$$= \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln x_i - u, \quad u \geq 0 \qquad (5.1)$$

where the one-sided error term forces $y \leq f(x)$.

Aigner and Chu suggested the estimation by mathematical programming methods. The parameters may be estimated by linear programming, i.e. minimizing the sum of the absolute values of the residuals, subject to the constraint that each residual be non-positive (i.e. negative). They suggest the minimization of

$$\sum_{i=1}^{n} [y_j - \ln (f(x_j))]$$

subject to $y_j \leq \ln f(x_j)$ where x_j is a vector of n inputs used by the j^{th} firm.

It can also be estimated by quadratic programming, i.e. minimizing the sum of the squared residuals, subject to the same constraint. The technical efficiency of each observation can be computed directly from the vector of residuals, since 'u' represents technical inefficiency. That is, the ratio of observed output of a firm to its efficiency frontier output provides the TE index.

The most important problem of this approach is that it does not allow for random shocks in the production process which are outside the firms' control. Two alternative approaches to the specification of the frontier have come into prominence, namely deterministic and stochastic.

5.3 DETERMINISTIC STATISTICAL FRONTIER

The frontier is called deterministic if all observations must lie on or below the frontier. A deterministic frontier production function envisages a deterministic optimal relationship between inputs and output, unaffected by random events and statistical noise such as measurement errors. Thus the actual level of output of a firm lies below the frontier only due to the existence of technical inefficiency in the production process. This implies the assumption that all random factors are under the control of the firm. Model in (5.1) can be written as

$$y = f(x)e^{-u} \tag{5.2}$$

Taking logarithms to the base e it may be written as

$$\ln y = \ln[f(x)] - u \tag{5.3}$$

where $u \geq 0$ (and thus $0 \leq e^{-u} \leq 1$) and where $\ln[f(x)]$ is linear in the Cobb Douglas case in (5.1). The assumption is that the observations on 'u' are independently and identically distributed (iid) and that x is exogenous (independent of u). For a deterministic frontier production function model, there are choices regarding the assumptions to be made about probability distribution of the error terms. Error terms may be assumed to follow any of gamma, exponential or half normal distribution. There do not appear to be good a priori arguments for any particular distribution.

Richmand (1974) suggested a method of estimation based on ordinary least square results called corrected ordinary least square (COLS) method. Richmand assumed 'u' has a gamma distribution. Let μ be the means of u, then equation (5.3) may be rewritten as

$$\ln y = (\alpha_0 - \mu) + \sum_{i=1}^{n} \alpha_i \ln x_i - (u - \mu)$$

where the new error term has a zero mean and satisfies all the usual ideal condition except normality. Therefore, the above equation can be estimated by OLS technique to obtain best linear unbiased estimate of (α_o - μ) and of the α_i. It can be shown that since u has been assumed to follow a gamma distribution, an estimate of μ is given by the variance of OLS residuals and this estimate can be used to 'correct' the OLS constant term, which is a consistent estimate of (α_o- μ). COLS thus provides consistent estimates of all the parameters of frontier.

A problem with COLS method is that even after correcting the constant term, some of the residuals may still have the 'wrong' sign so that some firms will lie above the frontier. That is, some firms show the efficiency index more than 100 per cent because their observed output is more than potential output. They can be assumed to be 100 per cent efficient (Golder and Agarwal, 1992). Another way to resolve this problem is to correct the constant term not as above, but by shifting it up until no residual is positive and one is zero. This method was followed by Greene (1980). Greene had shown that regardless of the distribution of error term one may obtain a consistent estimate of the intercept term by adding to it the largest error term in the sample.[1]

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1. Goldar and Agarwal (1992) modified this approach and had taken the average of five largest error terms as the correction factor. They claimed that this method is consistent and better than the Green's method in the sense that correction factor is based on five largest error terms.

5.4 STOCHASTIC FRONTIERS

The stochastic frontier approach accommodates exogenous shocks like power shortages, raw material supply breakdowns, machine and equipment failure, in addition to measurement errors by decomposing the deviation from the frontier into two components, the first of which is distributed symmetrically with zero mean reflecting randomness found in any relationship and the other is assumed to be distributed asymmetrically reflecting technical inefficiency. To lump the effects of exogenous shocks with the effects of measurement error and inefficiency into a single one-sided error term is questionable. This involves the specification of the error term as being made up of two components, one normal and the other from a one-sided distribution. Aigner, Lovel and Schmidt (1977) and Meesen and van den Broeck (1977) suggested stochastic error specification (composed error) models. They introduced two separate disturbance terms. A stochastic production model may be written as

$$y = f(x) \exp(v-u).$$

The disturbance 'v' represents the influence of factors outside the control of the firm, while 'u' represents technical errors of the firm. Technical inefficiency relative to the stochastic production frontier is given by 'u' per cent.

The model can be estimated either by maximum likelihood or COLS methods. In either case the distribution of 'u' must be specified. Stochastic frontier is considered superior because it gives less biased measure of efficiency. The main disadvantage of the model is that the frontier being stochastic, it is not possible to obtain estimates of efficiency for each observation or each firm. The best that one can do is to obtain an estimate of mean inefficiency over the sample (Forsund et al., 1980). The choice between deterministic and stochastic frontier mainly depends on the purpose of study besides information about the quality of data, and how data are generated.

There are two competing paradigms on how to construct frontiers viz.

1. Mathematical programming
2. Econometric techniques.

The main advantage of mathematical programming or 'Data Envelopment Analysis' (DEA) is that it does not impose any explicit functional form (such as Cobb-Douglas etc.) on production function to be estimated. But the calculated frontier may be warped if the data are contaminated by statistical noise. It can estimate only deterministic frontier and it produces 'estimates' which have no statistical properties such as standard errors or 't' ratios.

The econometric approach can handle statistical noise, but it imposes an explicit, and possibly overly restrictive, functional form for technology. This approach is capable of estimating deterministic as well as stochastic frontier and provides estimates with statistical properties. Researchers prefer econometric approach because of these advantages.

5.5 THE MODEL: PRESENT STUDY

Econometric estimation of frontier production function has been done to estimate efficiency of a firm or industry. Majority of the studies[1] have estimated the relative technical efficiency using deterministic frontier. Following them the present study also adopts a deterministic frontier frame-work.

Composed error model is considered to be more sophisticated approach to the analysis of technical efficiency. Jondrow et al., Greene and Mayes (1991) recommended the use of a composite error term stochastic

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1. Page (1984), Goldar (1985), Little, Mazumdar and Page (1987), Bhavani (1990), Goldar and Agarwal (1992).

frontier production function. These models require the estimation method of maximum likelihood when the assumed distribution of inefficiency component of error term is truncated at a point other than the mode. Olson et al.(1980) and Jondrow et al.(1982) had used mode as the truncation point and thus applied half normal distribution to the inefficiency error component. They had derived the average technical efficiency and firm level technical efficiency based on the moments of composite error term. The efficiency index so obtained is found upward biased on account of the assumption of mode being the truncation point. On the basis of these arguments Goldar and Agarwal (1992) applied deterministic frontier production function.

The frontier production function for the present analysis has been specified as deterministic since the main objective of the study is to measure inter-firm differences in efficiency. It is assumed that the technology of the spinning mills is represented by a Cobb-Douglas value added function. Hence the model specified is a homogeneous Cobb-Douglas production frontier and all observations are required to be on or beneath the frontier.

The model takes the following form:

$$Y = AL^{a} K^{b} e^{-u} \tag{1}$$

where $u \geq 0$ and thus $0 \leq e^{-u} \leq 1$

where y = Gross value added

L = Labour

K = Capital

A = Efficiency parameter

a = Coefficient of labour

b = Coefficient of capital.

A random disturbance term is added to account for the various factors that result in less than maximum production. For the interpretation of the function to remain that of maximum output, one requires that the disturbance takes only negative values. Thus the condition $u \geq 0$ ensures that all observations lie on or beneath the production frontier.

The model further assumes that the observations on 'u' are independently identically distributed (iid) and that L and K are exogeneous (independent of 'u'). If a firm is on the production frontier 'u' is equal to zero, so that e^{-u} takes on the value unity. e^{-u} is the measure of technical efficiency. The parameters 'a' and 'b' represent elasticities of value added with respect to labour and capital respectively and their sum gives a measure of returns to scale.

The logarithm of both the sides of the equation is taken to convert the equation in linear form. The log transformation is specified as,

$$\ln y = \ln A + a \ln L + b \ln k - u \qquad (2)$$

$$u \geq 0$$

The model is expanded introducing time element (T) and converted as follows:

$$\ln y = \ln A + a \ln L + b \ln k + gT - u \qquad (3)$$

$$u \geq 0$$

The model now allows exponential technological change at a constant annual rate of 'g'. The parameters of the model are A, a, b and g. The model is estimated using corrected ordinary least square (COLS) method pooling cross section and time-series data (panel data). The error term is assumed to follow Gamma distribution.

Then, an estimate of the parameters may be obtained from the OLS residuals. The OLS residual of each mill is obtained as,

$$e_{it} = \ln y_{it} - \ln \hat{y}_{it}$$

where e_{it} is the difference between the actual and estimated value of ln y for firm i in year t. Then the constant term of the estimated production function is corrected by using the term m, where m is the variance of the OLS residuals. The corrected constant term is ln A+m.

Let e_{it} be the OLS residuals for firm i then an estimate of technical efficiency (TE) of firm i in year t is computed as,

$$\exp\ (e_{it} - m) \quad = \quad e^{e_{it} - m}$$

The average efficiency level of each mill is computed using the efficiency indices computed for that mill in different years. In this approach, a few firms have efficiency index more than 100 per cent and they are assumed to be 100 per cent efficient and TE index is taken as one. Then the firms are grouped ownership-wise and size-wise to compute average efficiency level of each group.

Sources of variations in technical efficiency are examined by using a multiple regression framework. The dependent variable is the firm-specific index of technical efficiency. The relationship is assumed log-linear.

Inter-sectoral difference in efficiency are also analysed with the help of dummy variable. The model takes the given form

$$\log y = \beta_o + \beta_1 \log L + \beta_2 \log K + \gamma D_1 + \delta D_2 + \epsilon D_3 + \alpha_1 S_2 + u_i \qquad (4)$$

where,

β_o, β_1, β_2, γ, δ, ϵ and α_i are the parameters to be estimated.

$D_1 = \begin{matrix} 1 & \text{if the mill is a co-operative one} \\ 0 & \text{otherwise} \end{matrix}$

$D_2 = \begin{matrix} 1 & \text{if the mill is a KSTC mill} \\ 0 & \text{otherwise} \end{matrix}$

$D_3 = \begin{matrix} 1 & \text{if the mill is an NTC mill} \\ 0 & \text{otherwise} \end{matrix}$

$S_1 = \begin{matrix} 1 & \text{if spindles} \leq 26{,}000 \\ 0 & \text{otherwise} \end{matrix}$

5.6 THE MEASUREMENT AND INTERPRETATION OF TECHNICAL EFFICIENCY: REGRESSION RESULTS

The present study has selected total factor productivity as the index of technical efficiency. The estimated parameters of Cobb-Douglas frontier production function give the following best fitted equation.[1]

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1. Equation is estimated after adjusting for serial correlation by the Prais-Winston method.

$$\log y = -3.2496 + 0.8405 \log L + 0.3542 \log K + 0.0378$$
$$\qquad\qquad\qquad\qquad (3.26) \qquad\qquad (2.97) \qquad\qquad (2.88)$$

$R^2 = 0.551$

D.W. = 1.98

Figures in parentheses below the regression coefficient denote their t-values. The magnitudes of the coefficients are reasonable. The estimated coefficients are significant at the 5 per cent level. The R^2 obtained is not so high. In cross-section data it is customery to get low R^2s. This is particularly so while using an abstract production function in an aggregate form. In the present panel data set weightage of cross-section is high. As a first approximation to the problem of technical efficiency, the estimated production function is acceptable.[1]

Elasticities of output with respect to labour capital are found as 0.84 and 0.35 respectively. A linear test for the null hypothesis $\alpha + B = 1$ was undertaken with the OLS estimates and found the null hypothesis could not be rejected.

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1. A more general production function with different types of capital and different types of labour such as : $Q = A.\, K_1^{\alpha_1} K_2^{\alpha_2} \cdots K_{i_2}^{\alpha_i}\, L_1^{\beta_1} L_2^{\beta_2} \cdots L_s^{\beta_s}\, u$ would have yielded better R^2. Hence, low R^2 can be attributed to the inability to distinguish differential impacts of different types of capital and labour. The results point towards the formulation of new questions and hypotheses which require further research.

The sum of labour and capital coefficients (returns to scale) is not significantly different from one. Hence, it can be concluded that the production technology is characterized by constant returns to scale. The evidence revealed the relevance of estimating Cobb-Douglas production function parameters. However, interpreting the sum of labour and capital coefficients as a measure of returns to scale is not quite accurate (Goldar, 1981). Elasticity of substitution is sensitive to specification, method of estimation, data and time period (Nerlove, 1967).

Another reason for selecting Cobb-Douglas production function is its simplicity, comparability and general credibility. Time trend variable introduced in regression allows for exponential technological change at a constant annual rate of 3.78 per cent per annum. The coefficient of time is statistically significant at the 5 per cent level.

Estimates of indices of technical efficiency by ownership and by firm-size are presented in Table 5.1. The analysis suggests variations in technical efficiency among different sectors. The technical efficiency of private sector is the highest (88%) among ownership categories. The least efficient is the co-operative sector with mean technical efficiency of 51%. Among size-categories, the medium-sized mills are technically more efficient than small-sized mills.

Table 5.1

Technical Efficiency Indices of Spinning Mills in Kerala by ownership and by firm-size

Ownership/size	Mean	Standard Deviation	Cases
Private	0.88	0.49	100
NTC	0.81	0.23	40
Co-operative	0.51	0.21	30
KSTC	0.76	0.28	40
Spindle $\leq$ 26,000	0.78	0.31	150
26,000 $\leq$ 50,000	0.80	0.22	60
All units	0.79	0.36	210

The estimates are based on the assumption that 'u' follows a gamma distribution. The intercept term is corrected by adding the variance of error terms 'u'. If a different assumption of exponential distribution is followed, the relative position of mills will remain the same eventhough technical efficiency index varies (Goldar, 1985). The study by

Ramaswamy (1993) also substantiated this argument. Ramaswamy tried four different methods of measuring technical efficiency and found that the relative position of firms remained the same.[1]

Estimates of technical efficiency clearly indicate that private sector mills are relatively more efficient when compared to its public sector counterparts. To test statistical significance, pair-wise Z-test was applied between private and its public counterparts and between small-size class and medium-size class. The results are presented in Table 5.2.

Table 5.2

Estimates of pair-wise Z-tests of indices of technical efficiency

Groups	Computed Z-value	Significant at 5%	10%
Private - NTC	1.14	No	No
Private - Co-op.	5.946	Yes	Yes
Private - KSTC	1.548	No	Yes
Small - Medium	0.52	No	No

1. An alternative method of converting the intercept term of OLS estimate by adding to it the largest error term was also tried. This also led to different estimates of technical efficiency. But the relative position of different mills and different categories remained the same. Hence, the results are not reported here.

The results reveal that there is no statistically significant variation of efficiency with firm-size. There is a statistically significant difference between the mean technical efficiency in the private sector and that for the cooperative sector. Among other ownership categories, the difference between mean technical efficiency of private and KSTC is significant at the 10 per cent level.

There is statistically no significant difference between the mean values of private and NTC sectors. The graphical illustration of technical efficiency is charted out in Fig.6 in Appendix B.

The firm specific technical efficiency indices are given in Table 5.3.

The efficiency index is found 100% in the case of Sri Bhagawathi, Asok Textiles, GTN Textiles and Madras Spinners--all private mills. Some other firms of which efficiency index is found above 90% are Kathayee Cotton Mill, Vanaja Textiles, Prabhuram, Kottayam Textiles and Cannanore Spinning and Weaving Mills. Among the private mills the efficiency index is lowest in the case of Euro Spinners (68%). Trivandrum

Table 5.3

Technical efficiency index of individual spinning mills in Kerala

Sl. No.	Name of the mill	Technical efficiency index	Ownership	Size
1.	Sri Bhagavathi Textiles	1.00	P	S
2.	Asoka	1.00	P	S
3.	Kathai Cotton Mills	0.92	P	S
4.	Raj Gopal Textiles	0.58	P	S
5.	Vanaja	0.99	P	S
6.	Trichur Cotton Mills	0.89	P	S
7.	GTN Textiles	1.00	P	M
8.	Madras Spinners	1.00	P	M
9.	Euro Spinners	0.68	P	S
10.	Thruvepathy Mills	0.69	P	S
11.	Quilon Co-op.	0.51	C	S
12.	Malappuram Co-op.	0.49	C	S
13.	Cannanore Co-op.	0.53	C	M
14.	Trivandrum Spinning Mills	0.59	K	S
15.	Prabhuram Mills	0.94	K	S
16.	Kottayam Textiles	0.90	K	S
17.	Malabar Spinning and Weaving Mills	0.62	K	S
18.	Vijaya Mohini Mills	0.79	N	M
19.	Kerala Lakshmi Mills	0.78	N	M
20.	Alagappa	0.68	N	M
21.	Cannanore Spinning and Weaving Mills	0.98	N	S
All units		0.79		

Note: (1) The very low observed levels of efficiency of mill numbers 11 and 12 can be attributed to its infant industry problems faced during the first half of the period of study.
(2) P - Private, C - Co-operative, K - KSTC, N - NTC, S - Small, M - Medium.

spinning mills with 59% efficiency is the least efficient KSTC mill. Malappuram Co-operative (49%) and Algappa Textiles (68%) are least efficient among cooperative and NTC sectors respectively. There are two 100% technically efficient mills both in small and medium sector. The firm-level survey and investigations conducted give ample proof that the estimated levels of technical efficiency are plausible even though measurement error and data difficulties necessitate qualification in interpreting empirical results.

5.7 SOURCES OF TECHNICAL EFFICIENCY: EMPIRICAL RESULTS

The data set collected provides substantial information on a number of enterprise characteristics which might be related to the level of technical efficiency. Table 5.4 reports the results of attempts to explain variations in relative technical efficiency in terms of qualitative and quantitative variables.[1]

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1. Page Jr (1980) analysed four variables to explain variations in technical efficiency across three Ghanaian industries. Page (1984) analysed ten explanatory variables for this exercise in the case of four Indian industries. Pitt and Lee (1981) examined three firm characteristics to investigate the sources of technical efficiency.

Table 5.4

Determinants of Technical Efficiency: Regression Results[1]

Number of observations = 210 Dependent variable = Log (TE)

Explanatory variables	Regression coefficient	Computed t-value	Significant at 5%	Significant at 10%	Sign of regression Expected	Sign of regression Obtained
X_1	-0.364011	-2.88	YES	YES	-ve	-ve
X_2	0.630297	3.97	YES	YES	+ve	+ve
X_3	0.391436	2.71	YES	YES	+ve	+ve
R^2	0.60					
D.W.	1.914					

X_1 : Dummy variable = 1 for firms having no modern well equipped Research and Development (R&D) Department

X_2 : Capacity utilization

X_3 : Wage rate

1. The equation is linear and was estimated by OLS. The dependent variable is the firm specific index of technical efficiency derived from Cobb-Douglas production function.

The regressions are relatively successful in explaining variations in technical efficiency. To test the importance of Research and Development (R&D) as determinants of technical efficiency, mills in the sample were classified into two groups, those with well equipped R & D facility and those with poor or no R & D facility. A dummy variable, assigned the value of one for those in the latter group was introduced into the regression with the prior expectation that lack of R & D facility would be negatively correlated with the level of technical efficiency. The coefficient obtained is of expected sign and significant at the 5 per cent level.

The level of capacity utilization was included in the analysis to test the influence of spindle utilization. The expectation was that the sign of the regression coefficient would be positive. The result obtained shows that capacity utilization is positively correlated with technical efficiency and statistically significant at the 5 per cent level.

Wage rate was the third explanatory variable used to test its influence on technical efficiency. It had been computed by dividing total wage bill by total number of employees. It is assumed that higher the wage rate more will be the efficiency in the utilization of labour and other factors of production. It is seen from the estimated result that regression coefficient is positive as expected and statistically significant at the 5 per cent level.

More variables were regressed to measure the sources of technical inefficiency. But the results revealed weak relationship and statistically insignificant.[1]

5.8 DUMMY VARIABLE ANALYSIS

Inter-sectoral differences in total factor productivity (TFP) are analysed with the help of dummy variables using Cobb-Douglas Production function. The estimates of parameters are presented in Table 5.5.

Table 5.5

Least squares estimates of the Cobb-Douglas Production Function with dummy variables

Variables	Regression Coefficient	Computed t-value	Significant at 5%	10%
Intercept	-3.218	-4.356	Yes	Yes
Log K	0.828	3.037	Yes	Yes
Log L	0.382	2.450	Yes	Yes
Dummy Co-op.	-0.561	-3.973	Yes	Yes
Dummy KSTC	-0.183	-1.855	No	Yes
Dummy NTC	-0.220	-1.965	Yes	Yes
Dummy small	-0.134	-1.230	No	No
R^2	0.575			
D.W.	1.868			
Cases	210			

1. Some such explanatory variables tested were capital intensity and assets per spindle. These variables were subsequently dropped from the equation.

The coefficients of sectoral dummy variables give the level of efficiency vis-a-vis the excluded category, co-operative sector is 56% less efficient than private sector (excluded category); KSTC 18% and NTC 22% less efficient than private sector. The coefficient of small sector is -0.134 which shows that small mills are 13.4% less efficient than medium mills (excluded category).

5.9 CHARACTERISTICS OF FRONTIER FIRMS (BEST PRACTICE FIRMS)

Firm-specific efficiency index of four firms is 1 obtained by the ratio of its observed output to the maximum producible output. These firms are termed as frontier firms or best practice firms. Table 5.6 provides some descriptive

Table 5.6

Characteristics of Best Practice Firms: Pooled Cross-Section and Time-Series Data: 1982-83 to 1991-92

Type of firm	LP_1	LP_2	KP	KL	GPM	CU(%)
Best practice firms	0.301	2.910	0.304	1.38	15.02	87.74
Private	0.271	2.691	0.291	0.98	8.86	77.06
NTC	0.204	1.756	0.359	0.61	6.21	80.78
Co-operative	0.127	1.981	0.194	0.80	5.09	56.78
KSTC	0.169	1.517	0.331	0.55	0.13	64.76
Spindle $\leq$ 26,000	0.206	2.191	0.290	0.80	5.06	69.46
26,000 $\leq$ 50,000	0.247	2.181	0.318	0.81	8.91	80.16

statistic of these best practice firms and compares them with the average of all other group of firms.

The firm-characteristics reveal that the best practice firms are ahead of all other groups in terms of all efficiency indices presented except in capital productivity. The capital productivity though not very low, we would however realize that it is not sufficient when compared to gross profit margin earned by these groups. This may be the result of high capital intensity or due to errors in measurement of capital.

In five of the high profit mills selected for study, four firms were having technical efficiency equal to one. Another feature noticed is that the least efficient category (co-operative) is having very low capacity utilization percentage. Another noticeable feature is that even though KSTC is more efficient than NTC mills (Dummy variable analysis) the gross profit margin is relatively very low in KSTC group of mills. This can be considered as evidence of substantial X-inefficiency. A well equipped research and development department is found as another characteristic of all best practice firms. In many of the mills in Kerala, traditional method of quality testing is another most unsatisfactory feature. These firms are having comparatively low technical efficiency (eg. Raj-Gopal and Thiruvepathy mills).

High technical inefficiency has important implications for policy framework. Increased output gains can be realised through increase in technical efficiency for firms operating below 'best practice' spinning mills. As suggested by the results if public sector units tend to be less efficient, direct government measures should be undertaken to improve its technical efficiency. Since the estimates indicate substantially lower inter-firm variation in majority of the cases measures to shift the frontier itself through modernization and technological upgradation is highly warrented.

5.10 PRODUCTIVITY DEPRESSING FACTORS

The overall effects of technical change in spinning mills cannot be estimated since data over time were not available. Firm level interview conducted helped to elicit important factors retarding production as a result of slow technical change.

Majority of the spinning mills in Kerala have adopted an intermediate technology--a mix of semi-modern with modern technology, while a very few mills have started shifting from modern technology to best practice technology of international standard. Technology of international standard is by and large absent in Kerala.[1]

Three important operating characteristics which shift production function downward were empirically analysed by Pack (1987). He described the functional relation in the form of an equation:

$$Q = \frac{R}{T} e$$

The output per spindle hour of a given count of yarn; Q, depends on the speed; R, at which spindle rotates per minute, the number of twists, T, inserted per inch, and the hourly rate of spindle utilization, `e' ie., machine or spindle efficiency.

Information gathered from firms reveals the position of spinning mills in Kerala. The important productivity depressing factors are detailed below.

Speed

The speed at which spindle rotates is lower in almost all mills surveyed. For each mill, the speed in revolutions

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1. For a detailed discussion of traditional and modern technology see Pickett and Robson (1981). Details of emerging trends in spinning machinery of international standard are explained by Doraiswamy and Chellamani (1992).

per minute for different counts of yarn is compared with the desirable speed fixed by SITRA. The rpm of 40s count is as low as 10,000 in certain mills while SITRA standard is 14,400 (SITRA standard in Appendix C-2).

The speed is found lower mainly because of inadequate maintenance, greater yarn breakage and objection from workers. Improper plant lay-out, lack of good humidification plant, technological obsolescence, poor raw material quality are the main reasons of increased breakage.

The lower speed can be mainly attributed to technical and managerial inefficiency (x - inefficiency). No mill surveyed is found reducing speed to economize electricity. Mills are not resorting to scientific study regarding the relationship between speed, breakage rate, output and electricity consumption given the vintage and design of firm level plants. They are found simply relying SITRA standard evolved on the basis of vintage and design of best-practice plants.

Twist Per Inch (TPI)

Higher than normal twists are found inserted in most of the plants simply to compensate poor quality in cotton. The increase in twist per inch is also due to deficient blending and back process. In some mills, the tpi of 40s carded count is as high as 28.76 while SITRA specification is only 26.56. This increases cost of production, reduces output and adversely affects the profitability position.

Some plants are found increasing tpi due to stiff objection from workers as a result of increased breakage. The customers in the local market are not specifying tpi, while customers in the international market specify required tpi of each count. This creates problem to catch international market for plants deviating from best-practice standards.

A major defect of SITRA standards is that it is solely based on production per spindle shift and not on value added or economic efficiency. The loss in quantity due to reduction in spindle speed and maintaining tpi as per customer requirements can be well compensated by high quality and increased value addition.

Spindle Efficiency

Machine or spindle efficiency indicates the percentage of each hour during which spindle works without interruption. Frequent interruptions are found in most of the mills due to a variety of reasons. Hence, idle spindle is observed in many units mainly due to following reasons.

1. Spindle tape
2. Ring defect
3. Top roll short
4. Apron cut
5. Roving bobbin runout
6. Separators

In addition to this, spindle utilization may be affected by time taken to repair broken end, for doffing, replacing bobbins and other usual factory interruptions, and labour inefficiency. Idle spindle percentage is fixed as 0.1% by SITRA. But it goes upto 5% or even more in very poor performing firms.

Frequent alteration of machine setting due to change in counts spun is common in public sector mills. This significantly affects productivity. The remedy is to limit production to certain specified counts which can be spun economically. Increased product diversity will result only in increased cost.

Among many other reasons, one of the main reasons for low spindle speed, high twist per inch and low spindle efficiency is due to deviation from best-practice technology.

Chapter VI

CAPACITY UTILIZATION

6.0 This chapter deals with the measurement of capacity utilization with the identification of factors influencing capacity utilization. The analysis is carried out separately for all the sectors under study and for industry as a whole. The analysis of capacity utilization is based on the installed capacity. Important factors influencing capacity utilization are identified and Kendall coefficient of concordance is applied to judge the significance in agreement in ranking by different judges.

6.1 CAPACITY UTILIZATION

Maximum utilization of scarce capital resources in an under-developed country like India is of great importance. Under-utilization of capacity is a national waste, and one can seldom afford it. Increased or fuller capacity utilization can be taken as an important indicator of efficient running of an enterprise. Better utilization of existing capacities will bring down the existing capital-output and labour-output ratios. This will also lead to lower cost and higher profitability.

Utilization of installed whether in private firms or in public firms, small or big in size, is perhaps the largest single important indicator of their operating efficiency. So production below capacity or sub-optimal utilization is considered a luxury in a capital scarce country like India. The accelerated growth depends on sustained creation of capacity and optimum use of machinery and equipment already installed.

"There are few words capable of covering more meaning than capacity. The deceptively simple term 'capacity' has been much discussed, too frequently misunderstood and conjures up different images to different people both in the industry and outside the industry" (Hari, 1975). Hence the first requisite is to specify the objectives and conditions of each study. According to Bergstrom (1973), "Capacities may be defined with reference to product lines and technical characteristics as well as inter-relationships among various machine groups". Karim and Bhide (1975) put it in a different way. According to them, the fundamental meaning of the word capacity is the output expectations from the production enterprise vis-a-vis investment input. It is said that capacity is a measure of the expectations of the investor from the productive capital sunk into the making of the enterprise/unit. Productive capacity is also defined as the maximum output that can be produced with the current stock of plant and machinery.

6.2 MEANING OF CAPACITY CONCEPT

Capacity refers to "the potential output per unit of time that a plant can yield under given processes and conditions" (Budin and Samuel Paul, 1961). Capacity utilization refers to total capacity utilized for production of required goods and services. It is expressed as a percentage of actual production to the 'capacity' and is mathematically expressed as:

$$\text{Capacity utilization (in per cent)} = \frac{\text{Actual production}}{\text{'Capacity'}} \times 100$$

The time horizon for determination of capacity utilization is usually taken as one year. One has to distinguish between different types of 'capacity' concepts currently used such as: licensed capacity, designed capacity, installed capacity, rated capacity, achievable capacity, attainable capacity and available capacity.

Licensed capacity is the capacity for which a firm has obtained a licence as per government rules and regulations. Designed capacity refers to the specification of capacity as designed by the manufacturer or supplier. Installed capacity refers to the maximum possible output which can be produced by the plant once it is properly installed according to specifications. This installed capacity may or may not be equal to licensed or designed capacities.

Rated capacity is usually identified with installed capacity. But due to climatic conditions, or environmental constraints and conditions peculiar to a firm or an area it may not be possible to achieve that level of output which is expected. Hence rated capacity is the maximum possible output which a plant is capable of producing under given conditions.

The ideal condition prevailing in a plant may be undermined due to certain unforeseen and uncontrollable factors affecting the potential capacity. The maximum possible output under changed circumstances is called the attainable capacity.

However, even attainable capacity may not be available for certain period of time due to factors such as non-availability of power, feed stocks, spares etc. These factors temporarily affect the potential output and as a result available capacity will be less than attainable capacity.

Kale (1975) mentioned conditions of capacity utilization more than 100 per cent. It was quite possible that the utilization could be greater than 100% if the time horizon was taken as a day or a week or a month. This might be due to favourable conditions of operations existing during the period under review. The capacity utilization figures even for the year could be greater than 100 per cent by bettering on the down-time and stoppages provided for in the basic assumptions. MOre than 100 per cent capacity utilization figures had been possible though some of the innovations and other production facilities and improvement strategies were used internally by the management.

"The unit chosen for capacity is generally such that a physical measurement of the unit which is convenient and accurate under industrial operating conditions. It will also depend upon the type of product, ie., whether it is a solid, liquid or gas, whether it is to be measured in tonnes, kilograms, litres, m^3 or simply numbers", (Kale, 1975).

Some of the important methods of calculating capacity utilization are given below:

Wharton Index Method

This method is based on the time series of output developed by Klein and Summers (1966) of the Wharton School. The peak outputs are identified from time series. The capacity output between the peaks is estimated by joining successive peaks by a straighline and so it is called the Trend Through Peaks Method. Capacity utilization is obtained as a ratio of actual output to potential output.

This approach faces some practical problems. The peaks identified may not truly reflect capacity output of the industry. It may represent less than full capacity, the result is lower than true peaks will be identified. The capacity expansion may not take place in a smooth and gradual manner as the Trend Through Peak Method presupposes.

Minimum Capital-Output Ratio

Capacity utilization is measured on the basis of minimum capital output ratio by the National Conference Board of the US. Fixed capital output ratios are estimated in terms of constant prices. On the basis of the observed lowest capital output ratio, a bench mark year is selected, along with other independent evidences. The lowest observed capital output ratio is considered as capacity output. As per this method, capacity utilization can be measured as follows:

$$U = \frac{O}{\hat{C}} \times 100$$

$$\hat{C} = \frac{C}{(C/O)\ \text{min.}}$$

where U = capacity utilization

O = gross value added

$\hat{C}$ = estimate of capacity

C = gross fixed capital

(C/o) min = minimum capital output ratio.

The estimate of capacity is obtained by dividing gross fixed capital stock by minimum capital-output ratio. The utilization rate is given by actual output as a proportion of the estimated capacity. The success of this method depends on how far one is able to measure capital accurately.

Maximum Output per Spindle

Capacity utilization can be measured on the basis of maximum output per spindle over the period· 'capacity' and 'output' are not measured in common units and hence production per spindle is calculated on the basis of production and installed capacity. Several local maximum outputs per spindle are identified and carefully examined in relation to growth of spindles. The estimate of capacity output is equal to maximum output per spindle multiplied by the total number of spindles. Actual output as a proportion of capacity output gives the rate of capacity utilization. But the main problem encountered is the non-availability of reliable capacity data.

Measures Based on Machine Hours

The capacity utilization in the cotton textile industry has been estimated by the National Productivity Council on the basis of machine hours. The total number of machine hours is to be obtained by the total number of spindles existing in the year multiplied by 24 (ie., 3 shifts of eight hours each). This represents capacity of the mill. The actual number of machine hours worked is estimated by the number of spindles which actually worked during the year in each shift multiplied by 24 which is the standard work hour of three shifts in a day.

Survey Method

Gokhale Institute of Politics and Economics and National Council of Applied Economic Research (NCAER) conducted surveys for estimating the rate of utilization of capacity in Indian Industries. The survey provides a measure of the extent to which businessmen can increase their output with given questions regarding capacity in terms of physical volume, rate at which companies are actually operating at the end of the year and at the rate at which companies would prefer to operate. The surveys take the form of questionnaire filled in by the businessmen and hence get its own drawbacks of personal prejudices creeping in and also with judgements regarding 'normal' or maximum capital output.

The RBI Index

The RBI index of Potential Utilization is a modified version of the Trend Through Peak Method. The RBI index takes monthly output of locating peaks and treat monthly peaks as potential output of each year. Since these monthly indices of output are not deseasonalized, annual peak is considered in the case of sugar, tea and salt to indicate potential output.

Different measures of 'capacity' suggest different conceptual base and different data requirement. The choice of appropriate measure of capacity utilization depends on the purpose of study and the availability of data.

6.3 METHODOLOGY ADOPTED IN THE PRESENT STUDY

The analysis of capacity utilization in the present study is based on the installed capacity which is the plant concept of capcity.

Plant capacity is determined by the number of days to be worked in an year, number of shifts in a day, number of hours in a shift, and output per hour per shift etc. The installed capacity is based on the spindles installed (commissioned) and spindle shifts to be worked. The spindle shift to be worked is estimated by the number of spindles multiplied by the shifts to be worked. The actual spindle shift worked is estimated by number of spindles which actually worked multiplied by the shifts worked. The rate of capacity utilization is given by the ratio of actual spindle shift worked to total spindle shift to be worked

$$\text{Capacity utilization} = \frac{\text{Spindle shift worked}}{\text{Spindle shift to be worked}} \times 100$$

The difference between the spindle shift to be worked and spindle shift worked is spindle shift lost. The concept of spindle shift is appealing not only because it is homogeneous but also because it is a physical measure. But it assumes that the efficiency of the spindles in the year 1982-83 is same as in 1991-92. It also assumes that the efficiency is same between different types of spindles.

6.4 EMPIRICAL FINDINGS

Table 6.1 presents inter-sectoral differences in capacity utilization by ownership. Sub-period estimates of average for the first half show high utilization percentage in

Table 6.1

Estimates of capacity utilization percentage by ownership: 1982-83 tods 1991-92

Year	All units	Ownership			
		Private	NTC	Co-operative	KSTC
1982-83	67.24	70.92	73.81	49.45	64.81
1983-84	62.47	73.00	58.79	47.64	50.68
1984-85	70.59	75.09	81.77	44.32	67.84
1985-86	76.44	83.43	87.25	45.94	71.03
1986-87	69.41	74.31	82.67	50.63	60.39
1987-88	68.98	78.47	74.72	52.44	54.25
1988-89	70.72	69.21	87.52	63.65	62.97
1989-90	78.06	79.61	87.23	76.61	65.73
1990-91	81.59	84.56	86.15	72.97	76.04
1991-92	80.07	82.03	87.91	72.83	72.77
Quinquennial averages					
1982-83 to 1986-87	69.23	75.37	76.86	47.60	62.95
1987-88 to 1991-92	75.89	78.78	84.71	67.70	66.35
Decennial average					
1982-83 to 1991-92	72.56	77.06	80.78	56.78	64.76
Number of cases	21	10	4	3	4

NTC groups and private mills. Co-operative and KSTC show lower utilization, the reason is evident. Sub-period capacity utilization average during the period from 1987-88 to 1991-92 shows an increase in all sectors along with industry average. Average for the whole period also shows that NTC mills are far ahead of all other sectors in the average rate of capacity utilization. KSTC mills are on the average using only 64.76 per cent of capacity utilization and co-operative mills show a poor performance with a capacity utilization of 56.78 per cent.

A look at the year to year variation shows that there are wide variations in utilization percentage in co-operative and KSTC sectors, while the range of variation is comparatively lower in private sector followed by NTC sector. Estimates also reveal more than 80 per cent capacity utilization in private and NTC sectors alone. This is a clear indication of already existing better capacity utilization in these two sectors. Average capacity utilization of all the years in co-operative and KSTC sectors is also found below industry average while NTC and private mills have capacity utilization percentage above industry average.

Table 6.2 presents inter-sectoral differences in capacity utilization by firm-size. Sub-period estimates of two periods and for all the years show that medium sized mills

Table 6.2

Estimates of capacity utilization percentage by firm-size: 1982-83 to 1991-92

Year	All units	Size	
		Spindles ≤ 26,000	26,000 ≤ 50,000
1982-83	67.24	63.17	77.40
1983-84	62.47	59.93	68.80
1984-85	70.59	66.72	80.24
1985-86	76.44	73.11	84.75
1986-87	69.41	65.94	78.07
1987-88	68.98	68.33	70.47
1988-89	70.72	66.10	82.25
1989-90	78.06	74.51	86.35
1990-91	81.59	79.62	86.49
1991-92	80.07	77.37	86.82
Quinquennial averages			
1982-83 to 1986-87	69.23	65.77	77.85
1987-88 to 1991-92	75.89	73.19	82.48
Decennial average			
1982-83 to 1991-92	72.56	69.46	80.16
Number of cases	21	15	6

are much above small sized mills. Average capacity utilization of all the years shows that medium sized mills have 11 per cent more utilization than small sized mills. Small sized units' capacity utilization percentage for the two sub-periods as well as for the whole period shows utilization is less than industry average. Medium sized mills with more than 26,000 spindles have capacity utilization percentage above industry average for all the years as well as for two sub-periods.

A look at the year to year figures also reveals less variation in medium sized mills ranging between 68 to 86 per cent whereas it is between 59 and 79 in small mills with less than 26,000 spindles. The overall trend is bigger the units more will be the capacity utilization percentage.

Estimates of indices of capacity utilization and trend growth rates by firm-size during the period from 1982-83 to 1991-92 are given in Table 6.3. Comparison of terminal years show a rising trend in capacity utilization in all sectors. The trend growth rates are also positive in all sectors. Small sized mills with a trend growth rate of 2.48 rank first. The medium sized mill were having comparatively higher utilization per cent throughout the period of study than small mills. Hence, the scope for further improvement is

Table 6.3

Indices of capacity utilization percentage by firm-size: 1982-83 to 1991-92

(1982-83 = 1.00)

Year	All units	Spindle size	
		Spindles ≤ 26,000	26,000 ≤ 50,000
1982-83	1.00	1.00	1.00
1983-84	0.929	0.949	0.889
1984-85	1.050	1.056	1.037
1985-86	1.137	1.157	1.095
1986-87	1.032	1.044	1.009
1987-88	1.026	1.082	0.911
1988-89	1.052	1.047	1.063
1989-90	1.161	1.180	1.116
1990-91	1.213	1.260	1.117
1991-92	1.191	1.225	1.122
Growth Rate			
Terminal years	19.1	22.5	12.2
Trend growth rates	2.25** (0.006)	2.48** (0.066)	1.70 * (0.007)

Note:-

$LnCU = A + B_t + e$ (Trend equation of capacity utilization).

** Significant at 5% probability level.
* Significant at 10% probability level.
Figures in parentheses represent standard error.

limited. This may be the reason for low terminal year growth rate as well as low trend growth rate in the case of medium sized mills. The estimate of trend growth rate of small mills is statistically significant at the 5 per cent probability level. The trend growth rate of industry as a whole is also statistically significant at the 5 per cent level.

Indices of capacity utilization and trend growth rates by ownership for different years during 1982-83 to 1991-92 are presented in Table 6.4. The trend growth rates show co-operative and NTC units stand top with a rate of 6.20 and 2.72 per cent respectively. But a relatively consistent growth of capacity utilization was witnessed only in private sector. The reason for this may be attributed to the fact that private sector was already maintaining sufficiently higher rate of capacity utilization even during the beginning period of study.

NTC sector shows a better capacity utilization when compared to all other sectors. The trend growth rate of 2.72 shows its superiority over all other sectors. The higher growth rate achieved by co-operative sector is merely due to a jump from initial very low capacity to reasonably good utilization in subsequent period. This is clearly supported by the fact of 47.3 per cent terminal growth rate. The

Table 6.4

Indices of capacity utilization percentage by ownership: 1982-83 to 1991-92

(1982-83 = 1.00)

Years	Ownership				
	All units	Private	NTC	Co-operative	KSTC
1982-83	1.00	1.00	1.00	1.00	1.00
1983-84	0.929	1.031	0.797	0.963	0.782
1984-85	1.050	1.059	1.108	0.896	1.047
1985-86	1.137	1.176	1.182	0.929	1.096
1986-87	1.032	1.048	1.120	1.024	0.932
1987-88	1.026	1.107	1.012	1.061	0.837
1988-89	1.052	0.976	1.186	1.287	0.972
1989-90	1.161	1.123	1.182	1.549	1.014
1990-91	1.213	1.192	1.167	1.476	1.173
1991-92	1.191	1.157	1.191	1.473	1.123
Growth Rates					
Terminal years	19.10	15.70	19.10	47.3	11.23
Trend growth rates	2.25** (0.006)	1.28 (0.007)	2.72** (0.012)	6.20** (0.012)	1.97 (0.013)

Note:-

Ln CU = A + B_t + e (Trend equation of capacity utilization).

** Significant at 5% probability level.
* Significant at 10% probability level.
Figures in parentheses represent standard error.

estimates of trend growth rates of NTC and co-operative sectors are significant at the 5 per cent level.

6.5 CHARACTERISTICS OF HIGH PROFIT MILLS

Estimates of capacity utilization of high profit mills (mills earning net profit in almost all the ten years under study) are presented in Table 6.5. High profit mills are having very high capacity utilization of 87.85 per cent while the average of all other units is only 67.71 per cent. The comparatively good industry average is mainly due to the influence of high profit mills.

Estimates presented in Table 6.6 compares the mean capacity utilization of high profit mills with that of all other groups.

Table 6.5

Capacity utilization percentage of high profit mills: Pooled cross-section and time-series data: 1982-83 to 1991-92.

	Capacity utilization	Cases
High profit mills	87.85	50
Other mills	67.71	160
All units	72.55	210

Table 6.6

Inter-sectoral differences in capacity utilization (percentage) by ownership and by firm-size, compared with high profit mills: pooled time-series cross-section data from 1982-83 to 1991-92

Ownership/size	Capacity utiliza-tion (%)	Std.Dev.	Cases
Private	77.06	16.70	100
NTC	80.78	10.14	40
Co-operative	56.78	20.58	30
KSTC	64.76	9.84	40
Spindle ≤ 26,000	69.46	17.03	150
26,000 ≤ 50,000	80.16	15.60	60
High profit mills	87.85	6.12	50
All units	72.55	17.29	210

The mean capacity utilization of high profit mill is significantly above all other groups at the 1 per cent level.

It is observed that there are perceptible differences in capacity utilization among different groups of mills. Private mills, NTC mills and mills under spindle size group 26,000 to 50,000 have capacity utilization more than 75 per cent. The capacity utilization percentage of NTC group of mills is 80.78 per cent. The capacity utilization is lowest in the case of co-operative mills with 56.78 per cent. The KSTC mills rank third in the case of capacity utilization.

Among the size categories, it is evident that the capacity utilization increase with size. Medium sized mills are found 10.70 per cent higher than that of small sized mills in capacity utilization. The graphical illustration of capacity utilization by ownership and by firm-size is charted out in figure 7 in Appendix B.

There is a tendency of capacity utilization to rise with size. The mean capacity utilization of medium size class is significantly above small size class at the 5 per cent level of significance. But the difference between means in private and NTC sectors are not statistically significant even at the 10 per cent level. There is, however, a significant difference between the mean values of private and other ownership categories.

The mean capacity utilization of private is significantly above co-operative and KSTC sectors at the 1 per cent level. The mean capacity utilization of high profit mill is significantly above all other groups at the 1 per cent level. The standard deviation of high profit mill is also the lowest while co-operative sector has the highest standard deviation.

6.6 EXPLANATION FOR THE UNDERUTILIZATION

There are innumerable factors which cause underutilization of capacity in a firm or in an industry. In most of the studies, the factors which affect underutilization are detected as power shortage, transport bottlenecks, industrial unrest, shortage of raw material, lack of demand and a market structure. The factors which affect underutilization of capacity are broadly categorized as follows by Singh (1975).

1. Factors which affect the industry as a whole such as power shortage, transport bottlenecks, licencing policies, law and order situation etc.

2. Those, whose impact is normally restricted to a particular industry, viz. (a) demand factors like lack of demand, uncertainties in demand estimation, price control etc. and (b) supply factors like shortage of raw materials, labour trouble, gestation period etc.

In addition to these there are also certain internal engineering factors affecting capacity utilization.

SITRA (Ratnam, 1992) study reveals some important factors which affect spindle utilization. In Kerala, in some mills there existed only 6 working days in a week years back. Mills not working 7 days in a week and 24 hours in a day contributed mainly to loss in spindle utilization. Other reasons cited are shortage of workers, back stuff and spares, strikes, lock-outs and power failure.

A study conducted by All India Federation of Co-operative Spinning Mills Ltd. (Spinner's Year Book, 1993) reveals the major factors affecting capacity utilization of spinning mills. The study divides mills into two groups--Group A and Group B. The major factor which affects group A mills is power failure (3.24%) while it is shortage of workers (8.78%) in the case of group B mills. The loss in utilization due to power failure in group B mills is 5.18%. The results are presented in Table 6.7.

Capacity utilization of group A mills is 86.85 per cent while it is only 65.27 per cent in the case of group B mills.

The present study collected details regarding reasons for underutilization from a sample of one mill each from each category. The data collected reveal reasons for spindle underutilization for one month.

The capacity utilization percentage and spindle stopped reasonwise are given in Table 6.8. The major reason which influences spindle utilization is shortage of workers or absenteeism. The rate of absenteeism increases depending on the working condition, climate, season (eg. festive season) etc. Power failure is another major determinant. The rate of power failure also increases in summer season when load shedding and power cut are common in Kerala.

On the basis of information collected along with details gathered from floor level interview nine important determinants of capacity utilization are framed. A schedule (Appendix D-3) has been prepared accordingly and production

Table 6.7

Loss in capacity utilization of impressive performance mills and poor performance mills in the year 1991-92

		Group A	Group B
1.	Capacity utilization %	86.85	65.27
2.	Loss in utilization due to		
	i) Power cut/failure	3.24	5.18
	ii) Shortage of back process	0.70	3.08
	iii) Shortage of raw material	1.27	3.45
	iv) Shortage of workers	2.26	8.78
	v) Shortage of stores/spares	0.20	0.40
	vi) Strikes/lockouts	0.50	2.14
	vii) Not working 365 days and 24 hours	3.01	7.38
	viii) Miscellaneous	1.97	4.32
	Total	13.15	34.73

Table 6.8

Average spindle utilization (in percentage)
of a sample of six mills for one month

Shifts to be worked	90
Shifts worked	90
Spindles to be worked	2265480
Spindle worked	1919550
Spindle shift lost	345930
Capacity utilization (%)	84.73
Non-utilization of capacity (%)	15.27
Total	100.00

Spindle stopped reason-wise:

1. Absenteeism/short	128681	(5.68%)
2. Power failure/cut	40690	(1.79%)
3. Repair/mechanical	17108	(0.75%)
4. Repair/electrical	1200	(0.05%)
5. Maintenance	10270	(0.45%)
6. Count change	1075	(0.04%)
7. E.B.S.	12895	(0.56%)
8. Cleaning	11377	(0.50%)
9. Doffing delay	5182	(0.22%)
10. Lapping	314	(0.01%)
11. Others	73765	(3.27%)
12. B.S.S.	12147	(0.53%)
13. Overhauling	29615	(1.30%)
14. Miscellaneous	1611	(0.07%)

manager has been asked to rank reasons for capacity utilization on the basis of importance from all the 21 mills under study. To determine the degree of association among production managers (judges) Kendall coefficient of concordance is used. The value obtained, i.e. W 0.150 shows that there is significant agreement in ranking by different judges at the 5 per cent level of significance.

The production managers (judges) were found applying the same standard in ranking the reasons for underutilization. As suggested by Kendall, the best estimate of the true rankings is selected by the order of the various sums of ranks. The best estimate is related to the lowest value observed among R_j (sum of ranks). The lowest value observed among R_j suggests that the most important reason for underutilization in spinning mills in Kerala is due to "Absenteeism" or technically called "Want of Hands".

Another alternative method of weighted average ranking is also applied to determine the order of ranking. Both the methods yielded the same result. The reasons which influence capacity utilization are given by the order of ranking.

1. Want of Hands
2. Power problems
3. Unscheduled breakdowns
4. Old and obsolete machinery
5. Strained employer-employee relation
6. Raw material shortage
7. Sick units
8. Managerial shortcomings
9. Demand deficiencies

The low capacity utilization is mainly due to the factors mentioned above. Managements of the units can improve the position by viewing this factors seriously and applying necessary corrective measures. The factors which affect capacity utilization are analysed in depth.

1. Absenteeism

Absenteeism also called want of hands is the major problem in all the spinning mills. It is considered to be a common phenomenon. The working condition in cotton textile mill is such that normally labourers will find it very difficult to work twenty-six days in a month excluding four off days. The rate of absenteeism is very high during festival seasons, rainy seasons and summer seasons. 'Sound', 'dirt' and 'heat' inside the factory are unbearable to a worker put in 8 hours work in a shift. Dust control measures and humidification plant are not adequate in many of the mills surveyed.

Another reason which promotes absenteesim is 'increased breakage rates' or yarn. This will render piecing difficulty. Normally a worker is expected to piece maximum 20 breakages per hour i.e. 160 breakages per shift. During monsoon, moisture in the air will be very high leading to more yarn breakages. Machine condition also influences breakage rates, i.e. older the machines, the more the breakages. Some mills are forced to spun specified counts using low quality cotton. These low quality cotton may not satisfy all the properties of fibre index quality (FQI), and consequently breakage rate will increase.

In factories where women workers are employed, more male labourers are continuously employed in second and third shifts spreading from 3 p.m. to morning 7 a.m. which is usually inconvenient. To facilitate shift, rotation smooth is thus prevented in such mills and consequently absenteeism increases.

Another feature observed is that generally workers above the age group 45-50, if relieved from major family financial burdens (daughter's marriage, sons get employment etc.) used to abstain from inconvenient shifts, especially night shifts. Increased physical fatigue also compels them to abstain from work.

Modernization, humidification (plant air-conditioning is not feasible in developing countries like India), work-load reduction through automation, effective implementation of dust control measures, wage incentive for maximum work days engaged are some of the remedial measures to reduce absenteeism.

2. Power shortages

Plant level study shows that frequent power failures and acute power shortages have affected production seriously. High cost of generators and high operating cost of diesel generator prevented most of the mills from installing generator. The study shows that there are mills in Kerala where there is no generator. Also mills with 100% generator capacity for production is achieved only by a few mills.

Additional investment and proposals for electrical standardization and purchase of diesel generator will help a lot for reduction of energy consumption and uninterrupted power supply which in turn will result in increased machinery utilization and lower cost of production. Another peculiarity of power position in Kerala is introduction of frequent load-sheddings during peak hours from 6 p.m. to 9 p.m. in summer seasons. Such shortfalls in power besides substantial power cut and power failure usually affect production and consequent loss in capacity utilization. Remedy to this peculiar situation is to be sought at higher levels.

3. Unscheduled breakdowns and old and obsolete machinery

One of the important reasons for low utilization is frequent machinery breakdowns. Old and obsolete machinery will lead to exorbitant energy consumption. It will also affect yarn quality. Incidence of hard waste will be higher and consumption of stores and spares will also go up. All the benefits of high efficiency motors like savings in energy cost, lower load, less noise, longer service life and reduced sensitivity to voltage fluctuations will be lacking if there is no modernization.

In most of the poor performing mills, upkeeping and maintenance of machines have been neglected. This will lead to vicious circle which affects ultimately, utilization, productivity and profit. Consequent erosion in finance will act as an impediment to rehabilitation and modernization. Besides a number of mills having more than 30 years life are found using technology out-dated. New innovations and new technologies introduced are yet align to most of the spinning mills in Kerala. Since modernization is a continuous process, a separate modernization fund is to be set up with an annual investment of four to five per cent of the sales revenue as suggested by SITRA (Ratnam and Indra Doraiswamy, 1992).

SITRA also gives an expression to calculate the economics of modernization. A capital investment would be economical if the sum of the present worth of the income from savings, price changes, tax concessions on depreciation and salvage value of machine less the additional expenses like erection charges, sales tax, conveyance charges etc. exceed capital investment.

4. Strained employer-employee relations

A strong school of thought that prevails today is that strained employer-employee relation is not the reason for capital flight from Kerala. Plant level interview clearly establishes contrary facts. Most of the companies surveyed are found not functioning in different periods varying from one day to several months in an year due to labour strike, and lock-out. The negotiations held with the labour unions in the presence of Joint Labour Commissioner and the management also fail to materialize without delay either due to the adamant stand of the management or of that of labour unions. This completely affects the production programme which results in underutilization and heavy loss.

5. Raw Material Shortage

Raw cotton provides nearly 50 per cent of the total raw materials of the industry. Inadequate supply of raw material is defined as one of the most important factors responsible for low capacity utilization in cotton textile industry as a whole. There is a positive relationship between capacity utilization and raw material availability. Sastry (1984) specified an equation to test this relationship. The equation is as follows:

$$US_t = \alpha_o + \alpha_1 (IY/SY)_{t-1} + \alpha_2 RCA_t + \alpha 3T + \epsilon_t$$

where

US_t = Capacity utilization in spinning at time t

$(IY/SY)_{t-1}$ = yarn stocks to yarn sales lagged one period

RCA_t = raw cotton availability at time t

T = time trend

ϵ_t = disturbance term.

Capacity utilization in spinning mills is explained in terms of stocks of yarn to sales of yarn lagged one period and current raw cotton availability. The spinning mills produce yarn output using the basic raw material of raw cotton. The inventories of yarn to sales of yearn relate to demand variable and raw cotton availability relates to supply variable. The method of ordinary least square was used in estimation. The results showed that lagged raw cotton availability and lagged yarn stocks to current sales appear to be important variables influencing capacity utilization.

Most of the mills in Kerala could not store quality raw materials for uninterrupted working either due to nonavailability of quality materials or due to paucity of funds. This has led to underutilization of capacity.

6. Sick Units

The definition of a sick unit by the Reserve Bank of India is as "one which incurs cash loss for one year and the judgment of the bank is likely to incur cash loss for the current year as well as for the following year and has an imbalance in its financial structure such as current ratio of less than one and worsening debt-equity ratio" (Ratnam and Indra Doraiswamy, 1992).

As per 'Board for Industrial and Financial Reconstruction' (BIFR) a company is identified as sick and viable if

(1) The net worth of the company to be calculated and the accumulated losses should be more than the net worth.

(2) Cash loss for preceding two years should have been incurred.

The sick units are commonly characterized by the symptoms viz., high manufacturing costs, lack of modernization and low fixed assets, paucity of working capital, high idle machine capacity, low sales turnover and inventory of raw material.

The units which are financially unsound especially under inefficient management cannot effectively put the cart right easily. Coupled with this, frequent strikes, lock-outs, clamour for more amenities or to restore lost benefits, obsolescence of equipments etc. will act as an impediment to efficient utilization of capacity. It will lead not only to underutilization of capacity but also to unutilization of capacity.

Measures to help sick mills to recoup to good health and to maintain health in good mills are to be given top most priority by the authorities concerned.

The important signals and symptoms of sickness are

* Frequent breakdown of plant and equipment

* Decline in capacity utilization, technical efficiency, financial ratios, market price of shares, quality of product or service.

* Rising stocks, out-dated products, declining market share and increased customer complaints.

* Poor management like unbalanced top management team, non-participating top management, lack of requisite personnel, poor information and reporting system, inability to respond to changes.

All mills should identify in advance the reasons for sickness and take suitable measures to reduce costs. Special efforts should be made to control cost and to store good quality raw materials. Proper upkeeping of the existing machinery, preventive maintenance and overhauling, high utilization on ring frames, exploiting the scope for increased work are other steps in right direction.

7. Managerial Short-Comings

It is a well-known fact that an effective management can lead even a weak project to prosperity. Ineffective or weak management can transform even a strong project into a weak one. All chances of survival of a firm can be jeopardized by a weak and ineffective management. Hence only with the assured continuity of the experienced management with administrative ability, technical competence, integrity and resourcefulness can lead to high production and better utilization of capacity. The managerial ability of a firm plays a crucial role in the utilization of capacity. Poor technical and operational management will generally lead to

- Improper plant maintenance
- Obsolete technology
- Underutilization of capacity
- Shortage of power
- Non-availability of raw material
- Lack of proper production planning and control
- High material wastage
- Poor labour productivity.

To conclude it must be said that, "the exercise of capacity utilization is a management tool to ensure the optimum utilization of all the resources and hence should be done in a most objective manner. It should neither become a camouflage for inefficiency nor a stick to beat the production personnel" (Hari, 1975).

8. Demand Deficiencies

Low production efficiency can be partly attributed to lack of demand for the year produced. This is especially so in the case of low quality yarn produced. Again it is obligatory and statutory on the part of mills to produce a stipulated percentage of hank yarn to toal yarn production. Export yarns, hosiery yarns and synthetic yarns are exempted from this 'hank yarn obligation'. Hank yarn is demanded only by handlooms whereas bulk order is from powerlooms, and naturally production of hand yarn becomes non-profitable. This naturally affects capacity utilization adversely.

In a world of competition, most of the mills fail to supply yarn of required quality both in the domestic and foreign market. Tough competition from private sector units also poses a danger to poorly performing public sector units. Poor quality of products and an inefficient marketing structure are the main reasons for low demand. Low capacity utilization is an inevitable consequence of low demand.

Chapter VII

ANALYSIS OF PROFITABILITY

7.0 Analysis of productivity and technical efficiency has highlighted the better performance of the private sector over its public sector counterparts. Thus, in this chapter an attempt is made to examine the financial performance of the various sectors.

7.1 CONCEPT OF PROFIT

Profit can be described as the extra gains which any producer or dealer obtains through superior business management. Profits are net income accruing to the owners of a firm after all costs are accounted for. "Historically, the concept of profit has evolved through various stages beginning with the Mosaic laws against usury and developing an ethical ideal of profit during the age of the Greek philosophers. This was succeeded by the Roman concept of customary profit and later, in mediaeval times, by the idea of just profit....In modern theory, profit constitutes what is called a fair rate of return" (Ghosh and Ghosh, 1987).

The prime aim of a business organization is to make profits. It measures the effectiveness and soundness of a business and is the final test of performance. According to the conventional economic theory of the profit maximizing firm, the basic marginal condition for profit maximization is marginal cost equals marginal revenue condition (MC = MR). In the accounting sense, profit is regarded as the revenue realized during the period minus the cost and expenses incurred in producing the revenue.

The use of productivity measures as managerial tools has been made by Professor Bela Gold, with his work on the relationships between various physical and financial ratios (Teague and Eilon, 1973). The ratio in itself is of limited use as a guide to managerial action as its value will never be in the control of an individual manager. Return on investment is taken as a starting point and by dividing assets between departments, the ratio can be used to measure performance. The pyramid of productivity ratios is shown in Fig.7.1. This practical work is advocated by Centre for Interfirm Comparison (CIC), Britain. The CIC is a non-profit making organization established by the British Institute of Management in association with the British Productivity Council. This pyramid management ratios help firms to know how its profitability and productivity are weaker or stronger than its competitors and what specific questions of policy or performance are needed to be tackled if the firm's profitability and productivity are to be raised.

1. OPERATING PROFIT / OPERATING ASSETS

2. OPERATING PROFIT / SALES x 3. SALES / OPERATING ASSETS 3a. OPERATING ASSETS / SALES

4. PRODUCTION COST OF SALES / SALES + 6. DISTRIBUTION AND MARKETING COSTS / SALES

12. CURRENT ASSETS / SALES + 13. FIXED ASSETS / SALES

+ 5. RESEARCH AND DEVELOPMENT COSTS / SALES + 7. ADMINISTRATIVE COSTS / SALES

18. LAND AND BUILDINGS / SALES + 19. PLANT AND MACHINERY / SALES + 20. VEHICLES / SALES

14. MATERIALS STOCK / SALES + 15. WORK IN PROGRESS / SALES + 16. FINISHED GOODS STOCK / SALES + 17. DEBTORS / SALES

8. MATERIALS COST / SALES VALUE OF PRODUCTION + 9. WORKS LABOUR COST / SALES VALUE OF PRODUCTION + 10. OTHER PRODUCTION COSTS / SALES VALUE OF PRODUCTION + 11. WORK SUBCONTRACTED / SALES VALUE OF PRODUCTION

FIG.7.1 PYRAMID OF MANAGEMENT/PRODUCTIVITY RATIOS (AS ADVOCATED BY CIC, BRITAIN)

7.2 RATIO ANALYSIS

"Ratio analysis simplifies, summarizes and systematizes a long array of accounting figures. Its main contribution lies in bringing into bold relief the interrelationship which exists between various segments of business, as expressed through accounting statements, and in avoiding any distractions that may result from an absolute study of accounting information" (Manmohan and Goyal, 1973). Ratio analysis is a widely used tool of financial analysis. It expresses numerical or quantitative relationship between two items or variables. Ratios are calculated by dividing an item of the relationship with other.

Ratio analysis is a tool or technique to understand and interpret balance sheet. It is a kind of statistical yard-stick to measure the efficiency of a company in relation to others in the same field. Thus ratio analysis makes related information comparable. To the management, the analysis is an invaluable guide in the discharge of its basic function of forecasting, planning, co-ordination, communication and control.

"Financial ratios are for a business enterprise what blood pressure, pulse rate, and temperature are for an individual. They are symptoms whereby the state of health of the enterprise may be determined. An analysis of these ratios will reveal whether the financial condition of the enterprise is very strong, good, partly good, questionable or poor" (Foulke, 1961). Ratio analysis helps to evaluate the liquidity, solvency, profitability and turnover position of firms.

There is a total of 77 ratios or more. Important ratios used to interpret the functioning of the company are (1) Liquidity, (2) Activity, (3) Leverage and (4) Profitability.

Liquidity Ratios

These indicate the commercial or short term solvency of a company. That is whether the business has sufficient current assets to meet the current liabilities when the claims arise. The important among them are the (1) current ratio and (2) quick ratio.

Activity Ratios

These ratios indicate how effectively the funds have been utilized in the business. If the business keeps its fund idle, there will not be generation of income. Also it is dangerous to invest without maintaining sufficient balance in the form of cash to meet ensuing eventualities. The liquidity and profitability are therefore need to be properly balanced. The chief ratios under this category are (1) Creditor's velocity; (2) Debtor's velocity; (3) Inventory velocity.

Leverage Ratios

These ratios reveal the relationship between the debts raised by a business unit in relation to its own fund. This is also called the Gearing Ratio, since mathematically a higher return can be achieved by a firm with high debts and low equity than a firm having low debts and high equity level. The main among the ratios in the cateogry are: (1) Debt equity; (2) Equity to block and (3) Debt service coverage ratio.

Profitability Ratios

The profitability ratios are determined to measure the operating efficiency of the enterprise. The ultimate aim of any business unit or manufacturing company is to earn more and more profit. Sales and profit are interlinked, increased sales should yield higher profits. Hence, one of the ways to ascertain the operational efficiency is to express profit in terms of sales.

The optimum utilization of the available resources profitability is indicated by these ratios. An interfirm comparison and industry average for the same firm help in determining the firm's profit, fairly and accurately, in relation to others in the same trade. The important ratios are: (1) Gross profit ratio; (2) Net profit ratio; (3) Operating ratio and (4) Return on investment. These are expressed in percentages.

Gross profit margin is the ratio of gross profits to net sales, expressed as a percentage. It is calculated by dividing gross profit by sales and multiplying the result by 100. Gross profit is taken as the profit before interest, depreciation and taxes. Sales are taken as the net sales ie., sales less excise duty discount and returns. A high gross profit is an indication of good management as it implies relatively low cost of production. "The gross profit margin reflects the efficiency with which management produces each unit of product" (Pandey, 1981). If gross profit margin is lower, it may reflect higher cost of production due to inefficient utilization of resources, over-investment in plant and machinery etc.

If the organization's operational expenses are on the higher side, then the productive efficiency revealed by the gross profit ratio may not be reliable. Hence the need to resort to the net profit[1] ratio. It is the ratio of net

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1. Net profit is arrived at after providing the depreciation but before taxes and development rebate etc.

profit to net sales expressed as a percentage. This ratio is expected to give a fairly accurate estimate of profitability. The ratio will be higher if the operating as well as the manufacturing expenses tend to be lower with increasing sales figure. Progressive increase of this ratio year after year is a good healthy sign. This ratio is also known as margin on sales.

Sometimes the profitability is also measured in terms of manufacturing and operating expenses to sales. This ratio is called operating ratio or operating profit. Operating profit means profit after interest and depreciation but before tax and adjustment of other income. It is gross profit minus interest and depreciation. Operating profit margin is the ratio of operating profit to net sales expressed as a percentage. The ratio indicates the margin left after deducting all expenses of a business, from its sales revenue adjusted for changes in the level of stock.

Return on Assets (ROA)

Return on Assets is a useful capital productivity measure. An organization invests in plant and equipment and machinery and other assets for production and ultimately to earn profit. Therefore, a study whether profit generated commensurate with capital employed is of great importance.

Both as a measure of performance and as a goal, ROA is more significant than such criteria as total profit, gross margin or net profit as a percentage of sales. Return on assets measures the efficiency of utilization of capital invested in business.

Improvement in the productivity of men, machines, and materials should ultimately reflect in a better ROA, which, therefore constitutes a good overall key productivity measure. ROA is widely used as the overall measure of organizational performance.

The return on assets ratio is used to measure the profitability of a firm in relation to investment. It expresses the relation between operating profit and operating assets as a percentage. Operating assets are defined as the total of net fixed assets, capital work-in-progress and current assets.

Return on assets is a measure of the overall efficiency of a business concern. ROA varies directly with the net profit. ROA is higher if net profit is higher. On the other hand, if ROA is low for a given constant turnover, it clearly indicates that the "costs" have gone up and margin has reduced.

Operating Assets Turnover (OAT)

Operating Assets Turnover expresses the relationship between sales and operating assets. It is calculated by dividing sales by operating assets. OAT tells us the relative efficiency with which a firm utilizes its resources to generate output.

Ratios and Their Limitations

The ratio analysis brings out the functional or the structural relationship between various variables of financial statements. In this system of analysis there are some limitations.

While ratios are taken, it is pertinent that the ratio so arrived is compared to an appropriate standard. Otherwise it turns out to be a mere number. The standard will have to be fixed up after observing the "similar lines of business" for a considerable length of time. As such, any decision arrived at on the basis of ratios is only relative interpretation and not an absolute information.

All the terms in the balance sheet are expressed taking money as a common denominator. As such, a suitable allowance for price fluctuations of the commodities is to be made. This is particularly of importance if one compares ratios of different years.

The terms like the gross profit, operating profit, net profits etc. do not have precise definitions and hence different people are likely to compute figures differently resulting in different interpretations.

Some companies resort to "window dressing" particularly in the matter of valuation of assets, which may not be easily detected. This results in misleading results.

The financial statements being prepared as at a particular date or covering a certain period, usually an year, fail to record or reveal the short term fluctuations if any. On account to this, only a broad overall picture of the functioning of the firms may be available but not the actual.

When different methods of accounting are followed in computing depreciation, valuation of assets, writing off bad debts etc., the comparison between two similar units with the help of ratios is tend to be subjective.

The ratios having been so calculated on the basis of previous financial statements, serve only as guides to establish a trend to a reasonable extent and can be considered as clues to the future. Considerable expertise needs to be developed to understand and forecast on the basis of trends and deviations so arrived.

Applications of ratio analysis, are a matter of one's judgement as to how much of significance is to be attached to each ratios, figures or trends observed. Over-employing of ratios is likely to land oneself in confusion. Ratios are not solutions to financial problems and hence cannot be mechanically employed. A sound common sense approach is most essential and cannot have a better substitute.

7.3 INTER-SECTORAL DIFFERENCES IN PROFITABILITY

Inter-sectoral comparisons of profitability are measured pooling cross-section and time-series data and cross-section analysis of three time periods ie., during the beginning period of study (1982-83), mid period (1986-87) and end-period of study (1991-92).

The present study adopts the following profitability[1] ratios.

1. Gross profit margin
2. Cash profit margin

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1. Following Meena Gupta (1989), the present study takes profit at current prices as is the normal practice.

3. Net profit margin
4. Return on assets
5. Operating assets turnover
6. Gross profit per spindle

The operational definition of profit is similar to those of the definitions used by SITRA (various issues) in its analysis of balance sheet of mills for inter-firm comparison. Gross profit is taken as the profit before interest and depreciation. Profit cash is taken as profit gross minus interest, and profit net is taken as gross profit minus interest and depreciation.

Profit gross = Net profit + Interest + Depreciation

Profit cash = Net profit + Depreciation

Measure of spindles is taken as the number of spindles commissioned.[1] Operating assets is taken as the sum of net fixed assets, current assets and work in progress.

The profitability in textile industry is generally low when compared to that in other major industries. The profits of textiles over the past three decades as per the

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1. Installed capacity measure as taken in many studies may affect results since all spindles installed may not be utilized. Hence, installed capacity need not necessarily be equal to commissioned capacity.

Reserve Bank of India Bulletin averaged only 6.1 per cent of sales after depreciation but before interest as against a profit of 9.5 per cent of other industries during the same period. It is therefore imperative for mills to control each and every item of cost to stay competitive, if not to survive (SITRA, 1992)

As per SITRA analysis, a high profit mill earns after providing for depreciation and interest a profit margin of 8 per cent of the sales turnover for an average count of 40s. An average profit mill earns just half of the high profit mill at 4 per cent. The raw material cost relative to yarn sales revenue would decrease and the power cost increases as the count becomes finer, with a net increase in profit margin in finer counts.

7.4 GROSS PROFIT MARGIN

The estimates of gross profit margin by ownership and by size using pooled cross-section and time-series data are presented in Table 7.1. The gross profit margin of the private sector is very high and also above industry average. The NTC mills also earn good gross profit margin next to private mills, followed by co-operative mills. The KSTC mills are in a precarious position earning a gross profit margin of only 0.13. Among size categories, medium mills are earning

Table 7.1

Estimates of gross profit margin by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92.

Ownership/size	GPM	Std.Dev.	Cases
Private	8.86	15.96	100
NTC	6.21	7.95	40
Co-operative	5.09	13.83	30
KSTC	0.13	10.26	40
Spindles ≤ 26,000	5.06	14.84	150
26,000 ≤ 56,000	8.91	9.70	60
All units	6.17	13.64	210

very high gross profit margin and are also above industry average.

The gross profit margin earned by private sector is not statistically different from that of NTC and co-operative sectors. KSTC is the only sector where the gross profit margin is significantly below (at the 5 per cent level) to those of private sector. Across size class the gross profit margin of medium firm size mills is significantly above to small firm size mills.

7.5 PROFIT CASH MARGIN

Estimates of profit cash margin presented in Table 7.2 show that private mills and NTC mills alone are having positive cash profit while co-operative and KSTC mills have only negative cash profit. The negative cash profit is highest in co-operative mills which is due to high interest burden. Steps should be taken to reduce interest obligation at higher levels. Among size categories medium size mills are only earning cash profit. Financial position of small mills is found not sound as that of medium mills in terms of cash profit margin. The negative profit cash margin of KSTC sector and small size mills is also due to high interest burden as per the balance sheet analysis.

Table 7.2

Estimates of profit cash margin by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92.

Ownership/size	PCM	Std.Dev.	Cases
Private	2.00	19.30	100
NTC	0.58	10.11	40
Co-operative	-10.44	19.22	30
KSTC	-6.22	10.84	40
Spindles ≤ 26,000	-3.76	18.69	150
26,000 ≤ 56,000	3.69	10.56	60
All units	-1.61	17.07	210

7.6 PROFIT NET MARGIN

Net profit margin estimates presented in Table 7.3 show that all the mill groups are having negative net profit margin. Co-operative sector is having a net profit margin of -34.03 implying a very high interest and depreciation expenses. Corrective measures are urgently needed in co-operative sector. In spite of very high gross profit margin, the negative net profit margin in private sector may be due to the presence of sick mills.

Table 7.3

Estimates of profit net margin by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92.

Ownership/size	PNM	Std.Dev.	Cases
Private	-2.75	20.78	100
NTC	-3.41	11.20	40
Co-operative	-34.03	59.31	30
KSTC	-11.33	11.58	40
Spindles $\leq$ 26,000	-12.50	33.47	150
26,000 $\leq$ 56,000	-0.37	11.24	60
All units	-9.00	29.36	210

7.7 RETURN ON ASSETS (ROA)

The return on assets ratio is a useful measure of the profitability of all financial resources invested in the firm's assets. Estimates of ROA presented in Table 7.4 show that all groups have negative values. The negative value is highest in the case of KSTC mills. It is also seen that all values except that of private, NTC and medium size mills are less than industry average. This indicates that return on assets

Table 7.4

Estimates of return on assets (ROA) by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92.

Ownership/size	ROA	Std.Dev.	Cases
Private	-.005	.126	100
NTC	-.026	.125	40
Co-operative	-.098	.159	30
KSTC	-.133	.140	40
Spindles ≤ 26,000	-.070	.144	150
26,000 ≤ 56,000	-.014	.121	60
All units	-0.046	.143	210

employed is comparatively lower in co-operative, KSTC and small size mills.

Private mills are using assets more efficiently than all other sectors eventhough the ROA of private sector is -.005. The reason for negative ROA in private sector can be attributed to the presence of sick mills. This is substantiated by the fact that the five high profit earning private mills are having an ROA of 0.059 and net profit of 4.52. (See Table 7.7).

The overall efficiency of KSTC mills, judged on the basis of return on assets, is the poorest among all other categories. This strongly suggests that there is inefficiency of utilization of capital invested and hence does not justify nationalization of sick spinning mills in Kerala.

7.8 OPERATING ASSETS TURNOVER RATIO (OAT)

This ratio helps to measure the efficiency in the utilization of operating assets. A high OAT shows efficient utilization of assets while a low OAT is an indication of inefficient management and under-utilization of assets. The measure of relative efficiency in utilization of operating assets is presented in Table 7.5. The highest operating assets turnover ratio is reported in the case of private

Table 7.5

Estimates of Operating Assets Turnover (OAT) by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92.

Ownership/size	OAT	Std.Dev.	Cases
Private	1.479	0.716	100
NTC	1.171	0.430	40
Co-operative	1.046	0.557	30
KSTC	1.194	0.330	40
Spindles ≤ 26,000	1.326	0.672	150
26,000 ≤ 56,000	1.249	0.420	60
All units	1.304	0.609	210

mills. The lowest ratio is reported in the case of co-operative sector. The mean ratio of private and small size mills alone is reported above industry average.

The operating assets turnover ratio of private sector is significantly above NTC, co-operative and KSTC sectors at the 5 per cent level. But the difference between small size mills and medium size mill in respect of OAT is found insignificant at the 5 per cent level.

7.9 GROSS PROFIT PER SPINDLE

Gross profit per spindle is a good indication of spindle efficiency. More stoppages and frequent count change and decreased spindle efficiency will affect per spindle profit. Estimates of gross profit per spindle are presented in Table 7.6. As per the estimates, private mills are earning

Table 7.6

Estimates of gross profit per spindle by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92.

(Rs. per spindle)

Ownership/size	GPS	Std.Dev.	Cases
Private	328.00	460	100
NTC	150.00	200	40
Co-operative	148.00	240	30
KSTC	19.00	50	40
Spindles ≤ 26,000	175.00	340	150
26,000 ≤ 56,000	295.00	440	60
All units	210.00	380	210

highest profit per spindle. Gross profit per spindle of private sector is significantly (at the 5 per cent level) above to those of all other ownership categories. KSTC mills are earning very low profit per spindle. This can be attributed to the fact that KSTC mills are earning very low gross profit margin when compared to other mill groups (Table 7.1). The performance of KSTC mills is close to the performance of sick mills as per SITRA study. The average gross profit per spindle for the period 1982-88 is only Rs.10/- per spindle, in the case of sick mills (Ratnam, 1992).

Among size categories, medium size mills are performing better than small mills. As size increases, gross profit per spindle also increases, but the increase is not statistically significant at 5 per cent level. Private mills and medium mills alone are having gross profit per spindle higher than industry average.

This estimate suffers a very serious limitation of price deflation. In other measures of profitability ratio both numerator and denominator are measured at current prices whereas in gross profit per spindle, denominator is a physical measure. The same limitation can be seen in various SITRA studies also. There are considerable variations in the profitability of different group of mills. As per the estimates, wide variations in the net profit margin are noticed when compared to variations in gross profit margin. This can be attributed to the fact that there are wide variations in respect of depreciation charges and interest payment. This is because of the varying levels of investment in fixed assets and borrowings. The reported net profit margin is -34.03 in co-operative sectors while it is only -2.75 in private sectors. The interest burden is also found highly influencing cash profit margin of co-operative sectors and KSTC sector, and small units.

This may be due to the fact that these units were excessively depending on debt capital. The internal resource mobilization of two public sector units (i.e., co-operative and KSTC sectors) was found very poor as per balance sheet analysis. This is due to very low general reserve or retained earnings. Unhealthy practice of selling accumulated yarn at reduced rates to meet emergency funds is also found in most of these mills.

7.10 CHARACTERISTICS OF HIGH PROFIT MILLS

Five mills have been identified as earning net profit for most of the years under study barring one or two years. These mills belong to private sector. Some descriptic statistics of important financial variables are estimated and compared with that of industry average.

Table 7.7 presents the characteristics of high profit mills. The gross profit margin of high profit mill is 15.35 while industry average (all units taken for study) is only 6.17. The gross profit of high profit spinning mills over the period of five years from 1977-1981 is 17.1 as per SITRA (1992) studies. The profit cash and profit net of the same period are reported as 13.9 and 10.4 respectively.[1]

Table 7.7

Characteristics of high profit mills: Pooled cross-section and time-series data: 1982-83 to 1991-92.

Number of cases: 50

Variables	High profit mills	Std. Dev.	Industry average	Std. Dev.
Gross profit margin	15.35	7.15	6.17	13.64
Profit cash margin	10.04	6.34	-1.61	17.07
Profit net margin	4.52	5.78	-9.00	29.36
Return on assets	0.059	0.012	-0.046	0.143
Operating assets turnover	1.415	0.378	1.304	0.609
Gross profit (Rs) per spindle	500.00	450	210.00	380

1. The period of SITRA study is different and hence not strictly comparable with the present study.

The estimated profit cash margin and profit net margin of high profit mills in Kerala are 10.04 and 4.52 respectively. As a rough estimate, the conclusion drawn is that profitability position of spinning mills in Kerala is generally low when compared to SITRA (1992) study related to different samples of mills in South India.

The industry average rate of return on assets calculated is -0.046 but in the case of high profit mill it is 0.059. ROA computed by ownership and firm-size (Table 7.4) shows that the value is negative in all groups. The return on assets ratio reflects the profitability of all financial resources invested in a firm's assets. The operating assets turnover ratio is found above industry average of 1.304. The gross profit per spindle is Rs.500/- and above industry average of Rs.210/- The gross profit per spindle of all private mill (private sector) is only Rs.328/- This shows high profit mills are earning good profit per spindle.

7.11 FINANCIAL PERFORMANCE: CROSS-SECTION ANALYSIS FOR THE BEGINNING (1982-83), MID PERIOD (1986-87) AND END PERIOD (1991-92) OF STUDY[1]

A shift upward can be observed in the position of private mills and co-operative mills when comparing gross

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1. 1982-83 = T_o, 1986-87 = T_1, 1991-92 = T_2.

profit margin (Table 7.8). NTC mills show a downward shift from period T_o to T_1 and an upward shift again from T_1, to T_2. In the case of KSTC mills, period T_o (period of nationalization) shows a good gross profit margin and it declined deeply in the period T_1. A slight regaining trend can be observed in the period T_2 in the case of KSTC mills.

An overall look of the estimates of profit cash margin shows that interest burden deeply affected co-operative mills and KSTC mills in all the periods. But the co-operative sector is found relieved from interest burden in the period T_2 to a great extent. The interest burden continued to affect KSTC mills even in the period T_2.

Profit net margin is found again lowest in the case of co-operative sector and KSTC sector. Profit net margin being gross profit minus depreciation and interest payment, reflects variations in terms of depreciation charges and interest payments. ROA also shows that co-operative sector and KSTC sector are not functioning as efficient as private and NTC mills.

Firm level interview and balance sheet analysis show that the profitability position of co-operative sectors increased substantially. But the accumulated interest burden

Table 7.8

Financial performance by ownership during the period T_o, T_1 and T_2: cross-section analysis

Type of Mills/ year		Gross profit margin	Profit cash margin	Profit net margin	Return on assets	Operating assets turnover	Gross profit/ spindle
Private	T_o	6.29	0.93	-3.07	-4.36	1.51	0.10
	T_1	8.34	2.65	-1.15	-0.09	1.67	0.18
	T_2	15.37	1.56	-4.55	-4.01	1.19	0.87
NTC	T_o	5.82	0.37	-3.08	-3.49	0.99	0.06
	T_1	0.07	-7.94	-12.51	-13.11	1.12	0.16
	T_2	5.22	1.19	-1.37	-1.52	1.06	0.17
Co-operative							
	T_o	-2.33	-13.29	-58.03	-10.40	0.66	0.02
	T_1	1.80	-15.29	-36.79	-24.43	0.87	0.21
	T_2	7.33	-0.18	-2.51	-2.49	1.61	0.24
KSTC	T_o	6.31	-5.48	-12.36	-13.01	1.03	0.03
	T_1	-3.73	-10.89	-25.49	-27.80	1.14	0.11
	T_2	0.70	-3.24	-6.86	-14.59	1.57	0.02

was the main reason for huge loss in profit cash margin. Once the co-operative sectors are able to overcome this situation, the resource-use-efficiency of co-operative sectors will increase.

The financial position of KSTC mill is far from satisfactory. Net profit after tax is negative and hence efforts should be made to maximise profits. The reasons of poor financial performance are financial indiscipline, poor planning, out-moded technology, ineffective marketing, and poor product quality. Extravagent and indisciplined spending is observed in certain units. It is also observed that some executives furnished and airconditioned their official quarters and live in rented building miles away from factory sights.

The relative efficiency with which the firm utilizes its resources to generate output ie., OAT estimates show that private and KSTC mills are ahead of NTC and co-operative mills.

Gross profit per spindle is found increasing in all mills from one period to another except in KSTC mills where a decline is observed in the period T_2.

The financial performance of mills by firm-size reveals that medium size mills are performing better in terms of gross profit margin, profit cash margin and profit net margin and return on asset in all the three periods of study (Table 7.9). Operating assets turnover ratio estimates show a declining trend from T_o to T_1 and again an upward trend from T_1 to T_2 in the case of medium size mills. Small mills show a shift upward only from T_o to T_1 and a downward shift from T_1 to T_2. As per the estimates, gross profit per spindle is found greater in medium size mills when compared to the estimated value of small mills with a spindleage of less than 26,000 spindles.

Profit variability is not a peculiar phenomenon to the spinning mills in Kerala. It is a peculiarity of the cotton mill industry as a whole. The Indian cotton textile industry has witnessed an uneven history of cyclical booms and glooms. Ojha (1978) pointed out that "On the whole gross profit as a percentage to sales, gross profit as a percentage of capital employed and profit after tax as a percentage of net worth in respect of cotton textile industry are not only lower than those in the other industries but also have declining trend with wide fluctuations", SITRA (1992) analysis also upholds this view.

Table 7.9

Financial performance by firm-size during the period T_o, T_1 and T_2: cross-section analysis

Type of Mills/ year	Gross profit margin	Profit cash margin	Profit net margin	Return on assets	Operating assets turnover	Gross profit/ spindle
Spindle ≤ 26,000						
T_o	3.99	-4.23	-17.02	-8.52	1.22	0.06
T_1	3.81	-5.22	-15.52	-12.55	1.42	0.06
T_2	8.28	-2.60	-7.56	-9.67	1.34	0.40
26,000 ≤ 50,000						
T_o	7.42	-2.07	-1.87	-2.16	1.56	0.10
T_1	3.77	-3.45	-8.73	-7.38	1.13	0.12
T_2	12.52	7.63	4.58	5.52	1.21	0.69

Chapter VIII

THE STRUCTURE OF COST

8.0 Investigation into the causes responsible for differential performance arises the need for an analysis of the constituent elements of costs. This chapter is devoted to the analysis of important cost components and its percentage share to total cost.

8.1 RELATION BETWEEN OWNERSHIP, SIZE AND COST ANALYSIS

Cost analysis is very important to a firm, because it has to balance cost against revenue in an optimal manner with a view to earn profits. The term 'cost' possesses different meanings. Cost in principle include the sum of the direct and indirect expenditure incurred in bringing out an article to its existing conditions and location. All expenditure on capital assets, capital losses, payments by way of distribution of profits, and matters of pure finance cannot be included in cost accounts. Examples are income-tax, dividends paid, bonuses to directors, and employees voted at the annual meetings, expenses of raising capital, discount on debentures, losses on fixed assets, excessive depreciation, amounts written off, goodwill, preliminary expenses, underwriting commission, damages payable at law, and charitable donations where no direct benefit therefrom is desired by the employees.

The important cost elements taken for the present study are prime cost, works cost, administration expenses and selling costs. Because of the volatile nature of 'interest' and 'depreciation', and 'tax', these three are excluded from the analysis. Inter-firm comparison will be affected if these three variables are also taken as part of cost comparison. Interest payable in a particular year may accumulate due to default which will reflect in the balance sheet.

Firms enjoying interest subsidy especially new firms and sick firms will not be kept par with other firms. Depreciation charged differs on the basis of nature, life span of assets etc. Tax to be paid also varies due to several factors. Hence these factors are excluded from cost analysis since the study resorts to inter-firm comparison.

The items included are:

1. Raw material actually consumed for production which is derived by adding purchases of raw materials and semi-finished goods to opening stock and deducting sales from closing stock.

2. Personal expenses including salaries, wages, bonus, contribution to provident fund and other welfare expenses including executive directors' and managing directors' remuneration.

3. Manufacturing expenses taking separately, (a) stores, spares, (b) power and fuel and (c) repair and maintenance.

4. Administrative and miscellaneous expenses, and

5. Selling and distribution expenses like brokerage, freight, forwarding and shipping expenses, if any.

Provision for doubtful advances, absolute stores, doubtful bank balance, lease rent, proposed dividend if any, etc. are also not included for cost analysis.

Three most widely used methods for cost computation are statistical methods, engineering methods and accounting methods. Statistical approach ranges from simple graphical curve fitting to multiple correlation analysis to estimate cost functions. Engineering method is built up in physical units such as kilograms of yarns produced. It adopts such technique as method analysis, elemental time standards, learning curves etc. Accounting method is based on historical data available in the accounts of the firm. The method consists of classifying cost into different components.

Historical cost refers to past cost which is used as a basis for comparison and evaluation of future expectancies. It also helps to measure the comparative efficiency of firm over the years. According to Dean (1951), "it should be recognized at the outset that the only costs that matter for business decisions are future costs; actual costs i.e. current or historical cost are useful solely as a bench mark for estimating the costs that lie ahead if one course of action is chosen as opposed to another". Knowledge about nature of costs will help managers to control costs for achieving company objectives at minimum cost.

8.2 COST FUNCTION

Cost function relates to the firms' input decisions given its output levels and input prices. While production function gives the maximum possible output which can be produced from given quantities of a set of inputs, a cost function gives the minimum level of cost at which it is possible to produce some level of output, given input prices.

A cost function[1] $C(P, y^*)$ is defined as the solution of the cost minimization problem for the production of a given output bundle.

$$y^* = (y_1^* \ldots\ldots y_n^*) \quad \text{i.e. it is the solution of}$$

$$\text{Min} \sum p_i r_i$$

subject to

$$g(y_1^* \ldots\ldots, y_n^*, r_1 \ldots\ldots, r_m) \leq 0$$

where $g(.) \leq 0$ is the production function and where p_i is the given price of input i. That is, if r_i^o is the optimal value of input i in the above equation, then the cost function is

$$C(p, y^*) = \sum p_i r_i^o$$

8.3 COST STRUCTURE IN SPINNING MILLS

The spinning mills generally produce a variety of yarns i.e. yarns of different counts generally ranging from 10s to 140s. Hence it may not be very helpful, besides being difficult to estimate the different components of cost per unit of output. Further such an estimate will also fail to take into account changes in yarn composition in different periods. Hence for inter-sectoral comparison, share of cost

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1. For a derivation of cost function see Baumol (1978).

components in relation to total cost is expressed as percentages.

8.4 ANALYSIS OF COMPONENTS OF COST

A comparison of relative share of different cost components in total cost expressed in percentages between ownership categories and size categories is given in Table 8.1. To analyse the elements responsible for the wide variations in cost between sectors, total cost is broken into different cost components. Because of the volatile nature, interest, lease, rent and depreciation charges are excluded. The Table (8.1) presents the findings from the estimates of cost components as a percentage to total cost by ownership and by size using cross-section time-series panel data. The table shows that mean raw material cost is high in cooperative and private mills. Plant level interviews were conducted to account for the reasons of different cost components. The major factors found influencing cost are the following:

* Quality of cotton purchased
* Counts produced
* Purchase efficiency
* Purchase in right season

Most of the private mills are producing counts

Table 8.1

Contribution of various cost components on percentage to total cost by ownership and by firm-size: Pooled cross-section and time-series data: 1982-83 to 1991-92

Cost components	Ownership					Size	
	All Units	Private	NTC	Co-operative	KSTC	Spindles ≤ 26,000	26,000 ≤ 50,000
1. Raw material	63.49 (7.04)	65.87 (4.83)	60.64 (4.66)	67.70 (5.73)	57.45 (4.74)	63.98 (7.61)	62.31 (5.09)
2. Salaries and wages	20.30 (6.48)	16.76 (4.83)	22.26 (4.07)	20.59 (5.68)	26.92 (4.29)	20.31 (6.97)	20.26 (5.86)
3. Power and fuel	5.58 (1.81)	5.31 (1.74)	6.28 (1.95)	5.39 (1.97)	5.73 (1.44)	5.51 (1.76)	5.80 (1.90)
4. Stores and spares	3.30 (1.63)	3.85 (1.74)	4.17 (1.05)	2.14 (0.72)	2.01 (1.11)	3.06 (1.73)	3.93 (1.23)
5. Repair and maintenance	1.72 (2.01)	2.46 (2.52)	1.50 (1.18)	0.57 (0.51)	0.90 (0.54)	1.38 (1.59)	2.55 (2.56)
6. Administration and miscellaneous	3.30 (1.77)	3.59 (2.00)	2.77 (0.96)	2.14 (1.64)	4.12 (1.13)	3.55 (1.85)	2.79 (1.39)
7. Selling expenses	2.31 (1.15)	2.44 (1.18)	2.45 (0.76)	1.58 (0.91)	2.75 (1.21)	2.21 (1.20)	2.36 (1.01)
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Note: Figures in parentheses denote standard deviation.

varying from 20s to 140s while public mills are concentrating on production of counts less than 100s. The production of finer counts needs high quality of raw cotton. Thus the raw material cost relative to total cost will increase as count becomes finer. But at the same time raw material cost relative to yarn sales will decrease as the counts become finer with the net result of increased profit. This is substantiated by the fact that gross profit margin is greater in private mills (see table 7.1) than in public mills as a whole. The reason for increased raw material cost in co-operative mills may be due to the problems faced by the infant industries and X-inefficiency.

Purchase efficiency is yet another reason for cost variations. Paying a higher price for the same quality of cotton or same price for a lower quality of cotton, paying huge commission to intermediaries and above all paying agreed price for less than stipulated quantity of cotton for each wagon are some of the reasons for cost variations. Plant level interviews clearly substantiate these observations.

Purchase in right season will enable mills to reduce raw material cost. The average price of cotton varieties purchased varies from month to month during a particular year. Month-wise differences presented in Appendix C-7 show that the average price of high quality cotton DCH-32 (South) varies from Rs.4,796 to Rs.5,767 per quintal and low quality cotton (V-797) varied from Rs.2,207 to Rs.2,748 per quintal during the year 1991-92.

As size increases, share of raw material cost in relation to total cost is decreasing. Resource-use efficiency is higher in medium size units than in small size units.

The cost share of each component relative to total expenditure is influenced by a number of factors including X-inefficiency. No uniform reason could be traced for sources of variations. To test the significance of the difference between means ANOVA technique (in the case of ownership categories) and Z-test (in the case of size categories) were used.

Analysis of Variance (ANOVA)

There is wide variations in cost components of different categories. The variations are due to different reasons in each category.

Hence, it has to be made sure that the cost of production figures are from the same universe. The means of each group should give an estimate of the means of the universe and these can also be used as sample means to estimate the variance of the universe. For this analysis of variance (ANOVA) has been carried out for each cost component. It consists in the estimation of the amount of variations due to each of the independent factors separately and then comparing these estimates due to assignable factors with the estimate due to chance factor, the latter known as 'error'.

Table 8.2

Analysis of variance in raw material cost: Ownership-wise

Number of Observations: 210

Sources of variations	d.f.	Sum of squares (S.S.)	Mean (S.S.)	Variance Ratio (F)
Between the groups	3	2881.77	960.59	38.92***
Within the groups (Error)	206	5085.83	24.68	--
Total	209	7967.6	--	--

*** significant at 0.01 level.

Tabulated F

F 0.05 for 3 and 206 d.f. = 2.60 and

F 0.01 for 3 and 22 d.f. = 3.78

Here calculated value of F at 5% and 1% level is significant and Ho may not be accepted. It means that variance between the group is significantly greater than variance within the groups. So the mean value of private, NTC, co-operative and KSTC mills are significantly different from each other. As the difference is significant the ownership and cost of production are highly correlated.

Analysis of variance has also been carried out for salaries and wages, power and fuel, stores and spares, repair and maintenance, administration and miscellaneous and selling expenses. The test results are given below.

Salaries and wages

F - value : 46.33***

Tabulated F 0.05 for 3 and 206 d.f. = 2.60

F 0.01 for 3 and 206 d.f. = 3.78

Since calculated value of F is greater than tabulated value it is significant at both 5% and 1% level of

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*** significant at 0.01 level.

significance and the null hypothesis Ho may not be accepted. Accordingly we infer that F - ratio is significant at both levels which means the difference in salaries and wages among different group is significant.

Power and fuel

Tabulated F value : 3.03**

F 0.05 for 3 and 206 d.f. = 2.60

F 0.01 for 3 and 206 d.f. = 3.78

Calculated F value is not significant at 1% level but is significant at 5% level. Hence we can conclude that power and fuel consumption among private, NTC, co-operative and KSTC mills is significantly different (at 5% level).

Other F values computed are given below.

Cost Components	F Value
Stores and spares	27.93***
Repair and maintenance	11.87***
Administration and miscellaneous	10.40***
Selling expenses	7.00***

** Significant at 0.05 level.
*** Significant at 0.01 level.

There is considerable evidence that the mean values of cost components of private, NTC, co-operative and KSTC firms differ significantly. All cost components except power and fuel are statistically different at the 1% level of significance. The mean values of power and fuel consumption is also statistically significant at the 5% level of significance.

Hypothesis testing for differences between Means (size categories)

There are variations in cost components of two different size class also. Hence, it is to be tested whether there is any statistically significant difference. Pair-wise Z-test is applied between the small and medium size class.

The null hypothesis is that there is no differences in mean values of different cost components.

Ho: $\mu_1 = \mu_2$

Ha: $\mu_1 \neq \mu_2$

Cost components	Z-Value
Raw material	1.84
Salaries and wages	0.05
Power and fuel	1.02
Stores and spares	4.09***
Repair and maintenance	3.30***
Administration and miscellaneous	3.25***
Selling expenses	0.92

The analysis of cost components by firm size show that there is no statistically significant difference between small and medium size class in the case of most important cost components viz., raw material, salaries and wages, and power and fuel. But a statistically significant difference (at 1% level) is noticed in the case of stores and spares, repair and maintenance and administration and miscellaneous. These cost components does not seriously influence total cost, when compared to the first three major cost components. No statistically significant difference is noticed in the case of selling expense between small and medium firms.

The conclusion drawn is that size and cost of production are not highly correlated; but type of ownership

*** Significant at 0.01 level.

under which an enterprise operates and cost of production are highly correlated.

The comparison of raw material cost among three different periods--beginning period (T_o) mid-period (T_1) and end-period (T_2) are given in the Table 8.3.

All the groups show a declining share of raw material cost from period T_o to T_1 and correspondingly an increasing share from T_1 to T_2. This increased percentage of material

Table 8.3

Inter-sectoral differences in raw material cost as a percentage of total cost in the first (T_o), fifth (T_1) and last years (T_2) of the period of study

Ownership/size	T_o	T_1	T_2
Private	67.37	62.55	68.88
NTC	58.41	54.54	67.75
Co-operative	69.22	60.19	69.93
KSTC	57.17	48.96	64.15
Spindles $\leqslant$ 26,000	65.09	59.49	68.37
26,000 $\leqslant$ 50,000	61.22	56.49	66.77

input in T_2 is due to peculiar position of spinning industry during the year 1991-92 (details in chapter I).

The relative position of private, NTC, co-operative, KSTC mills and small and medium size mills is in perfect agreement with that of estimates obtained from panel data.

Salaries and wages

The salaries and wages differ substantially between groups from 16.76 per cent to 26.92 per cent of total cost as per estimates using panel data (Table 8.1). One of the main reasons for low salaries and wages share is due to higher capital-labour ratios in private sector and cooperative sector. This is evident from the estimates presented in Table 4.8. Private mills are highly capital intensive when compared to other groups by ownership. Majority of mills in cooperative sector comprise recently established units and hence more capital intensive. The labour saving device adopted by these sectors is the reason for low share of salaries and wages in relation to total cost. But with regard to different size mills no substantial difference in capital intensity is observed. The same is true in the case of share of salaries and wages in relation to total cost.

Estimates of salaries and wages for three different periods are presented in Table 8.4. Salaries and wages show a decreasing trend from T_o to T_2 in all groups. The share of salaries is found the highest in KSTC mills. The overall average for 10 years shows a comparatively lower wage rate in co-operative mills. The higher wage rate in KSTC mills can be mainly attributed to the following:

* Low capital intensity
* Overstaffing

Table 8.4

Inter-sectoral differences in salaries and wages as a percentage of total cost in spinning mills in first (T_o), fifth (T_1) and last years (T_2) of the period of study

Ownership/size	T_o	T_1	T_2
Private	18.04	18.48	13.43
NTC	26.27	24.32	16.94
Co-operative	20.10	24.34	18.71
KSTC	27.89	32.94	20.64
Spindles $\leq$ 26,000	21.16	22.62	16.17
26,000 $\leq$ 50,000	23.34	23.17	16.38

It is understood during the course of floor level interview that overstaffing in public sectors is partly the result of political pressures at the time of recruitment. Overstaffing will definitely lead to more benefits in terms of bonus, contribution to provident fund, and other funds of workmen and other staff-welfare expenses.

Power and fuel

Estimates presented in Table 8.4 show that power and fuel cost share in all group of mills is almost same as that of industry average except in NTC mills. The lowest percentage of power and fuel cost share is found in private mills. Between size categories, power and fuel consumption share is found little higher in medium size mills than in small size groups. The important factors affecting power and fuel cost are the following:

* Non-implementation of energy conservation measures
* Increased use of generator.

Energy cost constitutes highest component of cost conversion next to salaries and wages and raw material. Hence an accurate calculation of power cost for different counts and type of yarn is very important in the case of a spinning mill.

It influences cost of production and profit margin. Energy conservation has received top priority in mills. The main sources of energy is a spinning mill are:

1. Electricity
2. Generator using diesel
3. Through steam turbine/generator
4. Coal
5. Furnace oil
6. Other internal generation.

The speed at which spindle rotates and electricity consumption are directly related. It is important to distinguish between spindle speed and counts production to fix an optimum product mix. The relationship between units per kg. of yarn (UKG), counts produced, power consumed is to be analysed in detail mill-wise. Interview conducted reveals the fact that only a very few mills are conducting such internal study. A very few high performing mills are introducing Energy Conservation Programme (ECP). The important energy conservation measures taken are:

1. Strict vigilance is maintained over usage of energy by constant monitoring and educating the need to conserve energy.

2. Energy conservation plans have been implemented.

The consumption of energy has to be closely monitored. The correct method of adjusting the power consumption to 40s count as given by SITRA (Ratnam and Rajamanickam 1992) is given below:

Let U_1, U_2, U_3 .... be the power consumption per kg. of yarn in counts C_1, C_2, C_3, ... and U be that of 40s. Let N be the total number of units measured for yarn production of P_1, P_2, P_3, ... kg respectively in C_1, C_2, C_3, ... counts.

Then $N = (P_1U_1 + P_2U_2 + P_3U_3 + \ldots\ldots)$

$= [U(P_1 \frac{U_1}{U} + P_2 \frac{U_2}{U} + P_3 \frac{U_3}{U} + \ldots)]$

$= U \sum_1^r P_r\, a_r$, where a_r is the ratio of UKG in a given count r to that of 40s $= \frac{U_r}{U}$

Therefore $$U = \frac{N}{\sum_1^r P_r a_r} \quad (8.1)$$

The UKG as defined in expression (8.1) gives the actual power consumption in the mill for the production rate prevailing in the mill. The interesting feature is that mills are not adjusting spindle speed to economize electricity except a few. A scientific study is highly warranted in each mill to strike a balance between production, and electricity consumption.

One of the reasons for high fuel consumption is that energy generated through diesel generator is highly costly. The mills surveyed show that cost per unit of electric energy varied between 64 ps. to 95 ps. for the year 1991-92 while cost per unit of energy generated through diesel varied between Rs.1.799 to Rs.5.04. This trend can be noticed in previous years. The more the energy generated through generator, the more will be energy cost.

Another striking reason for variation is absence of introduction of energy conservation programme especially in non-private sector mills. Most of the mills especially poor performing mills are not conducting power audit. These mills are also not taking periodical measurement of power consumption or even if taking power consumption measurement, corrective steps are not taken due to lack of co-ordinating system. To monitor all these things, a well eqipped Quality Control Department is lacking in KSTC, NTC, co-operative and in few private mills. KSTC and NTC mills are relaying on their apex organization for even routine works. Hence individual mills fail to modify programmes to suit to their particular mill environment.

Estimates presented in Table 8.5 show that the percentage share of power and fuel increased from T_o to T_1 in all groups. The widespread application of energy conservation measures followed in mills shows its impact during the period T_2

Table 8.5

Inter-sectoral differences in power and fuel cost as a percentage of total cost in the first (T_o), fifth (T_1) and last years (T_2) of the period of study

Ownership/size	T_o	T_1	T_2
Private	3.59	7.18	5.11
NTC	4.00	9.45	5.17
Co-operative	3.78	8.20	4.99
KSTC	4.61	6.86	5.09
Spindles ≤ 26,000	3.92	7.59	5.04
26,000 ≤ 50,000	3.81	8.19	5.23

Stores and spares

Estimates presented in Table 8.6 show varying stores and spare cost as a percentage to total cost. The main reason influencing stores and spares are the following:

* Inadequate maintenance during the past years will lead to increased purchase

* Continuous and adequate maintenance will also lead to reasonable purchase of stores and spares.

* Poor maintenance reflects in poor share of stores and spares.

These three characteristics are reflected in spinning mills viewed as a whole. A detailed technical study can reveal the real reason for differences. Plant level interview reveals that KSTC mills are not following: Proper maintenance schedule. In co-operative sector, since majority of the firms are new mills, it requires lesser stores and spares stock for maintenance. Proper maintenance schedule increases stores and spares stock in private mills. Lagged and improper maintenance schedule in the past can be attributed to the reason for present increased cost share of store and spare in NTC mills.

Measured in terms of firm-size, the estimates reveal higher the size, higher is likely to be the maintenance and hence more stores and spares stock in relation to total cost.

Table 8.6

Inter-sectoral differences in stores and spares cost as a percentage of total cost in the first (T_o), fifth (T_1) and last years (T_2) of the period of study.

Ownership/size	T_o	T_1	T_2
Private	3.41	4.22	4.05
NTC	3.96	4.38	4.49
Co-operative	2.01	1.91	2.14
KSTC	2.08	2.85	2.12
Spindles ≤ 26,000	2.65	3.45	3.25
26,000 ≤ 50,000	4.08	4.03	4.09

Administration and miscellaneous

Estimates of administration and miscellaneous expenditure as percentage share of total cost are presented in Table 8.7. The composition of items included in the administrative and miscellaneous head is very wide and reasons for variations vary from mill to mill. The administrative and miscellaneous expenditure shows a declining trend in the case of all groups from T_o to T_1 and from T_1 to T_2. Arising trend can be observed only in the case of KSTC and medium size mills from T_o to T_1.

Table 8.7

Inter-sectoral differences in administration and miscellaneous expenses as apercentage of total cost in the first (T_o), fifth (T_1) and last years (T_2) of the period of study.

Ownership/size	T_o	T_1	T_2
Private	3.74	3.38	3.26
NTC	3.77	3.15	2.57
Co-operative	3.05	2.48	1.11
KSTC	3.82	4.81	4.06
Spindles ≤ 26,000	3.84	3.38	3.10
26,000 ≤ 50,000	3.23	3.35	2.67

Selling expenses

Sales and distribution expenses include brokerage, freight, forwarding and shipping expenses. The major factors influencing selling expenses are:

* Nearness to market
* Brokerage

In the case of mills producing coarse counts for local markets selling expense share will be low. Mills exporting goods to foreign market have to incur huge brokerage along with forwarding and shipping expenses. All the mill groups are having more or less same selling expense share and are close to industry average (Table 8.8). The only exception is that of cooperative sector with selling expense less than industry average of 2.31 (Table 8.1).

Table 8.8

Inter-sectoral differences in selling expenses as a percentage of total cost in the first (T_o), fifth (T_1) and last years (T_2) of the period of study.

Ownership/size	T_o	T_1	T_2
Private	2.39	2.55	2.26
NTC	1.77	2.78	2.34
Co-operative	1.47	2.21	2.17
KSTC	3.23	2.19	3.05
Spindles ≤ 26,000	2.29	2.34	2.47
26,000 ≤ 50,000	2.33	2.80	2.27

The three major items of cost of production in a spinning mill are raw material, salaries and wages, and power and fuel. These costs are to be controlled by management for keeping cost low and profit high. In the long-run, the profitability of a mill is determined to a large extent in its ability in reducing costs of production.

Low productivity and profitability are not the result of any single factor, but due to an accumulated effect of a large number of small factors. Cost structure and profitability are highly related, control should be exercised on practically every item of cost, however, small it may be.

Poor working condition are often a cause for low productivity and consequently high cost. Firm-level interview conducted shows that there are many more reasons for high cost viz., poor machinery maintenance, lack of house-keeping, low processing efficiency, bad work methods, lack of training to workers and supervisors etc.

A thorough diagnostic check of the working of the mills form the technical and commercial angles and a comprehensive analysis of balance sheet and profit and loss statement is necessary to find out the state of health of the mills as observed by Ratnam and Indra Doraiswamy (1992).

Chapter IX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

9.0 The primary objective of the study is to identify and analyse factors affecting productive and financial performance of various categories of spinning mills in Kerala and to draw some lessons relevant to industrial policy.

This section summarizes the principal findings and sets out some major conclusions relevant to policy.

9.1 PRODUCTIVITY

The productivity of labour, capital, spindle and raw material shows the amount of gross value added per unit of each factor. A high index is an indication of increase in gross value added, economies of scale, increase in efficiency etc.

The increase in labour productivity in most cases is due to capital deepening. In the case of private and medium sized mills increase in labour productivity may be due to capital deepening. But in cooperative mills capital deepening is followed by low capital productivity but no high labour productivity. This may be due to excess labour force absorption.

When capital intensity increases, this is reflected in the decreased capital productivity. This is true in the case of private, cooperative, small and medium size mills. Low capital intensity in NTC and KSTC mills is followed by high capital productivity in these groups.

The estimated labour productivity (LP_1) is highest in the case of private sector followed by NTC mills. Due to high labour absorption, cooperative sector is having the lowest labour productivity (LP_1). The average labour productivity of KSTC sector also is low and below industrial average. The mean labour productivity of private sector is significantly (at the 1 per cent level) above its public counterparts. But the difference is not significant at the 5 per cent level between size class.

The increased share of salaries and wages to total cost is followed by a decrease in labour productivity (LP_2). This is witnessed in KSTC, Cooperative and NTC sectors. Between size class, there is not much difference in salaries' and wages' share and hence difference in labour productivity (LP_2) is also not much.

Spindle productivity (SP) which is estimated as a proxy to capital productivity, is found highest in private mills compared to its public counterparts. But no significant difference in spindle productivity is noticed between size groups. Private sector is significantly above its public sector counterparts at the 1 per cent level.

A main argument in supporting small enterprises is that it is more labour intensive. But in the case of spinning mills there is no statistically significant (at the 5 per cent level) difference between capital-labour ratios between small and medium mills.

The hypothesized relationship that is the larger the size, the greater is the capital intensity and lower the capital productivity and the higher the labour productivity also does not hold good in our analysis. The differences are not statistically significant at 5 per cent level.

An examination of partial factor productivities by the type of ownership under which an enterprise operates reveals interesting results. Private sector is significantly above (at the 5 per cent level) its public sector counterparts in term of LP_1, LP_2 and SP.

9.2 TECHNICAL EFFICIENCY

The absence of a significant relationship between firm-size and technical efficiency shows that neither a positive or negative case can be made for mills with less than 26,000 spindles and mills with less than 50,000 spindles. Within each of the four ownership categories there exists differences in technical efficiency. A statistically significant difference (at the 5 per cent level) is observed only between private and cooperative sectors.

Firm level technical efficiency indices reveal that the four technically efficient (100%) mills belong to private sector. The important factors which influence technically efficiency are identified as capacity utilization, wage rate and the presence of well equipped Research and Development (R & D) department. 'Speed', 'twist per inch', and 'spindle efficiency' are other factors which forces to shift production function downward.

9.3 CAPACITY UTILIZATION

Inter-sectoral differences in capacity utilization indicate a higher level of performance of the private sector in relation to the cooperative and KSTC units. Pair-wise analysis of Z -test shows that private units are significantly (at the 1 per cent level) above those of cooperative and KSTC units. In terms of capacity utilization percentage even though NTC units are having more utilization than private units, the difference is not statistically significant at the 5 per cent level.

Firms with 26,000 or fewer spindles are significantly (at the 5 per cent level) below those of medium sized mills. Utilization level recorded by high profit mills is far higher than those of all other mill groups. High profit mills are significantly above all other categories at the 1 per cent level.

Of the reasons for low capacity utilization among different sectors, the maximum difference is caused by frequent and continuous absenteeism. Power problem is another major factor influencing capacity utilization. The next important reason for under-utilization is unscheduled breakdown as a result of old and obsolete machinery.

Another major reason which contributes for low utilization is the prevalence of strained employer-employee relations. Other reasons for adverse capacity utilization rates are raw material shortage, sick units, managerial short-comings and demand deficiencies.

9.4 PROFITABILITY

The gross profit margin (GPM) earned by private, NTC and cooperative sectors does not show statistically significant difference at the 5 per cent level. But the gross profit margin of KSTC sector is significantly below those of private sector at the 1 per cent level. Across size class, the gross profit margin of medium firm-size is significantly above to small firm-size mills at the 5 per cent level.

But interest burden seems to be heavily affecting both KSTC and cooperative sectors thus bringing down drastically their net profit margin. The overall efficiency of mills judged on the basis of return on assets (ROA) also indicate the very poor performance of KSTC mills followed by cooperative mills along with small size mills.

The operating assets turnover (OAT) and gross profit per spindle (GPS) of private sector are significantly (at the 1 per cent level) above its public sector counterparts. Between size class no significant difference is noted in the case of OAT and GPS at the 5 per cent level.

Cooperative and KSTC units were excessively depending on debt capital. The internal resource mobilization of these two groups was very poor due to low general reserve.

9.5 STRUCTURE OF COST

Analysis of constituents of cost reveals that differences in raw material cost and salaries and wages are two primary factors affecting total cost. The major differences in raw material cost are mainly due to differences in quality, poor purchasing policy etc. This has a bearing on raw material productivity also.

Another most important cost component ie., salaries and wages is found lowest in the case of private sector while all other public sector units are having high wages and salaries bill. Analysis of variance (ANOVA) test conducted on ownership-wise showed that mean values in the case of all the seven cost components are significantly different from each other at the 1 per cent level. The type of ownership under which an enterprise operates and cost of productivity are thus found correlated.

But, further analysis showed that the firm-size (where size of the firm is measured in terms of number of spindles installed) and salaries and wages are not highly correlated. The analysis of cost component showed no statistically significant difference between size class in the case of most important cost components viz., raw material, salaries and wages and power and fuel. The significant difference (at the 5 per cent level) in the case of other cost components does not have any serious policy implications.

9.6 CONCLUSIONS RELEVANT TO POLICY

The following conclusions may be useful for policy. Firm-size categorization between small and medium spinning mills is a very poor indicator of measurement of relative efficiency in terms of partial factor productivity, total factor productivity (or technical efficiency) and financial ratios. For policy purposes it is essential to look into these factors.

There is considerable evidence that private enterprises are more often relatively efficient in terms of most of the partial factor productivity ratios, financial ratios and technical efficiency over their public sector counterparts.

The difference in technical efficiency among various sectors is not so substantial except in the case of cooperative sector. This is because the average the mills in Kerala are much below best-practice technologies. The TE indices show that the scope for output gains with existing input quantities and combinations is rather limited. Measures to shift the frontier upwards through introduction of sophisticated technology and modernization are highly warrented. But modernization through technological progress and employment objective do not go together. Policy framers shall also look into the employment loss as a result of gain in output due to these measures.

Policy makers should take into account the technical change which can be incorporated while expanding/modernizing units. Spinning mills in Kerala are far behind international standard in copying with advanced technology.

A new policy of reserving coarser counts to weak units has many advantages. It tends to give more employment as well as saves units from becoming sick. There is no reason to believe that public fund is to be used for sheltering sick units, based on the experience of government take-over of sick mills.

Policy framers may encourage quality consciousness among suppliers since demand in international market for Indian textiles is fast widening. This is especially in view of the decision of European countries and USA to phase out import quota under Multilateral Fibre Agreement (MFA) over the period of ten years. This will definitely help Indian cotton exporters.

The potential to increase export depends how the exporters utilize the opportunities thrown open by the GATT multilateral trade treaty by becoming competitive in the international market.

The future of industry appears to be tough on one side due to lack of modernization and inefficient resource utilization of public sector units. On the other side, the future of spinning mills appears to be very bright due to fast expansion of exports of textiles especially from Tirupur (South India). The European countries are drastically cutting down yarn production due to increased labour cost. This increases the export potential of Indian goods, provided we are able to meet their quality specifications.

9.7 RECOMMENDATIONS

1. The presence of weaker units justifies the implementation of certain urgent steps to revamp the companies from its inefficient position. The Government has to take steps to reserve coarser counts for weak units; since coarser counts are labour intensive, it will help such units to increase employment opportunities also.

2. Firm level 'technical study cell' may be created in each unit with the participation of existing staff. They have to monitor production side closely so as to give suggestions to increase production and quality and to

reduce waste and cost. Adjustments in twist per inch (tpi), spindle speed, count composition suitable to particular machine conditions and mixing are some of the areas to be brought under the attention of the 'technical study group'.

3. Elimination of external interference including political and local interference in day to day administration of public owned companies is to be regulated. Purchasing and marketing policies should be entirely at the discretion of individual units with only overall supervision of government agencies.

4. The appointment of a training cum technocrat will help a great deal to impart continuous training and necessary engineering suggestions to the mills. Systematic training on efficient production methods, inculcating work culture, team spirit among lower, middle and top level management are all positive steps which help productivity. The principle of each for all and all for each is to be kept up.

5. The present practice of taking decisions regarding counts to be produced, type of raw materials purchased, where to market the goods, by the top officials sitting miles away

from the factory is to be dispensed with. Their role is to be limited to that of an 'advisory agency'. Along with this, count standardization is to be implemented giving top priority. Restriction of production to two or three counts that can be spun economically is advisable on technical and economic grounds, both in private owned and public owned units. This will also avoid frequent settings of machines for constant count changes.

6. Rationalization of workloads, work assignments, and other conditions of service of workmen is to be implemented as per SITRA standards in average mills and as per international standards in those mills where ISO:9000 series or equivalent is awarded. Installation of new machines, introduction of improved versions or conditions on existing machines, and work assignments without replacing existing labour are to be considered as a part of rationalization.

7. The workers in textile industry are found to be most disgruntled when compared to many other industries. The nature of the work warrants attractive pay package. The scope for vertical mobility in the form of promotion on higher grade is very low in the case of textile workers, barring few high level management positions.

8. Norms followed to recruit workers are different in public and private sectors. Most of the private sectors are recruiting suitable and meritorious workmen with I.T.I qualifications unlike in public sectors. Promotion of workmen to a higher category is strictly based on appraisal and merit in efficient private sector units. Public owned units may also evolve a strict recruitment and promotion policy giving due weight to merit if it suits to the basic objectives of public enterprises.

9. Implementation of work assignment and fixation of workload are so far restricted to workmen staff excluding office staff. An Human Resource Development (HRD) study by experts is to be conducted and office staff is also to be brought under work assignment/workload fixation rules.

10. Probe is urgently sought to detect 'strategic sickness' from 'genuine sickness'. Mills referred to BIFR are found technically efficient (as per TE indices). Hence there is every reason to believe that mills are window dressing the balance sheet to project a unit as sick for reasons obvious. In some cases, the entrepreneur of the sick unit is benefitted as he gets money at subsidized rates of interest while healthy units have to operate at market rates.

11. Absenteeism popularly known as 'want of hands' is a major problem in textile industry. The nature of work and work atmosphere are major reasons for this mounting problem. This is an area where mutual agreement among workers, entrepreneurs and government has to be reached.

12. Poor performance indicators found through observations, interviews and data analysis, which hamper productivity are the following:

i) Workers lethargy

ii) X-inefficiency

iii) Economic indiscipline in public owned units

iv) Excess labour force

v) Purchase of cotton at higher prices than market prices: in most cases quality will be sub-standard

vi) Absence of clear purchase, sale and market policy

vii) Non-professionalism in management and bureaucratic and political interference

viii) Improper or inefficient training to workers, supervisors

ix) Defective plant layout, lack of modernization, lack of good humidification, house-keeping and ill-qualified technicians and supervisors

Hence, corrective steps both short-term and long-term are to be implemented along these lines so as to improve quantity and quality of yarns.

13. Salaries and perks may be strictly based on the principle of "earn and pay". But the ceiling of pay if any is to be started from top managerial cadre onwards. The present practice of salary freeze of workers is found acting as a demoralizing agent. Along with this adequate incentive should also be extended for higher productivity. Some suggestions in this direction are:

    a) Medical benefit covering all family members
    b) Incentive on achieving annual target
    c) Ex-gratia payments
    d) Gift coupon on better productivity
    e) Free transportation
    f) House building allowance
    g) Company housing
    h) Financial assistance for hire-purchase
    i) Promotion policy.

Implementing the above suggestions may go a longway to improve the efficiency and performance of the mills by better utilization of men, money, machines and materials.

APPENDICES

APPENDIX A: SUPPLEMENTARY INFORMATIONS

Appendix A.1

MEASURES OF PERFORMANCE ADOPTED BY SITRA

The productivity measurement procedure developed by the South India Textile Research Association (SITRA) is as follows:[1]

As both labour and machine productivity are influenced by the counts spun productivity is usually compared against a standard. The labour productivity index is calculated by expressing the standard number of operative hours required for the counts spun by a mills as a percentage of the actual number of operative hours engaged. The labour productivity is commonly expressed in terms of HOK (Number of Operative hours to produce 100 kgs of yarn) adjusted to 40s count. The labour productivity (HOK) is determined by the number of operatives engaged per 1000 spindles (OHS) and production per spindle per shift in HOK can be expressed in terms of number of operatives and production per spindle by the relationship,

$$HOK = \frac{OHS \times 800}{P}$$

The machine productivity index (MPI) is assessed by expressing the actual production as a percentage of the

1. Various publications of SITRA.

standard production attainable for three shifts, working 22.5 hours a day and six days a week with no idle machine capacity. This index takes into account both the production per spindle and machine utilization. A high labour productivity does not necessarily mean a high machine productivity and vice-versa. SITRA norms for production per spindle achievable under good working conditions for 40s counts are given below:

Table A.1

SITRA norms for production per spindle for 40s count

Count	Spindle speed	Twist multiple (TW)	Machine effici-ency(%)	Production per spindle per 8 hour (g)
Corded counts 40s	14400	4.20	91.0	88.8
Combed counts 40s	15000	3.90	91.5	100.1
Staple fibre 40s	12500	3.10	92.5	106.1
Polyester blends 40s P/V	13500	3.30	92.0	107.1

$$\text{100\% production per spindle per 8 hours} = \frac{7.2 \times \text{spindle speed}}{\text{tpi} \times \text{count}}$$

$$\text{where tpi} = \text{Twist multiplier} \times \sqrt{\text{Count}}$$

$$\text{T.M} = \frac{\text{tpi}}{\sqrt{\text{count}}}$$

Appendix A.2

APPLICATION OF ISO: 9000 IN SPINNING MILLS

ISO: 9000 is a new set of international quality standards which provides guidelines to the selection and use of quality systems for manufacturers who wish to export or trade with European countries. It is a certification to the manufacturer if he has a quality competent system to provide goods of international quality. The quality assurance has gained permanent importance and its importance is very high in Exports Oriented Units (EOU). The International Standard Organization (ISO) has developed the concept of "Total Quality Management System" (TQM) to have an effective quality control starting from the procurement of raw material to the production of final product.

ISO has developed a system approach to the quality in the form of a series of standards namely ISO: 9000 to ISO: 9004 (1987) covering various aspects of quality management system. On the basis of this, the Bureau of Indian Standards (BIS) has adopted these standards under IS: 14000 to IS: 14004. The equivalent in UK is BS: 5720 and in European Community CEN: 29000. For attaining total quality management system, a unit has to go through different stages, to obtain accreditation under ISO: 9000/IS: 14000.

In the first stage, the organization has to aim at conformance to the product satisfaction. In the second stage, it has to meet the customer's needs through a systematic study of customer's requirements. In the third stage, the organization has to find out the replicate the world's best business practices. The last stage of TQM aims at retaining the already attained leadership position through continuous upkeeping, change, adaptation and improvement.

The EEC countries recently made it obligatory for the exporting countries to adopt ISO: 9000 series. This has forced all the countries to think about quality upgradation. About 40 countries all over the world have adopted the ISO: 9000 standards and 35 more are in the process of adopting the same. In this situation, the textile industry, particularly the exporting companies have to go for ISO; 9000 or its equivalent certificate to catch international market for their products.

"A textile mill having fairly good quality assurance system can consider implementation of ISO: 9002 and ISO: 9003 models. While ISO: 9001 model is more appropriate for a most modern mill and the mills producing speciality yarns and fabrics for industrial applications where the fabric has to be engineered to meet very stringent specifications" (Rakshit, 1992). Rakshit mentioned important steps to be followed in a textile mill for effective implementation of ISO: 9000 Quality Management System namely:

1. Train senior/middle managers
2. Form a task force with competent personnel
3. Collect data/informations on existing practices and analyses
4. Prepare a quality manual
5. Train statistical Quality Control (SQC), production and other technical personnel on the use of manual
6. Carry out internal audit for adequacy and compliance
7. Take corrective action for removing non-confirmities.
8. Repeat steps 6 and 7 till the system is perfectly operational
9. Conduct preliminary audit by an external agency
10. Take corrective actions on non-conformities
11. Maintain and improve the system.

For improving and maintaining quality, each mill has to adopt a 'package deal' containing, among other things the following corrective steps.

1. A well developed R & D facility with qualified staffs and equipments and all types of testing facilities.

2. Well maintained cleanliness and house-keeping to avoid all types of dusts and impurities along with time-scheduled maintenance in each department.

3. Quality control systems to be monitored continuously and corrected at each stage impeccably.

4. Modernization and technological upgradation to be done as a continuous process.

5. Complaints and suggestions both from the workers and consumers to be examined and studied properly and regularly.

6. Implementation of 'Quality Circle' and other quality teams including 'Idea Mill', 'Employee-cum-consumer suggestion Box' are all to be promoted.

7. Human Resource Development Training (HRDT) programme to develop a positive change in the attitudes of supervisors, and other non-technical staffs is to be conducted.

8. A variety of other training programmes like "Train the Trainer", 'Improving better relationships and work culture', 'creating quality work culture and awareness', 'training for scientific and systematic selection procedure' etc. are to be conducted with the help of textile research institutes.

The ISO: 9000 series or its Indian equivalent IS: 14000 series will help the textile mills to follow cost efficient and resource-use efficient methods so as to produce high quality products as per the requirements of both Indian and foreign customers at competitive prices.

APPENDIX B: GRAPHICAL ILLUSTRATIONS

FIG. 1: LABOUR PRODUCTIVITY (LP1)

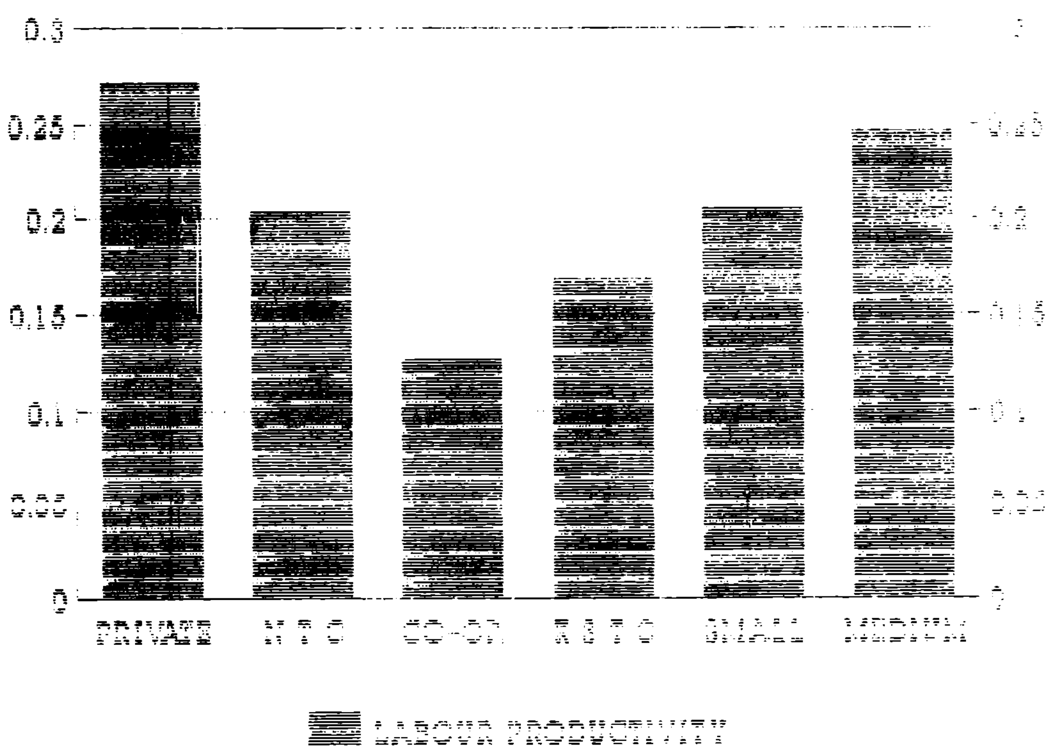


FIG. 2: LABOUR PRODUCTIVITY (LP2)

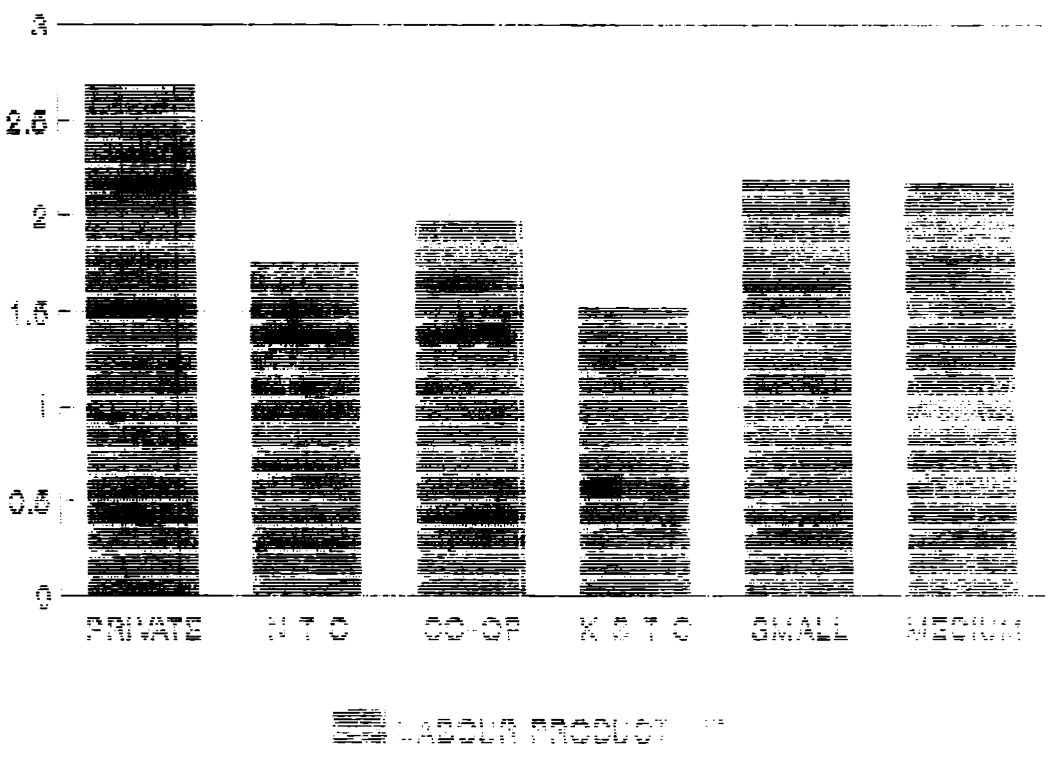


FIG. 3: CAPITAL PRODUCTIVITY (KP)

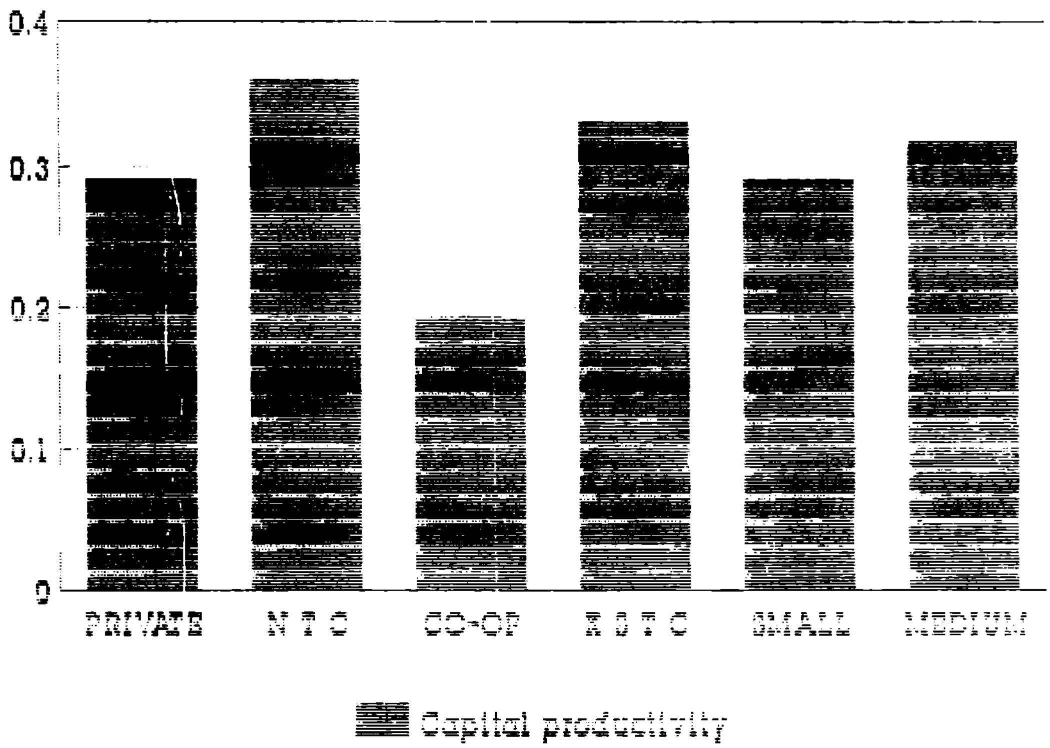


FIG.4:CAPITAL INTENSITY(K/L)

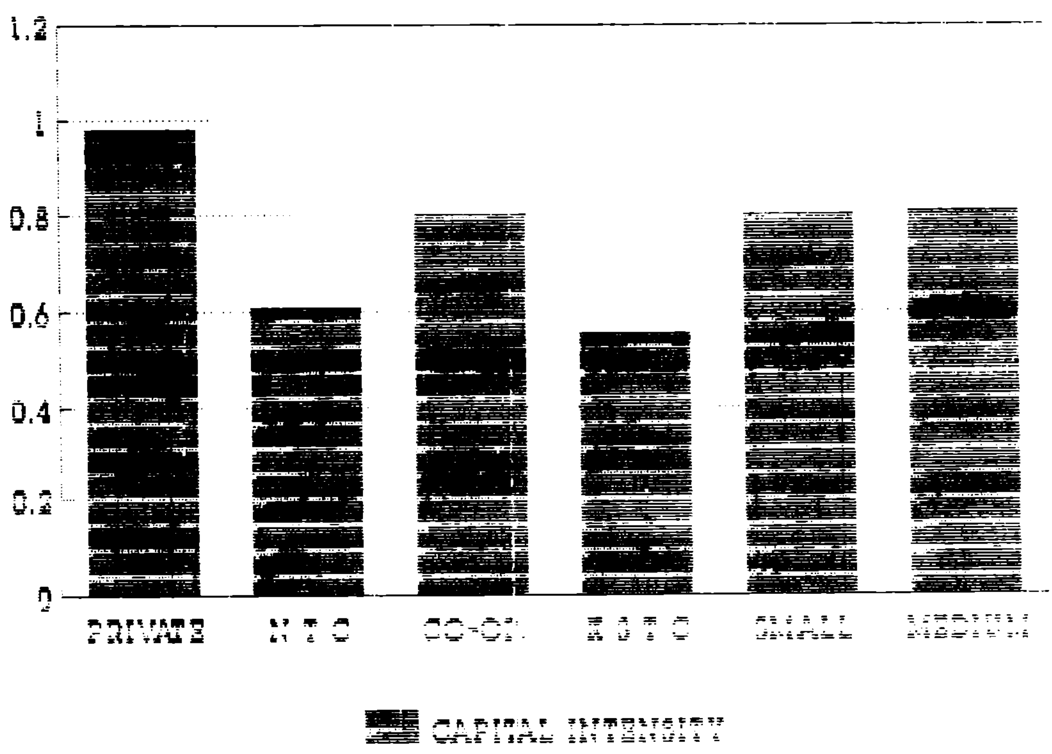


FIG. 5: SPINDLE PRODUCTIVITY(SP)

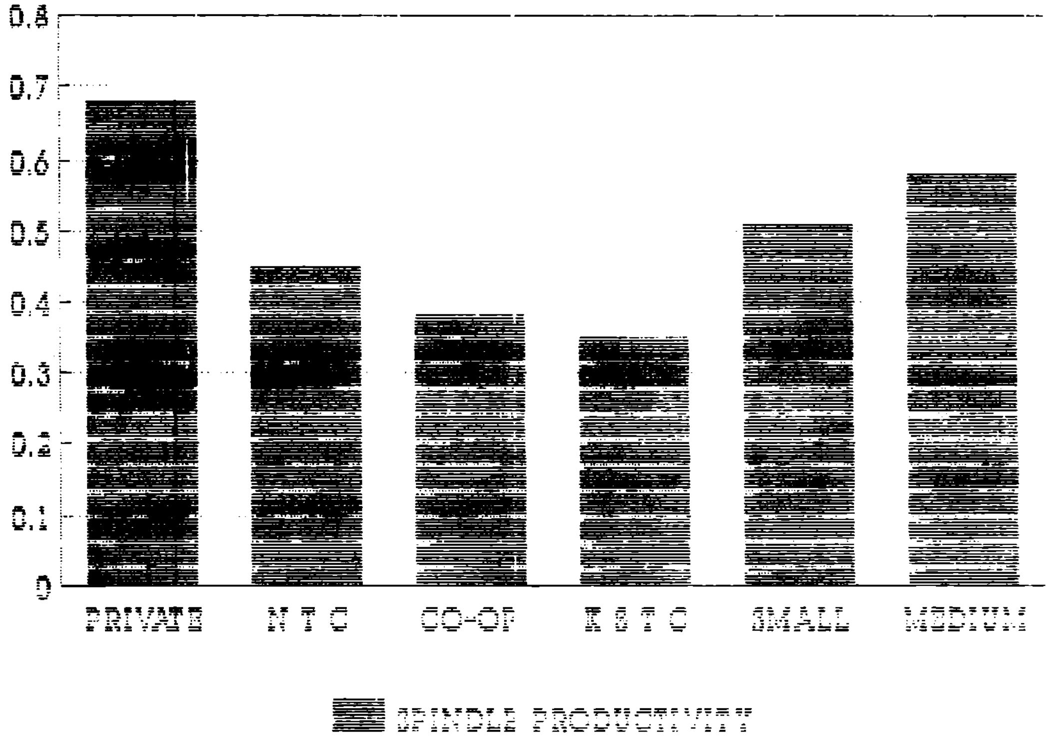


FIG. 6: TECHNICAL EFFICIENCY

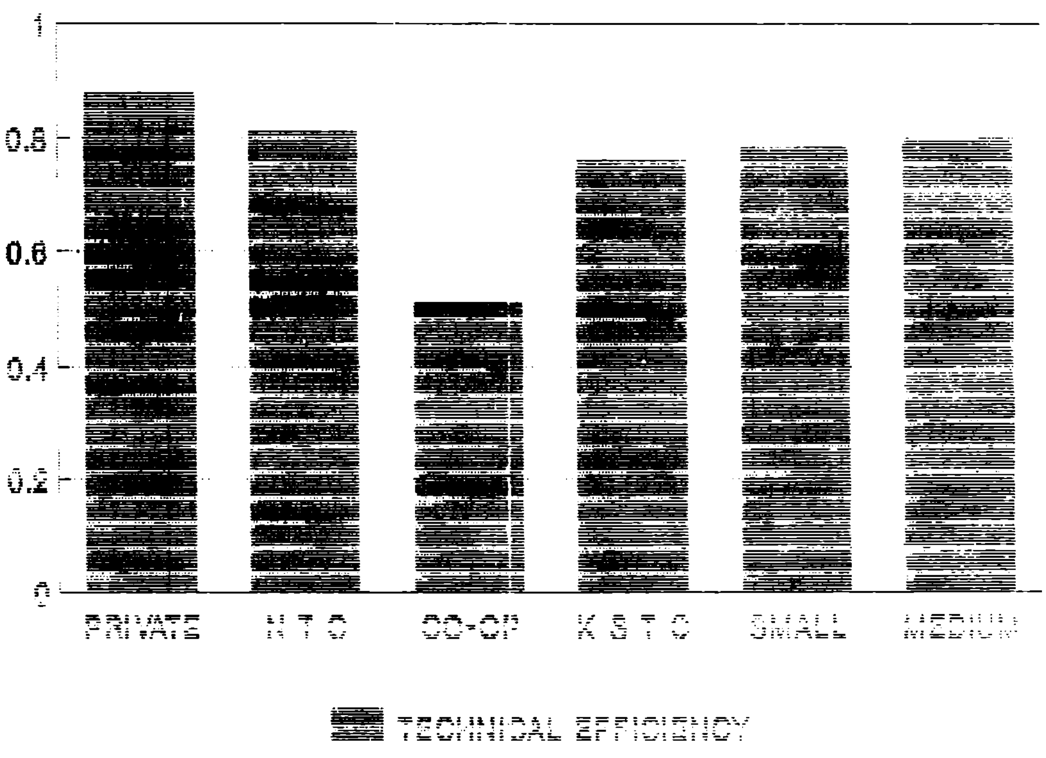


FIG. 7: CAPACITY UTILISATION

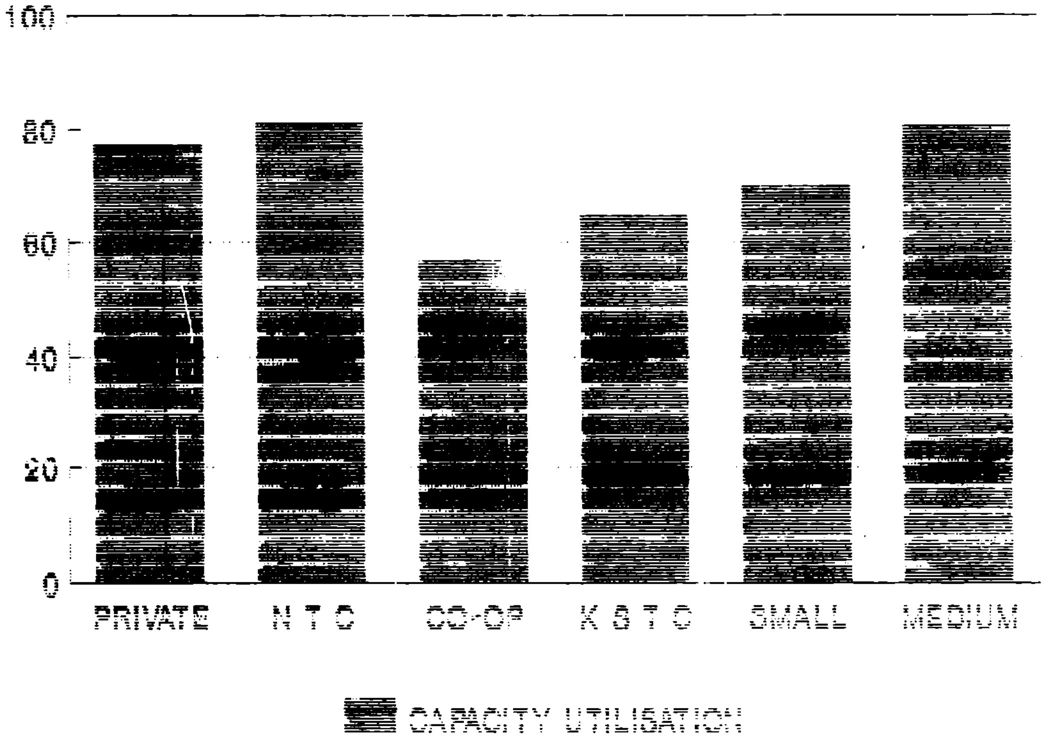
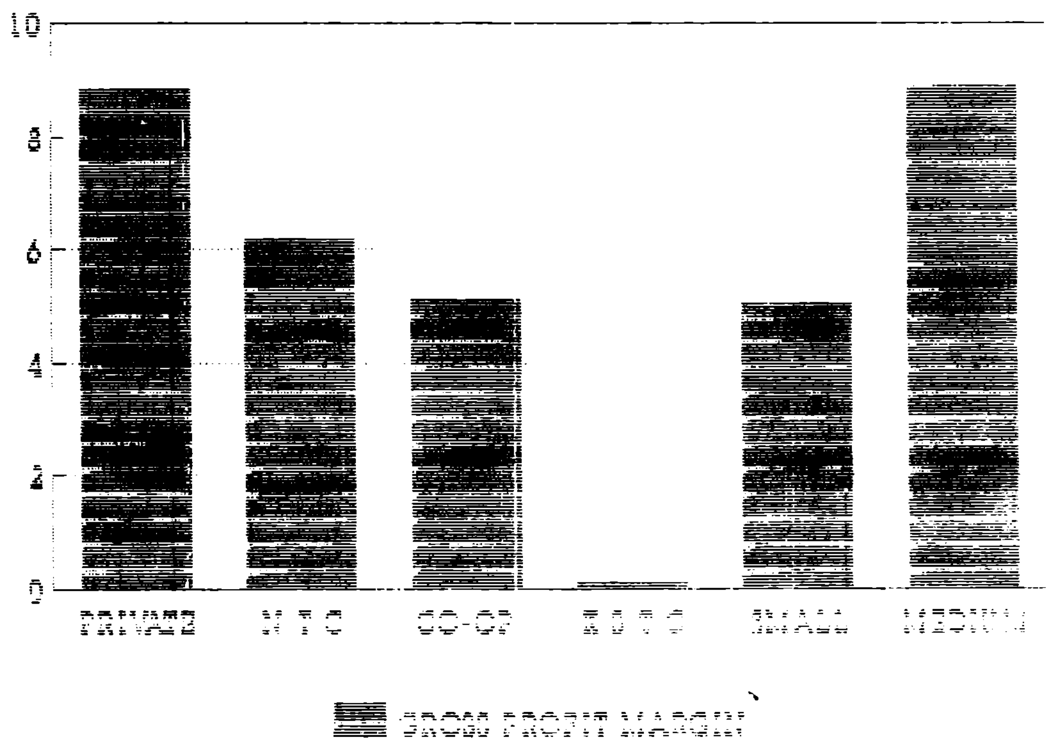


FIG. 8: GROSS PROFIT MARGIN



APPENDIX C: STATISTICAL TABLES

Appendix C-1

LIST OF SPINNING MILLS IN KERALA

Name of the Mill/Category	Year of establishment	Location	Capacity	
			Licensed	Installed
(1)	(2)	(3)	(4)	(5)
NTC Mills				
1. Alagappa Textiles Cochin Mills	1942	Alagappa Nagar Trichur	49,564	49,564
2. Vijaya Mohini Mills	1946	Tirumala, Trivandrum	30,476	30,476
3. Cannanore Spinning & Weaving Mills	1948	Cannanore	25,000	24,800
4. Kerala Lakshmi Mills	1963	Pullazhi, Trichur	41,520	41,328
Kerala Government				
1. Trivandrum Spinning Mills Ltd.	1959	Balaramapuram Trivandrum	25,200	25,200

(1)	(2)	(3)	(4)	(5)
KSTC Mills				
1. Kottayam Textiles	1968	Vedagiri, Karumulloor, Kottayam	26,760	17,968
2. Prabhuram Mills Ltd.	1973	Kottarakara Chengannur Alleppey	25,000	17,776
3. Malabar Spinnin & Weaving Mills	1883	Kallai, Kozhikode	25,000	19,524
4. Edarikkode Textiles	1986	Malappuram	25,000	15,360
Private Sector				
1. The Asok Textiles Ltd.	1952	Asokapuram, Aluva	25,396	25,260
2. Rajgopal Textiles Mills P. Ltd.	1948	Mulankunnathukavu Trichur	20,980	15,340
3. Kathayee Cotton Mills Ltd.	1952	Perumbavoor Road Aluva	25,000	14,860
4. Vanaja Textiles Ltd.	1951	Kuruchikara, Trichur	26,000	21,600
5. Pre-cot Mills Ltd.	1963	Kanjikode West Palghat	50,000	51,283

(1)	(2)	(3)	(4)	(5)
6. GTN Textiles Ltd.	1964	Erumathala, Aluva	37,080	36,684
7. Madras Spinners Ltd.	1964	Chullimade Pampampallam, Palghat	31,724	28,712
8. Eurospin Ltd.	1965	Chelembra, Malappuram Kozhikode	25,000	17,486
9. Trichur Cotton Mills Ltd.	1965	Nattika, Trichur	26,712	17,912
10. Sri. Bhagawathi Textiles Ltd.	1964	Chittoor Vannamadai Road, Palghat	25,520	25,520
11. Thiruvepathy Mills P.Ltd.	1918	Mill Road, Cannanore	25,000	17,760
12. Kerala Spinners Ltd.	1964	Komalapuram, Alleppey	15,848	15,848
13. Balaji Modern Spinners (P) Ltd.	1989	Pampampallam Palghat	2-OE 336 rotors	2-OE 336 rotors
14. Pre-cot Mills Ltd. (Unit - C)	1992	Valayar, Palghat	2-OE 6,000 rotors	2-OE 6,000 rotors

	(1)	(2)	(3)	(4)	(5)
1.	The Cannanore Co-operative Spinning Mills	1964	Thazhe Chowa Cannanore	28,000	28,000
2.	The Malappuram Co-operative Spinning Mills Ltd.	1981	Malappuram	25,056	25,056
3.	The Quilon Co-operative Spinning Mills Ltd.	1981	Chathannur Quilon	25,000	24,960
4.	The Trichur Co-operative Spinning Mills Ltd.	1987	Vazhani, Trichur	25,000	12,000

Appendix C-2

NORMS FOR PRODUCTION PER SPINDLE

Count	Spindle speed (rpm)	Twist multi-plier*	Machine efficiency (%)	Production per spindle per 8 hours (g)
(1)	(2)	(3)	(4)	(5)
CARDED COUNTS				
10s	9000	4.75	85.0	366.7
16s	11000	4.40	88.5	248.9
20s	12000	4.40	90.0	197.6
30s	13000	4.30	91.0	120.6
40s	14400	4.20	91.0	88.8
60s	15000	4.10	92.0	52.1
80s	15000	4.00	92.5	34.9
100s	14500	4.00	92.5	24.1
COMBED COUNTS				
30s	13000	4.10	91.0	126.4
40s	15000	3.90	91.5	100.1
60s	15500	3.90	92.0	56.6
80s	16000	3.80	92.5	39.2
100s	16000	3.80	92.5	28.0
STAPLE FIBRE				
20s	11500	3.00	91.0	280.7
31s	12200	3.00	92.0	156.1
40s	12500	3.10	92.5	106.1
60s	13000	3.30	93.0	56.8

(1)	(2)	(3)	(4)	(5)
POLYESTER BLENDS				
30s P/C	12800	3.80	91.0	134.3
50s P/C	14500	3.80	92.0	71.5
60s P/C	14500	3.80	92.0	54.4
80s P/C	14500	3.80	92.5	35.5
90s P/C	14500	3.80	92.5	29.8
40s P/V	13500	3.30	92.0	107.1
60s P/V	12500	3.30	92.5	54.3
80s P/V	12500	3.30	93.0	35.4

* The values shown are largely based on spinning mill practice. The twist multipliers used by composite mills are about 0.1 to 0.2 higher, particularly in coarse and medium counts. Composite mills may therefore, correspondingly reduce the production per spindle norms indicated here.

Source: SITRA.

Appendix C-3

GROSS NET RATIO AND AGE OF SPINNING MILLS

IN KERALA at 1982-83

Mill	Gross net ratio (1982-83)	Age
Quilon Co-operative	1.27	12
Thiruvepathy	4.74	75
Trivandrum Spinning Mill	1.61	34
Malabar Spinning & Weaving Mill	1.16	109
Vijaya Mohini	1.23	47
Kottayam Textiles	1.20	25
Kerala Laxmi	1.41	30
Malappuram Co-operative	1.32	12
GTN	1.56	31
Euro-Tex	2.57	28
Madras Spinners	1.87	29
Asok Textiles	1.76	41
Cannanore Co-operative	2.97	29
Prabhuram	1.21	20
Alagappa	1.22	51
Kathai Cotton	1.42	41
Raj Gopal	1.48	45
Vanaja	2.05	42
Cannanore Spinning & Weaving Mill	1.60	45
Sri Bhagwathi	1.60	29
Trichur Cotton Mill	1.75	28
Average gross net ratio:	1.76	

Appendix C-4

STATISTICAL TABLES--PAIRWISE Z TEST

GROUPS	Z-VALUE
Labour Productivity (LP_1)	
Private - NTC	3.23***
Private - Co-operative	6.78***
Private - KSTC	4.94***
Small - Medium	1.91
Labour Productivity (LP_2)	
Private - NTC	6.69***
Private - Co-operative	3.17***
Private - KSTC	2.51**
Small - Medium	0.068
Capital Productivity	
Private - NTC	2.51**
Private - Co-operative	4.46***
Private - KSTC	1.67
Small - Medium	1.29

Spindle Productivity	
Private - NTC	3.94***
Private - Co-operative	4.60***
Private - KSTC	5.71***
Small - Medium	1.25
Capital Intensity	
Private - NTC	6.01***
Private - Co-operative	1.07
Private - KSTC	6.80***
Small - Medium	0.26
Capacity Utilisation	
Private - NTC	-1.60
Private - Co-operative	0.05***
Private - KSTC	5.38***
Small - Medium	-2.21**
Gross Profit Margin	
Private - Ntc	1.31
Private - Co-operative	1.26
Private - KSTC	3.86***
Small - Medium	2.25**

Operating Assets Turnover	
Private - NTC	3.12***
Private - Co-operative	3.48***
Private - KSTC	3.22**
Small - Medium	0.998
Gross Profit per Spindle	
Private - NTC	3.18***
Private - Co-operative	2.83***
Private - KSTC	4.62***
Small - Medium	1.89

*** at the 0.01 level.
** at the 0.05 level.

Appendix C-5

SIMPLE AVERAGE ANNUAL GROWTH RATES AND ESTIMATED TREND GROWTH RATES

Ownership/size	1982-83 to 1986-87	1986-87 to 1991-92	1982-83 to 1991-92	Estimated trend growth rate
(1)	(2)	(3)	(4)	(5)
I. Labour Productivity (LP_1)				
Private	6.87	6.85	6.86	4.98
NTC	8.23	8.09	8.15	9.78
Co-operative	12.50	16.14	14.52	12.53
KSTC	7.04	15.45	11.71	7.98
Small	8.65	6.07	7.24	5.80
Medium	5.38	11.67	8.88	9.17
II. Labour Productivity (LP_2)				
Private	15.14	5.58	9.82	2.20
NTC	2.61	-3.78	-0.94	5.28
Co-operative	9.57	-30.80	4.08	4.71
KSTC	-59.25	13.46	7.22	5.52
Small	3.78	4.13	3.98	2.76
Medium	1.77	4.90	3.51	5.08

(1)	(2)	(3)	(4)	(5)
III. Capital Productivity (KP)				
Private	2.75	-1.83	0.21	-0.19
NTC	1.06	3.20	2.24	4.93
Co-operative	5.97	11.02	8.77	8.55
KSTC	6.40	4.96	5.60	3.01
Small	2.32	1.55	1.89	1.85
Medium	5.30	-1.30	1.63	2.89
IV. Spindle Productivity				
Private	5.02	17.68	12.05	7.26
NTC	5.54	6.05	5.82	7.71
Co-operative	7.70	15.36	11.95	9.26
KSTC	4.82	11.57	8.57	5.93
Small	4.20	16.31	10.93	6.46
Medium	5.75	10.28	8.27	9.41
V. Capital Intensity				
Private	6.85	4.50	5.54	4.77
NTC	6.51	4.93	5.63	5.10
Co-operative	-16.91	4.24	0.48	-3.89
KSTC	2.06	6.91	4.75	4.56
Small	0.78	3.61	2.35	2.76
Medium	1.98	8.26	5.47	4.56

(1)	(2)	(3)	(4)	(5)
VI. Capacity Utilisation				
Private	1.50	2.41	2.01	1.28
NTC	5.04	1.60	3.13	2.72
Co-operative	0.813	8.07	4.85	6.20
KSTC	0.453	4.34	2.61	1.97
Small	1.49	3.42	2.56	2.48
Medium	0.228	2.48	1.48	1.70

Appendix C-6

ESTIMATES OF TOTAL WORKERS PER 1000 SPINDLES BY OWNERSHIP AND BY FIRM-SIZE: PANEL DATA: 1982-83 TO 1991-92

Ownership/size	Workers/1000 spindles
Private	25.01
NTC	20.95
Co-operative	28.11
KSTC	19.71
Spindles ≤ 26,000	24.01
26,000 ≤ 50,000	22.83
All Units	23.67

Appendix C-7

AVERAGE PRICE OF V-797 AND DCH-32 (SOUTH) COTTON VARIETIES DURING VARIOUS MONTHS IN THE YEAR 1991-92

(Price in Rs. per quintal)

Month	V-797	DCH-32 (South)
September	2702	5179
October	2697	4796
November	--	--
December	--	5427
January	2748	5767
February	2647	5460
March	2453	5349
April	2332	5074
May	2207	5062
June	2405	5062
July	2515	5062
August	2409	4900

Source: Spinner's Year Yook (1993).

APPENDIX D: SCHEDULES

Appendix D-1

LIST OF INFORMATIONS COLLECTED THROUGH INTERVIEW FROM EACH UNIT

1. Spindle speed for each count of yarn.
2. Standard twist for each count of yarn.
3. Average spindle efficiency.
4. Average yarn breakages per hour and per shift.
5. Details of humidification plant.
6. Fibre quality, raw material quality, mixing methods.
7. Energy conservation methods adopted.
8. Details of technical change (See Appendix D2).
9. Age of the plant.
10. Age profile of machines.
11. Power used in the factory.
12. Managerial informations (See also Appendix D3).
13. Number of counts spun during the last 10 years.
14. Promotion and recruitment policy.
15. Work incentive measures adopted in the mill.
16. Training facilities to employees.
17. Grievance redressal forum, quality circles etc.
18. Reasons for productive efficiency/inefficiency and loss/profit.
19. Suggestions from employees (selected on random basis), production manager/executive.

Appendix D-2

TECHNICAL CHANGE IN THE TEXTILE INDUSTRY

Name of the Mill :

Age of the Machine :

Year(s) of Modernisation of each item :

Processing step	Traditional	Modern	Sophisticated (Please mention the machine & make)
	Processing Features		
1. Opening & Cleaning			
a. Plucking	Manual pluck & feed	Auto belt/cursel feed mechanical pluck	
b. Scutcher	Manual doffing & change of axis	Auto doffing & axis change larger lap, auto transfer to cards Better dust collection	
2. Carding	Low speed vibrating combs manual doffing and small cans	High speed rollers, auto doffing & large cans	

3. Drawing	Slow speed, manual doffing	High speed auto doffing & larger cans. Auto-leveller needed if chute feed at cards
4. Roving	Manual doffing	Auto doffing
5. Spinning		
a. Ring	Manual doffing and piecing	Auto doffing and piecing
b. Open-end		Sliver from draw frame broken into constituent fibre in spinning vessel (rotor) Higher rpm & draft factor
6. Cone winding	Manual feed of spindle & cheese doffing & knotting	Feed knotting and doffing automated little speed change
7. Warping	Slower speed & smaller beam size	Higher speed, larger beam & double sided creels
8. Pirn winding	Manual feed & doffing	Auto feed & doffing

Note: Please tick whichever is applicable in each item.

Appendix D-3

Name of the Mill:

Capacity Utilisation:

	Factors affecting Capacity Utilisation	Rank
A.	Old and Obsolete Machinery	
B.	Raw Material Shortage	
C.	Power Problems	
D.	Demand Deficiencies	
E.	Strained Employer-Employee Relations	
F.	Want of Hands	
G.	Sick Units	
H.	Unscheduled Breakdowns	
I.	Managerial Shortcomings	

OTHER INFORMATIONS

1. Manager (Entrepreneur)	: Prior Experience	..... Years
	No Prior Experience	
	Experience in Management	.... Years
	Experience in Production	..... Years
Age	: ..... Years.	

2. Technology	:	High Technology Low Technology
3. In House R&D Ratio of R&D to sales	:	
4. Foreign Trade Ratio to Import to Sales	:	Export
5. Entrepreneur education (Senior Manager)	:	1) School 2) University 3) Post-Graduate 4) Professional degree
6. Gross Retained Earnings	:	
7. Profits (Yes=1 for firms reported higher profits)	:	
8. Growth	:	Ratio of value added to output.

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