CHAPTER V

CAPACITY UTILISATION IN THE INDIAN NON-ELECTRICAL AND ELECTRICAL MACHINERY INDUSTRIES: AN EMPIRICAL ANALYSIS DURING 1973-74 TO 1988-89
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5.1 INTRODUCTION

The concept of capacity utilisation is extensively used in explaining the changes that take place in the rate of growth of investment, employment, income and the overall development of the national economies. Only passing references to the concept of capacity are found in economic analysis while dealing with imperfect market conditions in the theory of price and value. Chamberlin[1] in this context has observed that the concept of industrial capacity and the question of its effective utilisation has been paid relatively little attention in economic literature. To him, except for some limited references on the concept of capacity and the implications of full utilisation under Theory of imperfect markets, not much serious discussions are found on this vital question. He felt, economists by and large for studying the aspects related to capacity utilisation have adopted a less theoretical but a more empirical approach. This field, hence, has remained a dormant area of research in economics for a long time. At the core, full utilisation of industrial capacity addresses a number of critical questions that have a bearing on the economics of both the developing and developed nations.

Achieving full capacity utilisation appears to be at the crux of a number of pressing economic problems that are specifically faced by the developing nations. Under-utilisation of capacities in important sectors can cause sectoral imbalances in the process of economic growth. Both in theoretical and empirical studies, a close association has been proved between capacity utilisation and other crucial economic variables viz. the aggregate investment, employment, unemployment, factor
productivity levels, structural retrogressions, trade imbalances, trade cycles, income growth, inflation, etc.,. Defining 'economic growth' to be a function of 'investment growth' has undermined the importance and the role that intensive and fuller utilisation of the existing capacities had to play in the process of accelerating the pace and pattern of economic development. In view of the severe resource constraints to meet the growing demand for capital outlays, the developing nations have to realise and accord top priority to improving the rates of capacity utilisation in their productive sectors. This should form the part and parcel of their developmental effort. Optimal utilisation of the existing capital investment is a matter of serious concern in order to harness the full proceeds of industrialisation. Planning for fresh investments on plant and machinery vis-à-vis fuller utilisation of the existing stock of plant and machinery i.e., capacities already built in the system, have to be carefully evaluated of their economic importance so that optimal growth is achieved without wastage of scarce capital resources.

Full capacity utilisation of the manufacturing sector, will not only improve the overall factor productivity levels but also result in generating higher levels of aggregate demand by generating additional income. Increased demand for intermediate commodities by the industrial sector in the process of achieving fuller capacity utilisation and the induced demand from the household sector on account of higher per capita income will trigger the economy progressively to operate at much higher levels of aggregate investment, employment, output and income. Most of the developing nations by providing importance for generating more employment and income through fresh doses of net additional investments, have in relative terms, neglected the significance of improving the conditions to achieve better utilisation of the existing industrial capacities as a means for generating additional employment and income.
Changes in the rate of capacity utilisation rates over time, have spelt serious economic consequences in promoting the operational efficiency and toning up the process of industrialisation. The existence of high level of under-utilised capacities across different industrial sectors in the developing economies have the risk of leading the system to succumb to lop-sided and staggered economic growth. Much has been written focusing the need to improve capacity utilisation in the developing nations so as to reap the maximum flow of goods and services. Empirical studies, examining this issue have pointed out a number of causal factors. Little, et.al.[2] have observed that just as too fast migration of labour creates urban unemployment, so also, too much diversion of investible funds on a number of projects will create more industrial capacities than what can be effectively utilised. Indeed, chronic under-utilisation of manufacturing capacity among developing nations, as in the case of urban unemployment has been a common phenomenon.

In the development process of the developing nations, establishment of new industries, even though, creates new opportunities for accelerating the process of economic growth, the neglect of fuller utilisation of the built up capacities potentially nurtures disastrous consequences on the national economy. Most of the under developed economies have surplus manpower but shortage of required technical know-how and access to additional capital resources. In this context, achieving full utilisation of industrial capacity becomes a serious matter that could limit the entire growth process. Concerted efforts and multi-pronged policy programmes directed towards better capacity utilisation can only provide a rationale solution in quickening the process of economic development.

5.2 APPROACHES TO DEFINE CAPACITY

To understand the economic aspects of capacity utilisation, economists have used different approaches to define capacity. The 'normal' approach is the common approach according to which average capacity utilised over the last few years is taken...
as the standard for each firm or the industry. For example if two shift operation with an average of five per cent machine down time has been customary practice in industry - x during the last few years, then the capacity for the industry x is defined in those terms.

The 'normal' approach is certainly a feasible one. In terms of its use it has certain difficulties viz. in some industries during certain times we would expect 'normal' practice to represent considerable pressure to raise prices and expand capacity, while in other cases and at other times 'normal' practice might represent no such pressure. As a consequence, an aggregate capacity figure defined in terms of 'normal' practice may be difficult to interpret economically. Interpretation is made easier by a careful selection of 'normal' periods, avoiding cyclical peaks and troughs[3].

A second approach, the so-called 'engineering' approach, uses an estimate of the maximum attainable output per machine-year as a measure of the annual capacity of a machine. The approach is feasible for establishments or industries whose output is fairly homogeneous, so that the potential output of a machine in physical quantities is easily expressed. Electric generating stations and cement plants are examples of such establishments. Engineering capacity, like normal capacity, is sometimes difficult to interpret economically. In fact, normal capacity and engineering capacity may in many cases be closely related, since an 'engineering' judgment as to maximum attainable output often allows for 'normal' down time of machines, holidays, and other operating conditions.

A third approach is to define capacity as the most efficient operating rate-approach that is, as the minimum point on the short-run average cost curve. That this approach is at present scarcely feasible should not be a serious objection, for it is important to be clear about concepts even if measurement techniques lag behind.
That this definition runs counter to the popular notion of capacity, as some sort of upper limit to output should perhaps carry some weight.

A more serious problem under this definition is that in some firms or industries, we might expect price pressures or high investment demand to build up immediately above capacity, while for other firms pressures might not build up until well in excess of capacity. For one industry increasing output to 10 per cent above the most efficient level might raise marginal costs by only, say, two per cent. For another industry the corresponding rise in marginal costs might be 50 per cent. 'Capacity' under this definition might well have widely differing price, investment and efficiency implications for the two industries.

Leeuw[4] has defined capacity in terms of the difference between marginal cost and average cost. Specifically, it refers to that level of output at which short-run marginal cost exceeds minimum short-run average total cost by some given percentage. Capacity under this definition would be a point at which the cost of an additional unit of output is well above the most efficient unit cost. Therefore it could be expected that a high rate of capacity utilisation will represent appreciable upward price pressure and a high level of investment demand.

Choice of the 'given' percentage in this definition, at which marginal cost is 'well above' average cost, is to some extent arbitrary. This lack of precision arises from the fact that capacity is an attempt at a one-number summary of a complex cost situation. No one number can provide a complete summary, and no single number is best for all purposes. Since the percentage should be one at which businesses are aware of the pressures on the existing facilities. It might be selected by relating symptoms of such pressures -for example, slowdowns in efficiency or growing lags in filling orders- on the marginal-average cost margins for a particular facility (holding labour and materials costs constant). The percentage of capacity use hence may be
accompanied by significant slowdown or lags. However, the percentage of capacity use can be chosen by relating it to past price increases or major investment decisions taken having relevance to marginal-average cost margins. The percentage might be permitted to differ between broad classes of firms. But in the interest of a simple concept to arrive at capacity use one can probably assume it to be identical over different industries of an economy.

As in the case of the minimum average cost definition, the approach provided by Leeuw is scarcely feasible at present. But, the objection should not carry great weight at the stage of formulating concepts, because this approach probably comes fairly close to the popular notion of capacity. Its principal advantage, is that it leads to fairly clear expectations about the relationship of capacity utilisation to investment, prices, and other variables.

This approach suggest that it is marginal cost which is the most profitable criterion to use in judging what to include in a measure of capacity. If second-shift operation is no more costly per unit of final output than first-shift operation for product x, then it should be counted in capacity to produce x. This is so even if 'normal' operations have not recently made use of a second shift. If the second shift is not expected to create any price pressures or drive to add new plant and equipment, why to exclude it from capacity?. If 25-year-old plant and equipment is much more costly to operate, than a new plant and equipment for product Y, then it should be excluded from capacity to produce Y. So the final decisions as to an industry's capacity remains a matter of judgment under this definition. But it is important to be clear as to what is being judged.

5.3. FACTORS INFLUENCING CAPACITY CREATION AND CAPACITY UTILISATION

Capacity creation and capacity utilisation are influenced by many factors. To Budin and Paul[5] the utilisation of capacity are often influenced by market supply
and demand conditions (long-run and short-run), government policies, the degree of monopolisation within an industry, the social value system of the dominant entrepreneurial class and the attitudes of the managerial class in the firms.

A number of factors have became responsible for changing the attitudes of the entrepreneurs towards better utilisation of capacity. Employment laws, in the event of surplus labour force in a firm, typically influences its decisions on the expansion of work force. Administrative delays by government agencies hamper the smooth acquisition of additional equipment. Supplementary inputs have their influence on the production process and can do much harm while the entreprises consider additional shifts of operation for the first time[6]. The availability of raw materials and spare parts also influence the ability to utilise the installed capacity. In some cases, capacity under-utilisation is also related to restrictive market practices of the firms in an industry. The drive towards achieving higher per unit profit and the steps taken to avoid the risk of sinking new capital also play crucial roles when firms face expanding market. Thus, a number of operational conditions cause deterrent types of influence on both capacity creation and its utilisation.

The growth theories and models have greatly emphasised the importance of capacity creation and not capacity utilisation. Kuznets[7] defined economic growth as the long-term rise in the capacity of the system to supply increasingly diverse economic goods to its population. This growth in the capacity of the economy is based on the conditions that shapes the advances in the technology of production, institutional and ideological adjustments. He has laid stress only on the creation of capacity and not on the utilisation of capacity. Adam smith[8] the founder of the classical school in his book "Wealth of Nation", has observed that the scarcity of natural resources would limit the growth process because it sets the limitation on the creation of productive capacities in the system.
Ricardo[9] approached the growth process from the supply side. In his book, "Principles of Political Economy and Taxation" has observed that the central problem of the political economy is the distribution of output. Wages and Profits are determined on the basis of surplus principle. He established an inverse relation between wages and profits. Over production and crisis have a role in Ricardian economics while explaining capacity creation and its effective use in the actual production. In an indirect way, Ricardo advocated conditions that would lead to under utilisation of capacity.

Malthus[10], whose theory is considered as 'the earliest demand side theory' explains that when the wages rise due to competition, effective demand does not increase because workers may prefer leisure than increased consumption. Thus, there will be always a glut in commodity market due to under consumption. This will breed economic stagnation. Therefore, every action must be taken to raise the effective demand in order to exploit the production at full capacity use of the capital resources.

Harrod[11] and Domar[12] presented a model to maintain the growth of an economy at full employment equilibrium. In Domar's model, the demand effect is explained by the increase in income ($\Delta Y$) which is equal to multiplier ($1/1-MPC$) times the increase in investment($\Delta I$). On the other hand, supply effect is demonstrated by potential social marginal productivity of capital which represents the total increase in the productive capacity of the system. At full employment, the aggregate supply should be equal to aggregate demand. Thus, inorder to maintain a steady growth in income, the growth rate of investment must be equal to the marginal productivity($MPs$) times the productive capital. In this way Domar highlighted the significance of increase in the total productive capacity. The utilisation of capacity was not treated in his analysis but was rather implicitly assumed that there exists full capacity utilisation.
Harrod's[13] model is based on three growth rates of income viz., 1) Actual growth rate, ii) Warranted Growth rate and iii) The Natural Growth rate. This approach has not explained the relationship between Capacity Utilisation and the natural growth rate in income. It treats the maximum growth rate in income or output at full employment being determined by growing population and the rate of technological progress. Hanson[14] also feels population as a crucial factor in determining aggregate effective demand. Hence, if, population declines, conditions for secular stagnation according to him will set in. Like Harrod, Joan Robinson[15] in her model stressed the need for population and technology as the most important factors in determining the growth. Meade[16] developed another variant of a neoclassical model in which economic growth was explained under the assumption of perfect competition in the economy and constant returns to scale. He argued the real income per head can be raised either by the rate of growth of higher levels of technology(r) or by an increase in the capital stock(k) weighted by marginal product(U). Solow[17] also constructed a neoclassical economic growth model. He allowed variable factor proportions in production and took a continuous production function in his analysis of growth. This, in a way was an elaboration of Harrod's model. Solow admitted the features of Harrods' model viz., homogeneous capital, proportional savings function and a given growth rate of labour force. But, according to Solow, when production takes place under the condition of varying proportions of factors and constant returns to scale, there cannot be serious problems threatening the growth. Thus, in Solow's model, the steady growth is achieved through factor substitutability.

From the above discussion it is clear that the factors which influence capacity creation and capacity utilisation are the market supply, the long-run and short-run demand conditions, changing of government policies from time to time, the degree of monopolisation within an industry and the attitudes of entrepreneurial class. Even
though, the increasing levels of capacity utilisation will lead the growth of industry as well as the economy, the growth theories did not pay much attention in explaining the influence of the capacity utilisation levels on the growth of industry output. But, the growth theories to some extent have contained important reference to capacity creation.

5.4. A THEORETICAL VIEW OF CAPACITY UTILISATION

Capacity is a prominent variable in several modern business cycle theories, especially those based on the acceleration principle[18]. However, comparatively less important role is given for it in the theory of firms. Chamberlin observes that imperfect competition causes inefficiency in economic organisation and thus gives rise to excess capacity[18]. Excess capacity may be defined as the difference between the output that the productive agent is capable of producing and the output it is actually called upon to produce. Full capacity output is defined as that output level associated in a competitive equilibrium situation.

For the individual firm, this would be defined by 'OC' in Figure 5.1. At this level of operation, we have full equilibrium position equating marginal cost with average cost, average revenue (price) and marginal revenue. It is an optimal rate of output, with normal profits. But, in imperfect competition, the output produced (tangency solution) would be less than the above defined output(Figure 5.2). This would correspond to the loss occasioned by not having competitive market and is viewed as a departure from full capacity. Implicit in this comparison of the two operating points under competitive conditions is the assumption that the cost curve is invariant in the shifts between the two regimes. Since the cost curve is drawn up for given relative factor prices, the imperfection must all be in the product market and not in the factor market[19].
The main advantage of Chamberlin's concept is that it brings in the element of cost in defining capacity. The problem of aggregation of capacity takes into account this economic consideration. But, this concept poses the problem of obtaining a sharply defined minimum point for empirical average cost functions. Moreover, this type of definition has no link with the demand for output. Empirical determination of this version of capacity output is indeed difficult especially in the context of multi-product firms. In empirical estimates cost curves were L-shaped, as Johnston[21] has found in a number of his own studies and others that he has surveyed. Hence, the concept of capacity may well be approximated by using the engineering approach used by Smithies[22]. In his trend cycle model in which the
capacity variable plays a significant role, Smithies observed, "By full capacity output, I mean the output that the existing stock of equipment is intended to produce under normal working conditions with respect to hours of work, number of shifts and so forth."

There are many ways of interpreting the phrase 'normal working conditions'. It may be restricted to a single-shift operation or may be to a double or triple-shift operations, the number of days to worked within an year, the number of shifts within a day and, the number of hours within a shift have to be specified, if a clear picture of the capacity existing in a plant has to be ascertained. Without this, it is meaningless to talk about capacity since a plant working in two shifts or 300 days in an year will be having a much lower capacity than a plant working in three shifts or for 350 days in an year.

Although smithies' approach comprehends the capacity concept clearly, yet it does not provide us with enough information to go to the field with a measuring rod. His definition is more concerned with the cyclical aspects of capacity utilisation. One of the major drawbacks of this approach is that it does not take into account cost consideration. The concept of capacity for a firm or an economic sector may mean very little in the absence of the cost consideration. Thus, Bhatia[23] observed that the very concept of productive capacity is difficult to state and attempts to measure it are open to all types of criticism. The main discrepancies in the concept of productive capacity are as follows:

- The total output of plant is not the same as value-added in production, the latter concept being most relevant for the assessment of capital. Given the factor and commodity prices and the technological conditions, the ratio of value added to total output would be stable. Hence, the differences would be unimportant when establishing the index of capacity in use. But, even in this case, a firm which now produced a component previously bought in would record no rise in final output though value added might reasonably be expected to have risen.[24]
• Technological constraints exist in any large plant using an array of processes. Hence, some plants may be fully used while other units may not be required to run at full capacity.

• Productive capacity generally has only a most imperfect connection with any technical measure of the productive capacity of machines. In some processing industries, such as petroleum refinery, the links between the technical and the economic measures of capacity are fairly close.

If the difficulties inherent in the concept of capacity are borne in mind, the actual problems of measurement can be readily appreciated.

5.5 MEASUREMENT OF CAPACITY

Capacity output refers broadly to the volume of output per unit of time that a stock of plant and equipment can produce. Harries and Taylor[25] have defined capacity output as the output that could be produced during any given time period if all available inputs are fully utilised. Robinson[26] and Ball[27] have distinguished 'economic capacity' and 'physical capacity'. The economic capacity according to them refers to that output produced by utilising the available factors and material inputs so that profitability at higher levels of monetary demand can be easily maximised and that no excess capacity is left which could not be brought back into productive use in order to further maximise the profitability at higher levels of market demand. Physical capacity in a competitive firm is defined as a condition in which potential output level is less than the actual output level, resulting in non-achievement of average cost to be at its minimum.

An attempt in the following section is made to discuss various methods of estimating capacity utilisation and the economic implications involved in each of them. The concept of capacity is related to the size of the plant and machinery and it is widely used in analysing economic development. The currently available measures
of capacity have major discrepancies both in regard to their data base and their theoretic implications. Evaluating these measures will facilitate in arriving at a proper judgement as regards their economic implications and the desirability of their use in empirical studies for the purpose of estimating industrial capacities.

Six alternative measures of capacity utilisation are frequently used in empirical studies. These are:

i) The Wharton Index of Capacity Utilisation
ii) The RBI Index of Potential Capacity Utilisation
iii) Measure Based on Two Shifts
iv) Minimum Capital - Output ratio Measure of Capacity Utilisation
v) National Productivity Council Measure Based on Machine Hour and
vi) The Production Function Approach to Estimate Capacity Utilisation

5.5.1 THE WHARTON INDEX OF CAPACITY UTILISATION

Wharton School developed an index to measure the capacity utilisation. It is one of the widely used capacity measurement tool in applied economic research. It is constructed by a very simple procedure, and provides quick and frequent estimates, useful in economic statistics. The Wharton Index of capacity utilisation is based on time series data of output. The peak level of output in a time series output is treated as the capacity output. Capacity output between the peaks are estimated by joining the successive peaks by a linear straight line. Even though this method is called as "Trend Through Peaks Method", such linearisation is not allowed, if, the successive peaks are lower than the previous ones. The basic argument behind such a procedure is that once a level of capacity is built up, it will not decline in the subsequent periods. For the period before the first peak and the period after the last peak, capacity is estimated by extrapolation of the trend line. By using this method, capacity utilisation is obtained as a ratio of the actual production to the capacity level of output.
In using this method several problems arise due to the nature of the time series data used, viz., monthly or quarterly and the identification of peaks and peak-wise linearisation. It is argued that peaks which are identified as estimated capacity output may not truly reflect the capacity output of the industry. In under developed economies characterised by supply constraints and other structural rigidities due to market intervention by the state by way of controls and regulations, peaks which are identified may in fact be lower than the true or actual peaks. The consequence of this would result in capacity estimates to get either underestimated or overestimated.

Klen and Preston[28] objected to this method of capacity measurement on the ground that "some peaks may be marked as full - capacity utilisation peaks when in fact there may have been considerable under utilisation of capacity". The objections and shortcomings of this method has been summarised by Phillips[29] in his survey of various alternative measures of capacity. He observed the Wharton School Index of Capacity Utilisation often is prone for upward biased estimates. He felt the Trend Through Peak Method presupposes that capacity expansion takes place in a smooth, gradual and linear manner which may not be true in real world empirical conditions. The straight line segments also imply a uniform rate of net investment between peaks for a given marginal capital-output ratio which goes against the standard acceleration principle. Behrman[30] has pointed the problems involved in the process of aggregation of data over periods on the ground that vintage differences in capital would affect the true reliability of output. Whenever capacity expansion takes at discrete jumps then again, this method's reliability is affected. However, when aggregation is done across several firms, then expansion in capacity could be smooth and continuous.

5.5.2 THE RBI INDEX OF POTENTIAL UTILISATION OF CAPACITY

Reserve Bank of India (RBI)[31] to measure capacity utilisation has developed an Index of Potential Utilisation of Capacity. It is a modified version of the Wharton
School Index of Capacity. Some differences in the method adopted by RBI distinguishes it from the Wharton School Index. The important differences are:

i) The RBI Index of Potential Utilisation of Capacity makes use of monthly output indices for locating peaks while the Wharton index uses the quarterly time series data on output.

ii) The monthly peaks are treated as the potential output in the RBI Index and therefore successive peaks are not connected by linear interpolation as is done in the Wharton Index. The monthly peaks, if, connected over the respective years would look like a discrete stepwise function.

iii) In some industries like sugar, tea and salt the RBI's monthly indices of output are not de-seasonalised and hence annual peak is considered to be the indication of potential output rather than monthly indices to take account of seasonality.

Despite these differences, the RBI Index of Potential Utilisation is very much in the intellectual tradition of the Wharton School Index.

5.5.3 MEASURE BASED ON TWO SHIFTS

Paul[32] while examining the question of capacity utilisation in the Indian Industry has rejected Wharton Index. He felt that supply constraints and other institutional rigidities in the system makes it unsuitable for empirical measurement of capacity. He adopted a modified engineering approach based on 'Current Industry Practices' as regards the shifts worked in the Indian industry.

Paul classified the industries into three groups based on the number of working shifts. For 275 industries, the data was reported on the basis of single shift by CSO. For only seven industries, the data was on the basis of two shifts and for the remaining 18 industries, the data was on the basis of three shifts. Paul based his
assumption, that industries in the first group have been working on two shift basis and industries in the second group to be working on the basis of two and half shifts. The justification for the change in the assumption about the number of shifts was that in many industries peak outputs were consistently higher than the reported capacity on a single shift basis. The expanded two shift operation would reflect the potential capacity for each industry.

5.5.4 MINIMUM CAPITAL-OUTPUT RATIO MEASURE

The size of fixed capital stock should specifically bear a sound relationship with the output that it can produce. The minimum-capital-output ratio measure of capacity was developed based on this sound economic principle. In this method capital-output ratio should be computed for the time series data. Then, a benchmark year gets selected on the basis of the observed lowest value in the capital-output ratio. In choosing the benchmark year other empirical consideration can also be taken into account. The lowest observed capital output ratio is treated to represent the capacity level of output. The estimates of capacity is obtained from real fixed capital stock deflated by minimum capital-output ratio. The utilisation rate is given by actual output as a proportion of the estimated capacity

\[ C = \frac{C}{(C/O) \text{ min}} \quad \ldots \quad \ldots \quad \ldots \quad [1] \]

\[ U = \frac{O}{C} \times 100 \quad \ldots \quad \ldots \quad \ldots \quad [2] \]

Where,
- \( \hat{C} \) = Estimate of capacity
- \( C \) = Gross fixed capital
- \((C/O) \text{ Min}\) = Minimum capital output ratio
- \( U \) = Capacity Utilisation
- \( O \) = Gross value added
Capacity utilisation in this method can be also estimated by fitting a trend for the capital-output ratio and the deviations from this trend are then used as a measure of the extent to which the capital stock is being over utilised or under utilised. A modified version of this approach is to shift the underlying trend in the capital-output ratio vertically upwards in such a way that is passes through the highest positive deviation from the capital-output trend. This shifted trend value of the capital-output ratio is then used to estimate the capacity utilisation. Thus,

\[
CU_t = \frac{K_t/Y_t}{(K_t/Y_t)_t} \times 100
\]

Where,

- \(CU_t\) = Percentage Capacity Utilisation at time 't'
- \(K_t/Y_t\) = Ratio of capital stock to output at time 't'
- \((K_t/Y_t)_t\) = Trend value of the capital-output ratio shifts vertically upwards to pass through the largest positive deviation from the trend fitted to \(K_t/Y_t\).

The problems arising from the use of this method are formidable. It ignores the constraints on output imposed by labour and other material inputs. Hence, this measure suffers due to the absence of any acceptable production function logic characterising its methodology.

5.5.5 NATIONAL PRODUCTIVITY COUNCIL MEASURE BASED ON MACHINE HOUR

The National Productivity Council (NPC) has estimated capacity utilisation for the Indian cotton textile industry on the basis of machine hours. The total number of machine hours were obtained using the total number of looms and spindles actually worked during the year in each shift multiplied by 8 which represented the standard working hours per shift. By adding figures for all the three shifts, the total machine
hours actually worked were arrived. The rate of capacity utilisation then was obtained by the ratio of actual machine hours worked to the total machine hours available.

The concept of machine hours is surely an appealing one, not only because it is homogeneous but also it is a physical measure. But, it assumes that efficiency is the same between different types of looms/spindles, automatic and non-automatic. In other words, the whole problem of capital vintage gets ignored. Perhaps the vintage problem is also ignored in other approaches also. The measure completely ignores the problems involved in the measurement of capital and output. Increase in machine hours used does not necessarily imply increase in output, because there are a number of intervening factors determining the efficiency of resource use. It is not methodologically clear how these problems can be taken care of in this measure.

5.5.6 PRODUCTION FUNCTION MEASURE

Production function is a highly abstract and technical concept. It functionally establishes the conditions under which optimal utilisation of factor inputs will result in maximising the output of commodities. Desirability of this approach for estimating capacity lies in the fact that the underlying technical relationship between commodity output and factor inputs are taken into account. Since, several alternative formulations of the output-input relationships are available within the framework of production function methodology, a careful choice has to be made while using the most appropriate functional form. In practice data limitations to a greater extent pose constraints in using the functional relationship. However in practice the following production function framework is used in a number of empirical studies.

\[ X_t = A e^{rt} L_{et} \hat{A} K_{ut}^\beta U_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad [4] \]
Where,

\[ X_t = \text{Actual output at time } 't' \]
\[ L_{et} = \text{Man-hours worked at time } 't' \]
\[ K_{ut} = \text{Real Capital utilised at time } 't' \]
\[ \text{ett} = \text{A proxy for technical change} \]
\[ U_t = \text{The disturbance at time } 't' \]

Full capacity output is defined as,

\[ X_{ct} = Ae^{rt}L_t^\Lambda K_t^\beta \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad [5] \]

Where,

\[ X_{ct} = \text{Full capacity real output at time } 't' \]
\[ L_t = \text{Available man-hours at time } 't' \]
\[ K_t = \text{Fully utilised real capital at time } 't' \]
\[ \text{ett} = \text{A proxy for technical change} \]

Direct estimates of the actual output leads to problems of multi-collinearity and least squares bias. Hence, Klein and Preston [33] estimate A, \( \alpha \) and \( \gamma \) using the equation of the following type.

\[ \log_e(X_t) = \log_e(A) + \gamma_t + \alpha\left[ \log_e(L_{et}) + (\beta/\alpha) \log_e(K_{ut}) \right] \log_eU_t \quad \cdots \quad [6] \]

With estimates of A, \( \gamma \), \( \alpha \) and \( \beta \) where \( \beta = \alpha(\beta/\alpha) \)

The Capacity output can be computed with the given \( K_t \) and \( L_t \) for each industry using the regression estimates in the following equation

\[ R_t = \frac{x_t}{X_{ct}} \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad [7] \]

Where,

\[ R_t = \text{Capacity Utilisation} \]
\[ X_t = \text{Actual Output at time 't'} \]
\[ X_{ct} = \text{Full Capacity Real Output at time 't'} \]

5.6 TRENDS IN CAPACITY CREATION AND UTILISATION IN INDIA

The economic consequences of the Second World War provided impetuous for the growth of many Indian industries such as the Iron and steel, cotton textiles, jute, cement, etc., Most of these industries have registered better growth rates in output, employment and investment. In addition, some new industries such as ship building, diesel engines, locomotives, automobiles, textile machinery, bicycles, sewing machines, ball and roller bearings and rayon industries were also got newly established in India[34].

Rapid strides of industrialisation since 1951, has been the striking feature of India's derive towards accelerating economic development. The Industrial Policy Resolutions of 1948 and 1956, have set the stage for industrial development in India. The five year plans, with heavy outlays on public sector enterprises have built huge capacities over a wide spectrum of industries to serve as the nodal centres of industrial growth. Consequently, there had been significant diversification of India's industrial capacity and it broadly covered a wide range of the consumer, intermediate and capital goods. During the plan periods the structure of Indian industries shifted in favour of basic and heavy industries from the traditional ones. Fuller utilisation of the existing capacities has been given utmost priority during the Five Year Plans. Steps through suitable regulatory and incentive schemes were taken to obviate difficulties faced by the industries in this connection. Expansion and diversification of the existing capacities were felt imperative economic requirement in order to meet the additional demand created on account of population and economic growth. Balanced industrial growth also received its due recognition in the context of the diverse resource endowment conditions prevalent in the states of the Indian Union.
In terms of intensive utilisation of the existing capacity, production targets were drawn up for the First Five Year Plan. The targets were achieved in the industries engaged in cotton textiles, sugar, vegetable oils, cement, paper, soda ash, caustic soda, chemicals, rayon, bicycles and a list of other industry categories. But, due to non-fulfillment of investment outlays, short falls in output occurred in the aluminum and nitrogenous fertilisers in the private sector.

During the Second Five Year Plan three steel plants were built and the existing two steel plants in the private sector were doubled of their capacity. Notable progress was made in Machine building and consumer goods industries. In some industries the targeted capacity creation and production of output were fulfilled. In certain industries the actual production has successfully exceeded the targets set.

The Third five year plan was launched, keeping in mind a perspective for accelerating the process of industrialisation over the next 15 years to come. It viewed expansion of and diversification of industrial capacity in vital sectors as an important step in achieving self sustained growth. The plan also aimed at achieving self-sufficient growth in the iron and steel, machine-building and the manufacture of capital goods. However, the economic crisis that has set in the economy during 1965-66, severely handicapped several industries from realising the targeted levels of output. Particularly in the Iron and steel, fertilisers and cement the production fell short of the targets. It was partly due to the crisis in foreign exchange and partly due to the prolonged gestation period witnessed in completing the new industrial ventures.

The conflicts with China in 1962, with Pakistan in 1965 and severe economic crisis that prevailed during the mid-sixties due to monsoon failure and inadequate public sector investment programmes resulted in the postponement of the Fourth
Plan. But, the Annual Plans were adopted during 1966-67, 1967-68, 1968-69 and this period was declared as plan holiday.

The Annual Plans during 1966-69 emphasised the need to achieve fuller utilisation of installed capacities and improve the efficiency and performance of the public sector enterprises. The Annual Plan 1966-67 accorded sanctions to new projects, only if, they could help in expanding exports through industrial diversification or help in providing inputs for improving agricultural productivity. Difficulties in the imports of raw materials had caused non-utilisation of capacities in a vide spectrum of industries, viz., steel, aluminum, machine tools, electric power generation, transmission equipment, power boilers, transformers, agricultural tractors, steel forgings, sulfuric acid, cement, paper etc., During the Annual Plan 1967-68, electrical machinery, petroleum products, chemical industries have increased their levels of output. The Third Annual Plan(1978-69) showed an increasing trend in the industrial recovery. It witnessed about six to seven per cent increase in the industrial production. This gave a bright sign to be free from the traces of recession and step again into an era of planned economic growth.

While appraising the nature of industrial growth Hazari committee[35] observed that the licensing policy has projected an exaggerated picture of industrial capacity that was built in the Indian industries. In actual practice, it observed that such a policy has encouraged foreclosure of industrial capacities by influential and powerful industrial houses who after obtaining the licenses were sitting tight by non implementing the licenses provided. In the absence of a policy of revocation of licenses once issued, large industrial houses have prevented the entry of new enterprises. Consequently, industrial licensing which was supposed to act as an instrument of industrial development became an impediment. Following the findings of the Hazari Committee, the Government of India appointed a new committee under the chairmanship of Subimal Dutt to comprehensively examine the working of the
industrial licensing system in India. The committee[36] recognised the fact that industrial licensing in the actual practice has become a negative instrument and as such had played only a limited role. The recommendations of the Dutt Committee gave a blue print for the future policy prescriptions for promoting economic growth by avoiding monopoly concentration of economic power in the hands of large industrial Houses. The new licensing policy of 1970 largely was based on the recommendations of Dutt Committee.

The economic and political climate that prevailed during the Fourth Plan has accounted for its failure. This plan, introduced after a gap of three years, was an ambitious plan as it aimed at an annual growth rate of 5.5 per cent in the GNP (as against an average of 3.5 per cent during the previous plans) to attain self reliance and also to provide for national minimum for the people of India. The first two years of the fourth plan were quite promising. The industrial sector by and large registered a rising trend in production. But, the successive three years proved to be a great disappointment due to power break downs and load shedding, transport bottlenecks, industrial unrest etc. The production lagged behind in certain industries on account of capacity under-utilisation. The shortage of power and coal have also contributed for low utilisation of productive capacities in a number of industries. This plan also has failed in realising targeted industrial output due to diversion of resources to handle the large number of refugees who fled from Bangladesh and Pakistan consequent upon Indo-Pakistan war in 1971.

The Fifth Plan was introduced at the time when the country was reeling under a veritable economic crisis arising out of a run-away inflation, fueled by the hike in world oil prices since September 1973. The overall industrial growth during 1974-78 was around 4.6 per cent. The fifth plan was terminated by the Janatha Party in March 1978. The Janatha Government's Sixth Plan, appreciating the need to keep the tempo of industrialisation, has observed that a major achievement of India's
industrial growth that has been particularly impressive was the extent of diversification and expansion of production capacities that has put her as a leading industrial power in the world. The country was self-sufficient in a number of consumer goods and basic industrial commodities like the iron and steel, cement, etc. The capacity in other vital industries like fertilisers registered a rapid expansion and has met a major portion in meeting the internal demand. The growth of capital goods industries was specifically impressive and India has obtained the strength to sustain the growth in most of her industries like the textiles, food processing, cement, power generation and transport, through her domestic production. In the capital goods sector only marginal imports were required.

There were two sixth plans. The Janatha Party's Sixth Plan and Congress(I)'s Sixth Plan. The Industrial growth during the sixth plan (1980-85) was about six per cent per annum. There was significant increase in the generation of power, but the lack of enough capacity as in the past has been a major constraint in meeting the power needs of the Industrial sector in India. Further, notable increase in capacity was created in key sectors like the cement, fertilisers, heavy and light engineering etc.

On the industrial sector the Seventh Plan laid special emphasis on the following categories, viz., [a] important in infractructural facilities particularly the power, [b] greater attention to modernisation and maintenance of productive capital assets, [c] up gradation of technology, [d] improvement in productivity, [e] reduction in cost and improving commodity competitiveness, [f] introduction of new products and [g] a special effort to accelerate the development of select industries in which the country has already proved its comparative advantage. As against the target of 8.3 per cent growth rate of industrial output, the plan ended up with 8.1 per cent growth per annum. In an overall sense, the Seventh Five Year Plan's target of industrial production was fulfilled. However, serious shortfalls were noticed in the level of production in a number of items like the crude oil, vanaspathi, iron ore, jute,
cement, steel, electric motors, commercial vehicles and as well as the electricity generated. But, the plan achievement in the manmade fibers, nitrogenous fertilizers, machine tools was more than the targeted level.

The Eighth Five Year Plan has just came to an end with the New Economic Policy guiding the process of overall economic revival and industrial growth. This plan will keep in view the need for the following: continued reliance on domestic resources for financing investment, increasing the level of technical competitiveness through the development of science and technology, and suitable R & D programmes so that the Indian economy can keep pace with the global economic developments. A serious effort has been made to raise the domestic production in a number of important manufactured commodities so that the import of these commodities are substantially reduced. This course of development is likely to help India in attaining the goal of self reliance and thus reduce our foreign exchange requirements. The industrial production is expected to grow by 8 per cent per annum during the eighth plan.

From the above discussion it becomes clear that during the Five Year Plans industrial capacities were built in several critical sectors which had strengthened the economy and helped to broad base her industrial output. Lakadawala[37] observed, that there has been some satisfaction in the economic progress made by India on several fronts, the rate and diversification of economic growth, the increase in savings and investment, almost self reliance realised in food grains production, the big transformation in the structure of industry, the capacity in training highly skilled manpower so as to lead to an exportable surplus in major industries, the extension of normal and special banking facilities to hitherto unbanked areas and sectors, the unprecedented expansion of state, quasi-state and co-operative institutions in the areas of marketing and technical aid and guidance and improvements in select indicators of the quality of life of the people - viz. expectation of life at birth,
reduction in death rate and infant mortality rate - have also recorded changes in the desired directions and magnitudes.

5.7. REVIEW OF SELECT STUDIES

In the following section we present a review of select empirical studies on capacity utilisation in the manufacturing sector. These studies, would give us an useful insight into the scope of the present study.

Budin and Paul[38] have made a statistical investigation for studying the utilisation of industrial capacity in India and analysed India's experience during 1949-59. The study, besides examining the time pattern of the capacity utilisation, also analysed inter-industry variations. The study has found, the Indian industries, in general, having not only experienced better rates of utilisation of their capacity but also registering overall improvement in the levels of capacity utilisation during the study period. However, 1958 stood as an exceptional year with a low capacity use. The significant conclusion of the study was that the consumer goods industries, in contrast to the infrastructure and intermediate goods industries, have expanded far too rapidly and also achieved an intensive utilisation of their capacity. The study provided additional evidences to support the argument that better utilisation of capacity was dependent upon expansion of investments in the infrastructure and intermediate goods sector industries.

Leeuw[39] in his study on "The Concept of Capacity" examined the uses, the definition and the techniques for measuring capacity. He observed the concept of plant and equipment capacity was widely used in analysing economic development, which when interfaced with the available measures of capacity have produced major discrepancies. He has shown how some of the available measures when empirically estimated tended to yield different capacity indices. In this background he discussed in detail the problems that arise while measuring capacity and its utilisation. It
became clear from his study that capacity estimates were useful indicators of short-run cost conditions. He also pointed out the meaning of capacity and the implications involved in using normal, engineering and most efficient operating rate approaches. In his alternative approach the marginal cost assumed great importance in empirically measuring the capacity.

Klen and Preston[40] developed an alternative method to measure the capacity and capacity utilisation. It is a modified version of the Wharton and FRB measurements at the industry level and has employed production function frame work. They compared the results of their study with that of the Wharton index. They have incorporated certain adjustments in the components of the Wharton index and noticed the results obtaining some amount of bias drift. A sample sample of 11 industries were studied by them.

Trivedi[41] in his study on the 'Relation Between the Order - Delivery Lag and the Rate of Capacity Utilisation in the Engineering Industry of the United Kingdom' for the period 1958-1967 has empirically estimated the relationship between deliveries and orders with the help of quarterly data. It has been found that the industries that had a lower ratio of unfilled orders against deliveries, were able to achieve increases in the proportion of orders to deliveries within the first four quarters. From a methodological point of view, the distributed-lag model used in the study has yielded functionally well meaning results.

Venkataraman[42] has studied "Under-Utilisation of Industrial Capacity: Some Basic Issues". He has probed the questions of what is under-utilisation, and what is the proper basis of its measurement?. He found answering these questions to be difficult because of two reasons, 1) lack of capacity data for units which were in existence before the Industrial Development and the Regulation Act of 1951 under which all investments over Rs.10 lakhs must be licensed and the capacities specified,
ii) the inadequacy of capacity data for the licensed units after 1952. The study viewed under-utilisation of capacity in three constraint sets, viz., Demand constraint, Supply constraint and Sickness of the units caused by managerial shortcomings. The study suggested to the government that liberal licensing policy should be adopted after sufficient arrangements were made to ensure adequate availability of raw materials, so that increased capacity utilisation of the industries can be easily achieved.

Bergestran[43] in his study on "Resource Utilisation in Indian Manufacturing: A Mathematical Analysis" has developed a linear programming model for defining maximum short-term capacity utilisation of the industrial manufacturers. He has observed, certain constraints in the availability of direct labour time, raw materials, infrastructures like electricity, water, gas, etc., transportation facilities, changes in government policies, policies of the enterprises towards working capital management and the variations in market demand capable of adversely affecting the fuller utilisation of capacities. However, not all these constraints could act as bottlenecks in all the firms. It could vary from one particular firm to another. In a linear programming model the inclusion of constraint sets has provided reasonable insights as regards their influence on the optimal utilisation of capacities.

Sandesara[44] in a study on "Monopoly, Competition and Excess Capacity in Indian Industry" made an attempt to test the hypothesis that market structure will exert a decisive influence on capacity utilisation. He has used installed capacity data to estimate capacity utilisation. The study was based on Monthly Production Statistics for select Indian industries in 1967. In his study he classified industries on the basis of installed capacity viz. the industries which were working with under-utilisation levels and the industries working with over-utilisation of capacities. He observed that in the under-utilisation industry categories the actual value of capacity use when expressed as a per cent of potential value of the capacity, the utilisation
rate came to around 53 per cent. Further, he also found that the under-utilisation category of industries were mostly working in an oligopoly market setting. In the over-utilisation category the corresponding percentage was found to be around 119 per cent. These over-utilisation category industries were found mostly operating in monopoly and competitive market environments.

Sastri[45] examined the question of capacity utilisation in the mill sector of the Indian textile industry for the period 1950-73. He has attempted to estimate capacity utilisation for spinning and weaving separately and also for the composite units employing alternative methods of capacity measurement. The capacity utilisation results varied according to the models employed in estimating the capacity use. The actual rate of utilisation was estimated to be around 70.00 per cent during the study period. He found the different estimates yielding an increase in the general trend as the characteristic of the capacity utilisation levels in the Indian cotton textile industry. He found the raw material availability in the Indian context to be the crucial variable. The demand factors in his study did not establish much influence in determining capacity utilisation levels in the Indian cotton textile mills.

Schemener[46] made a study on "Choosing New Industrial Capacity, On Site Expansion, Branching, and Relocation". To him continuous on-site expansion meant, more workers, and often more products being managed productively. With more products in the plant, management encounters the risk of not only complicated supervision of work, inventory and production control systems, but also placing matching demand on managers, workers and various production systems in a factory environment. As an alternative, branching and re-location can avoid many of these long-term and frequently subtle pit falls in the on-site expansion. By branching, a company can exploit the latest production technology and a more sensible plant design. The empirical results have confirmed the relative advantages outlined above in the case of newly branching out plants. This study also found, explicit managerial
considerations such as factor price differentials, technological change, and regional import substitutions having their impact on decentralisation of the industries.

Berndt and Morison[47] have in their study pointed out, how the available capacity utilisation measures were not clear as to why one should take precausions to interpret changes in capacity utilisation over time in each measure and the variations in the estimates across various measures. The principle reason underlying such variations were argued to be due to the weak link prevailing between the underlying economic theory on the one hand and the empirical estimates of capacity utilisation on the other. The study reproduced several economic measures of capacity utilisation and has shown considerable difference characterising the empirical estimates, viz. the more familiar FRB(Federal Reserve Board) and Wharton measures.

De Vany and Frey[48] estimated the utilisation of capacity in industries with stochastic demand and production function relationship. The study has developed monopoly and competitive models of inflexible price, quantity rationing markets and estimated the capacity for several industries which included trucking, metal and steel industries. In this study they briefly stated the main theoretical results for the competitive model. A non-operational finding is that, under weak conditions, a competitive quantity rationing market is efficient. This finding provided some clarity on the objections raised by economists against a market that operated with inflexible prices and short-run quantity rationing.

Walter[49] found the equilibrium utilisation rate of the capacity to depend upon wage and user cost function as well as on the age profile of the plant and equipments with due allowances provided for the maintenance and depreciation allowances. A higher wage increased the price of maintenance ($\mu$) which in combination with a fall in price of capital goods($V$), led to earlier scrapping ages. Maintenance allowances and non-linear depreciation funds when provided for on the
other hand, can lead to a higher utilisation rate in response to a decrease in relative price of capital goods \((V/W)\). A fall in the relative price of capital goods \((V/W)\), redounds the benefit of the larger capital intensive firms causing the relative price of standardised products to fall. Since large firms choose higher equilibrium utilisation rates, the mean utilisation rate for all firms was found increasing.

Harris and Taylor\[50\] estimated capacity utilisation for four industry groups in the United Kingdom for the period 1958 to 1982. The purpose of their study was to describe and evaluate a method of estimating capacity utilisation which differs from previous studies. They fit a standard production function to the peak output data (for a given industry) inorder to obtain efficient estimates of the technical relationship between output and inputs. They also estimated the capacity utilisation by using the two-most commonly used methods viz., the Wharton method and output-capital method. They have found the Wharton method and output-capital method producing reliable estimates of capacity utilisation. However, the production function measure was in their opinion more preferable for arriving at correct estimates of the rates of capacity utilisation than other methods employed for the purpose of estimating capacity utilisation.

Bhatia\[51\] made a study on 'Industrial Development and Capacity Utilisation in India'. He has examined the capacity utilisation in the context of the relationship between capital investment and profitability. By using correlation method he observed a positive relationship between capital investment and capacity utilisation. But, no direct association was found between profitability and capacity utilisation in the Indian industries.

Goldar and Ranganathan\[52\] in their study of capacity utilisation in the Indian industries, made an attempt to analyse the effect of market structure and government policies on capacity utilisation and also between market concentration
and capacity utilisation. They have reported the presence of an inverse relationship between the level of effective protection enjoyed by the Indian industries and the rate of capacity utilisation attained by them. Their findings were similar to the earlier studies on capacity utilisation in the Indian context. Further, industrial policies pursued in India were found to having no influence on the extent of capacity utilisation.

Burange[53] has studied the implications of full capacity utilisation of the manufacturing sector industries on the Indian economy in 1973-74. The study was carried out using the Open Leontief Model and also the Semi-Closed Input-Output Model. The study examined the consumption demand on the capacity utilisation of the industries. He observed full capacity utilisation in the manufacturing sector in the year 1973-74. He also studied the investment and income implications on the full capacity utilisation of the Indian manufacturing sector and found the following sectors viz., 'mining and quarrying', 'banking and insurance' and the 'electricity' yielding high output elasticities.

Segerson and Squires[54] presented a methodology in their study for predicting the effects of quota-type regulatory constraints on capacity utilisation in the context of a multi-product profit-maximising firm. This approach was built on recent advances in the use of virtual prices to model the effects of rationing. This approach has provided allowances for the effects of regulatory constraints when examined in an ex-ante sense. The methodology was illustrated through a case study by imposing output quotas in an open-access marine fishing industry on the Pacific Coast in the United States. The results suggest that for certain species, output quotas can cause strong disinvestment incentives affecting capacity use.

The economic issues relating to under utilisation or non-utilisation of capacity have not received much attention in applied economic research in India as compared
to the developed nations. The studies in India have analysed the trends in capacity utilisation in respect of specific industries. We also note that most of these studies have used the data available in the Monthly Statistics of Production published by the Director General of Technical Development (DGTD). Yet another aspect is that they have used the installed capacity for estimating capacity utilisation. They compared the actual output data with the installed capacity in computing the rate of capacity utilisation.

5.8 RESULTS AND DISCUSSIONS

In the following section we present a detailed analysis of capacity utilisation trends estimated for the Non-Electrical Machinery (35) and the Electrical Machinery (36) manufacturing industries of India for the period 1973-74 to 1988-89. The discussion is presented highlighting the trends and the implications of the estimated capacity utilisation using three methods viz., the Wharton Index, the Production Function Index and the Minimum Capital-Output Ratio Index.

5.8.1. WHARTON INDEX OF CAPACITY UTILISATION

In table 5.1 and figures 5.3 to 5.10, we have presented the estimated indices of capacity utilisation based on the Wharton measure of capacity.

On the whole the 19 three digit level industries engaged in the manufacture of Non-Electrical Machinery (35) and the Electrical Machinery (36) products indicate the period being characterised with an aggregate average around 81.38 per cent. If, viewed from this mean we observe the period characterising relatively better average capacity utilisation in the Agricultural Machinery and Equipments (350), the Food and Textile Machineries (353), the Machinery Other than Food and Textiles (354), the Sewing, Merchandising, Washing and Cleaning Machinery (359) belonging to the Non-Electrical Machinery (35) and the Electrical Machinery and Parts (360), the Dry
WHARTON INDEX OF CAPACITY UTILISATION: INDIAN NON-ELECTRICAL MACHINERY MANUFACTURING INDUSTRIES DURING 1973-74 TO 1988-89

FIGURE 5.3

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.4

YEARLY TRENDS IN CAPACITY UTILISATION
FIGURE 5.5

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.6

YEARLY TRENDS IN CAPACITY UTILISATION
WHARTON INDEX OF CAPACITY UTILISATION: INDIAN ELECTRICAL MACHINERY MANUFACTURING INDUSTRIES DURING 1973-74 TO 1988-89

FIGURE 5.7

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.8

YEARLY TRENDS IN CAPACITY UTILISATION
and Wet Batteries (362), the Electrical Apparatus, Appliances and Parts (363) and the 'Other' Electrical Machineries and Parts (369) in the Electrical Machinery (36) manufacturing industries in India during the reference period.

In order to study whether or not the estimated mean of the various industries pertaining to the period is found to vary from their yearly indices of estimated capacity, we have computed the trend coefficient of variation. From the overall mean coefficient of variation for the 19 industries during the sixteen year period in reference, we have analysed what industry categories are associated with a high coefficient of variation characterising the period from the estimated mean coefficient of variation which was around 20.40 per cent. Our results indicate the industries belonging to the Non-Electrical Machinery (35) category having a very high degree of stability characterising the yearly trends in capacity utilisation in the constituent three digit industries. With the exclusion of the Prime Movers, Boilers, Diesel Engines and Parts (352) in all the remaining nine industries in this group a low magnitude of trend coefficient of variation compared with the aggregate mean coefficient of variation was observed. In the Electrical Machinery category (36), our analysis shows a relatively higher degree of instability characterising the yearly indices of capacity utilisation in a number its constituent three digit industries during the reference period. The industries include the Insulated Wires and Cables (361), the Radio, Transistors, Television and Transmission Equipments and Parts (364), the Radiographic Apparatus, Tubes and Parts (365), the Electronic Computers, Control Instruments and Parts (366) and the Electronic Components, Accessories etc., (367) manufacturing industries. Hence, during 1973-74 to 1988-89 we have empirical evidence to conclude that the Non-Electrical Machinery (35) industries in India have had greater stability in using their capacity rather than the Electrical Machinery (36) Manufacturing industrial categories.
For understanding the influence of years in determining the capacity utilisation levels of the 19 three digit industries belonging to the Non-Electrical Machinery(35) and the Electrical Machinery(36), we have computed yearly cross-section mean magnitudes and the associated measure of the coefficient of variation in order to measure the inter-industry variation. From the point of view of the aggregate mean capacity utilisation rate which was around 81.38 per cent, our analysis shows the following years viz., 1974-75, 1975-76, 1978-79 to 1982-83 and 1985-86 recording low mean rate of capacity utilisation characterising the 19 three digit industrial categories in reference. Clearly these years correspond with the recessionary situation that prevailed in the Indian economy. Thus, macro economic crisis which has crippled the aggregate demand for goods and services in India was found causing downward pressure on the capacity utilisation of the Non-Electrical Machinery(35) and the Electrical Machinery(36) industries in India. During above years, the corresponding measures of coefficient of variation also were found assuming high magnitudes implying high degree of inter-industry variations across the 19 industry categories in reference. Further, from the cross section mean magnitudes it became obvious that the Non-Electrical Machinery(35) and the Electrical Machinery(36) manufactures in India were able to record better rates of capacity utilisation with a high degree of consistency across the constituent three digit industries during most years of the Eighties rather than the Seventies. This means the economic reforms undertaken since the turn of 1980 in India by way a liberal industrial policies certainly providing favourable economic climate to achieve improved levels of capacity utilisation.

5.8.2. PRODUCTION FUNCTION BASED ESTIMATES OF CAPACITY UTILISATION

The estimates of capacity utilisation using the production function methodology for the Non-Electrical Machinery(35) and the Electrical Machinery (36)
manufacturing industries of India during 1973-74 to 1988-89 are presented in table 5.2 and the trends are portrayed in the figures 5.11 to 5.18.

On the aggregate, the period's mean capacity utilisation for the 19 three digit industry categories in reference was found yielding a mean rate around 101.04 per cent with an associated coefficient of variation around 1.94 per cent. Since, the magnitude of this variance is very low, we consider the capacity utilisation to be highly consistent and uniform across the 19 three digit industry categories during the reference period. If, we analyse from the mean rate of (101.04 per cent) capacity utilisation, we observe the period reflecting relatively better average capacity utilisation in the Manufactures of the Construction and Mining Machinery (351) and the Prime Movers, Boilers, Diesel Engines and Parts(352) in the Non-Electrical Machinery(35) category and the Electrical Machinery Apparatus Appliances and Parts (363),the Radiographic Apparatus, Tubes and Parts(365),the Electronic Components, Accessories etc.(367) and the 'Other' Electrical Machineries and Parts(369) belonging to the Electrical Machinery (36) in India during 1973-74 to 1988-89.

For tracing the yearly movements of capacity utilisation from the respective period's mean of the three digit industries, trend coefficient of variation has been computed. We have analysed the industry categories associated with a high and low coefficient of variation characterising their yearly trends from the estimated mean coefficient of variation. This across the industries has marked an average around 13.32 per cent. By comparing this mean coefficient of variation with the estimates of the individual industries, it can be observed that the three digit industries belonging to Non-Electrical Machinery(35) category were associated with relatively high degree of stability characterising the estimated yearly trends in capacity utilisation except for the two industries viz., the Construction and Mining Machinery(351) and the Prime Movers, Boilers, Diesel Engines and Parts(352). In the Electrical Machinery industry(36), a similar comparison has implied greater degree of instability charact-
FIGURE 5.11

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.12

YEARLY TRENDS IN CAPACITY UTILISATION
FIGURE 5.13

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.14

YEARLY TRENDS IN CAPACITY UTILISATION
PRODUCTION FUNCTION INDEX OF CAPACITY UTILISATION: INDIAN ELECTRICAL MACHINERY MANUFACTURING INDUSTRIES DURING 1973-74 TO 1988-89

FIGURE 5.15

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.16

YEARLY TRENDS IN CAPACITY UTILISATION
FIGURE 5.17

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.18

YEARLY TRENDS IN CAPACITY UTILISATION
erising the yearly trends in capacity utilisation in the following industries at three
digit disaggregation. These include the Electrical Apparatus, Appliances and Parts
(363), the Radiographic Apparatus, Tubes and Parts (365), the Electronic Compon-
ents, Accessories etc.,(367) and the 'Other' Electrical Machineries and Parts(369)
industries. The industries belonging to the Non-Electrical Machinery(35) category in
India have a greater degree of stability in regard their capacity utilisation as
compared to the Electrical Machinery(36) during the reference period viz., 1973-74
to 1988-89.

We have also tried to examine the behavioral trends by computing yearly
cross-section mean for the capacity utilisation indices and the associated measure of
the coefficient of variation so as to study the inter-industry variations prevalent
during the reference period. From the aggregate mean value of capacity utilisation
which was around 101.04 per cent, our analysis shows that the following years viz.,
mean rate of capacity utilisation characterising the Non-Electrical Machinery(35) and
the Electrical Machinery Manufacturing(36) industries in India. During these years,
Indian industries were affected by various internal and external forces of economic
destabilisation like the oil crises in 1973-74 and the general economic crisis during
1975-76 in the 70's. When the Janatha Party came to power, it terminated the Fifth
five year plan in 1978 and introduced a new Sixth plan for the period 1978-83 with
different economic policy orientation from the former. This change has caused
industries to make necessary adjustments which has affected the capacity utilisation
level in the immediately following years viz., 1979-80 and 1980-81. Again change of
the government with the coming back of congress party to power at the Union
Government and the world recession of early 80's all have forced the industries to
readjust their strategies in regard to capacity use.
Viewed from the aggregate mean coefficient of variation of the period which was around 14.40 per cent, it was observed that the 70's as a decade was indicative of a high degree of inter-industry variation in regard to capacity utilisation rather than the 80's. The industrial policies pursued during the 80's with an accent on providing favourable economic climate for the industries by removing regulatory obstacles seems to have caused different impacts on the three digit industries than the 70's. Infrastructure growth, encouragement to R&D capability, consulting and design engineering services, project management services and innovative approach to improve and adopt modern technologies in general have yielded impressive progress in terms of better use of the capacities in India.

5.8.3. MINIMUM CAPITAL-OUTPUT RATIO MEASURE OF CAPACITY UTILISATION

In table 5.3 and figures 5.19 to 5.26 we have presented the estimated indices of capacity utilisation based on the Minimum Capital-Output Ratio Method for the three digit industries belonging to Non-Electrical Machinery(35) and the Electrical Machinery Manufacturing(36) in India for the period 1973-74 to 1988-89.

The industries engaged in the Non-Electrical Machinery(35) and the Electrical Machinery category(36) on the aggregate during the reference period at three digit industry level were characterised with an over all yearly mean capacity utilisation at around 65.94 per cent. Viewed from this mean value, we observe the estimated period's mean capacity of all the industries belonging to the Non-Electrical Machinery(35) category, registering relatively higher rates of average capacity utilisation except for the Construction and Mining Machinery(351) industry. In the Electrical Machinery Manufacturing(36) industries, we observe the Insulated Wires and Cables(361), the Dry and Wet Batteries(362), the Radio, Transistors, Television and Transmission Equipments and Parts(364) and the Electronic Computers, Control Instruments and Parts(366) having witnessed their period's mean average capacity utilisation at rates greater than what on the whole has characterised the 19 industry
categories during the study period. In the remaining industries viz., the Electrical Apparatus, Appliances and Parts (363), the Radiographic Apparatus, Tubes and Parts (365), the Electronic Components, Accessories etc., (367), the 'Other' Electrical Machineries and Parts (369), the mean capacity utilisation was found to be lower than the aggregate of the 19 industry groups in reference.

In order to study the stability of the estimated trends in capacity utilisation indices during the reference period, the trend coefficient of variation for the individual industries were computed. The overall mean coefficient of variation for the 19 industry categories was found to be around 26.55 per cent. Our analysis shows that all the three digit industries of the Non-Electrical Machinery (35) category except the one engaged in the Construction and Mining Machinery (351) by assuming low magnitudes of the coefficient of variation has implied a high degree of stability prevailing during the reference period. In the Electrical Machinery manufacturing industries (36), we observe a number of three digit industries being subjected to a high degree of instability during the study period as regards their estimated capacity utilisation indices. These industries include the Radiographic Apparatus, Tubes and Parts (365), the Electronic Computers, Control Instruments and Parts (366), the Electronic Components, Accessories etc., (367) and the 'Other' Electrical Machineries and Parts (369). Thus, the empirical estimates of capacity utilisation indices, reveal that the Non-Electrical Machinery (35) industries in India have not only secured higher average rates of capacity utilisation levels but also a low coefficient of yearly variations indicating a greater degree of consistency characterising their yearly trends during the study period. On the other hand, the Electrical Machinery manufacturing industries (36) are found conspicuously suffering due to high degree of instability in their capacity utilisation during the period 1973-74 to 1988-89.

In order to study the inter-industry variations in the 19 three digit industries in reference, we have calculated cross-section mean rates of capacity utilisation and
MINIMUM CAPITAL-OUTPUT RATIO INDEX OF CAPACITY UTILISATION: INDIAN NON-ELECTRICAL MACHINERY MANUFACTURING INDUSTRIES DURING 1973-74 TO 1988-89

FIGURE 5.19

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.20

YEARLY TRENDS IN CAPACITY UTILISATION
MINIMUM CAPITAL-OUTPUT RATIO INDEX OF CAPACITY UTILISATION: INDIAN NON-ELECTRICAL MACHINERY MANUFACTURING INDUSTRIES DURING 1973-74 TO 1988-89

FIGURE 5.21

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.22

YEARLY TRENDS IN CAPACITY UTILISATION
MINIMUM CAPITAL-OUTPUT RATIO INDEX OF CAPACITY UTILISATION:
INDIAN ELECTRICAL MACHINERY MANUFACTURING INDUSTRIES DURING
1973-74 TO 1988-89

FIGURE 5.23

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.24

YEARLY TRENDS IN CAPACITY UTILISATION
FIGURE 5.25

YEARLY TRENDS IN CAPACITY UTILISATION

FIGURE 5.26

YEARLY TRENDS IN CAPACITY UTILISATION
their corresponding magnitude of the coefficient of variation. By comparing the yearly mean values with the overall mean we observe the capacity utilisation in the following years of the Seventies to be high viz., 1975-76, 1976-77,1977-78,1978-79 and 1979-80. Except for the period 1975-76 these years in India generally correspond with economic revival which has enabled the industries in reference to secure better rates of capacity utilisation. High levels of output accomplished due to improved capacity utilisation also were facilitated by the government policies during the emergency viz., 1975 that has enabled strict labour regimes eliminating strikes, lock-outs etc. Hence, loss of maydays due to industrial disputes were also low. Subsequent changes in industrial policies during non-congress government also had its favorable impact by way of higher mean rate of capacity use. During the 80's except in three years viz., 1981-82, 1985-86 and 1986-87, in most of the other years the industries in our study have scaled better capacity utilisation levels. Low capacity utilisation levels that existed during 1981-82 was due to the impact of the economic crisis of the early 80's that has slowed down the pace of industrial growth in India.

Such a situation also was present during 1985-86 and 1986-87 which has affected badly the capacity utilisation in the Indian context. During the 80's the Industrial Policies encouraged industrial revival by removing bureaucratic and other regulatory obstacles and helped the industries to achieve higher output levels. It also provided for a competitive industrial environment. Specifically, the policies like delicensing, broad basing and endorsement of new and additional industrial capacity, greater freedom to larger producers through an increase in the asset limit for MRTP purposes also provide logical reasons for the observed patterns of better capacity use in India. Encouragement to financial and technical collaboration agreements with MNCs as well as to foreign investment from the OPEC and the NRIs on a fully repatriable basis and full or partial decontrol of the pricing and distribution policies of a number of commodities also became factors that have enabled better use of industrial capacities.
The aggregate mean coefficient of variation of the 19 industries from their yearly mean was around 25.96 percent. Viewed from this mean in the following years we have indications of a high degree of inter-industry variation characterising capacity utilisation levels, viz., 1973-74 to 1977-78, 1981-82, 1984-85 to 1987-88. Economic policy reforms, undertaken during the reference period have had varying nature of their influence on the capacity utilisation levels on the 19 industry categories in our study hence the inter-industry variations were found to be quite high during the above years.
NOTES AND REFERENCES


18. e.g., Hick's Theory of Trade Cycle.


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### TABLE 5.1.

Wharton Index Estimates of Capacity Utilisation: Estimates for the Indian Non-Electrical (35) and Electrical Machinery Manufacturing Industries at Three Digit Disaggregation During 1973-74 to 1988-89

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Source: Computed From ASI Factory Sector, Summary Results, Various Reports, C.S.O., Government of India, New Delhi.

Note: X - Arithmetic Mean  C.V. - Coefficient of Variation
**TABLE 5.2.**

Production Function Estimates of Capacity Utilisation: Estimates for the Indian Non-Electrical(35) and Electrical Machinery Manufacturing Industries at Three Digit Disaggregation During 1973-74 to 1988-89

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Source: Computed From ASI Factory Sector, Summary Results, Various Reports, C.S.O., Government of India, New Delhi.

Note: X - Arithmetic Mean  C.V. - Coefficient of Variation
TABLE 5.3.
Minimum Capital-Output Ratio Estimation Of Capacity Utilisation : Estimates for the Indian Non-Electrical(35) and Electrical Machinery Manufacturing Industries at Three Digit Disaggregation During 1973-74 to 1988-89

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Note: X - Arithmatic Mean C.V. - Coefficient of Variation