Chapter V

AN EXPLANATION FOR UNDER UTILISATION OF CAPACITY IN INDIAN INDUSTRIES: 1960 TO 1973
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After discussing the existence and quantum of unutilised or excess capacity (Potential in the context of method adopted in this study) in industrial sectors during 1960 to 1973 in Chapter III, the reasons for such excess capacity using an inter-sectoral model in Chapter IV, the present Chapter complements the necessary aggregate analysis of Chapter IV, by examining the reasons for unutilised potential at the sectoral level using techniques of micro analysis. The Chapter has been organised as follows: Part I provides a short summary of the theories which have been advanced and practical policy variables which may explain the idleness of capacity, with reference to Indian industrial sectors. The coverage of variables, data and techniques of analysis are discussed in the second part. The regression results estimated for explaining the variation in capacity utilisation in Indian industries during 1960 to 1973, are discussed in Part III, Part IV presents summary and policy conclusions of empirical results of the chapter.
The literature on capacity utilisation provides a long list of reasons for unutilised capacity but they can be classified under two broad groups: (i) intended idle capacity and (ii) unintended idle capacity. The factors under the first group have been described as those based on rational decisions by entrepreneurs, which are mainly on the ground of Marris theory of shift operations which is briefly discussed below. The unintended reasons for idle capacity include all the variables attached to the unforeseen events and planning and policies at the macro level, namely economy level factors outside the control of the entrepreneurs, determined by the economic policy framework and those by the international economy i.e. exports and imports and terms of trade.

Marris' pioneering study for U.K. manufacturing provides an analysis based on the fact that night is a non-preferred time to work for most people. To induce people to work at night, firms have to pay higher wage.

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(a shift differential in Marris' terminology) for the same job; so the firm faces a higher total and unit cost for non-day time operations. Since Marris' is a profit maximisation model, it assumes alternative technique of production such that higher capital/labour ratios are associated with higher labour productivity and entrepreneurs maximise profits. For such system of operations there is a derived combination of technique of production and rate of utilisation, which gives maximum profit to the firm. If the firm is operating in a low wage economy with relatively labour intensive technique of production with highest level of utilisation, with maximum profit; a change (rather rises) in wage rate will change (rather reduces) the rate of profit. In this situation, the firm has to adjust to the new level of wages, either through reduction in the level of utilisation or through providing labourers more capital to work, through higher labour productivity or through capital deepening. Profitability for the firm depends on the size of shift differentials and the cost of the alternative techniques of production. Given the technological alternatives, high elasticity of utilisation (defined as proportionate change in utilisation rate relative to the proportionate change in average hourly wage) will adjust through
higher labour productivity, if the shift differential was small in the initial situation. This adjustment will be profitable for the firm. On the contrary, if the shift differential was large before the situation of adjustment, a rise in wage rate will be adjusted by reducing the level of utilisation given the elasticity of utilisation. This adjustment to maximise profit with rise in wage cost is associated with elasticity of mechanisation, which is defined as proportionate change in output per man-hour relative to proportionate change in capital per employee. In short, given the set of technological alternatives, the firm will maximise profit by adjusting the high wage cost through higher labour productivity, if the elasticity of utilisation and mechanisation are high, given small shift differential as an initial conditions and vice versa. Harris' analysis points out a second set of theoretical relationships between different technological characteristics and rate of utilisation in the sense that the former influence the latter through economies of scale, which includes both plant economies as well as managerial economies.2/ These are very important theoretical relationships

2/ Ibid.
which examine how size of firm, labour productivity, market structure or rate of mechanisation at a possible micro level, influence the rate of utilisation. Theoretically, it is postulated that larger the size of firm better would be the capacity utilisation, because large firms accrue the economies of scale mainly through division of labour and the integration processes. The conceptual definition of the size of firm not uniquely defined. The empirical measures of size of firm mainly output per reporting unit, fixed capital per unit and fixed capital per man-hour capture different types of economies of scale such as output per reporting unit captures managerial scale economies rather than technical, while the other two definitions capture more of technical economies of scale. As far as managerial economies are concerned, these accrue through managerial division of labour and economies through integration processes have little relevance, except in case of recent development.

3/ E.A.G. Robinson discusses factors which determine the economies of scale as the size of firm grows to its optimum size through (i) division of labour which is characterised by dexterity, saving of time which is lost in passing from one task to another and the development of specialised machines, (ii) vertical integration and disintegration processes (iii) economies of large machines (iv) balance of process (v) economies of massed reserves (vi) economies through large organisation (vii) economies through standardisation. See E.A.G. Robinson, The Structure of Competitive Industry, University of Chicago Press, 1959, pp. 13-19.
of machine book-keeping like use of electronic computers in large units. Economies due to large management, thus, lies in organising planning of production so that the worker can proceed without interruption and delay with his own work. For example, machines are kept in good order by special staff in large producing units. In case of technical economies of scale, Adam Smith's principle of division of labour requires a firm sufficiently large to obtain the maximum profitable division of labour. The size necessary to obtain this, may vary from industry to industry. In case of integration and disintegration processes of accruing economies of scale, in the former case the number of processes of manufacturing are to be reduced. It is only a large firm that can afford to keep very expensive machinery and running to its full capacity. Vertical disintegration means that when some given process requires a scale of production greater than the scale of smaller firms in an industry, this process tends to be separated from the main industry and all the small firms get this particular process completed through that separated unit.\footnote{Ibid; Vertical integration is seen}
in practice in case of motor car assembly work and
disintegration can be exemplified by textile industry
at finishing stages. Thus, the larger size of firm
enjoys economies of scale - technical and/or managerial.
But technical economies of division have certain
limits. Not only that but in view of the requirement
of of a balanced capital structure, the indivisibility
of a unit of equipment compels the firm to keep it idle
part of the time, if the maximum production falls
short of the capacity of that particular piece of
equipment. In this case, it is very much likely that one
may get a inverse relationship between the size of
firm and capacity utilisation. This problem arises
when a plant consists of a number of different types of
equipment with different maximum hourly rates of output
per unit. Indivisibility of management arises since,
if the size of the firm reduces the capital base,
shift work creates an additional burden on management
which may be too high and render it unprofitable.

5/ P.N. Mathur, Valvade and Kirloskar, Optimum Capacity
and Imbalance of Capital Structure: The Case of
Machine Manufacturing Industries, Economic Analysis
in Input-Output Framework: With Indian Empirical
Explorations., pp.148-154. Edited by P.N. Mathur and
India, held in Poona 1965.
Also the problem of co-ordination arises with further and further division of labour in case of optimum managerial unit. The problem of co-ordination and of managerial problems are much in case of the large firms. Thus, at a certain stage managerial economies set a limit beyond which additional cost per unit of output for coordination increases. Summing up the theoretical discussion about the relationship between size of firm and capacity utilisation (through economies of scale), theorists have come to the conclusion that technical economies of scale are secured in some industries by relatively moderate size. On the other hand, any serious diseconomies of size emerge after reaching a fairly considerable size. Since in this Chapter this relationship has been examined at a level of aggregation of an industry or industry group, it may be said that there are a number of industries in which firms of considerably different size appear to survive.

6/ "And so the big firm is always in danger of becoming a series of wheels within wheels, and elaborate hierarchy, in which every decision requires the consulting of this man, the referring to that man, the permission of a third, the agreement of a fourth, so that decisions become endlessly delayed". Op. cit., E.A.G. Robinson, pp.43-44.
in effective competition with each other. For the other technical characteristics such as market structure, labour productivity and rate of mechanisation, the theoretical relationship between market structure and rate of utilisation is positive. The argument put forward for this relationship is that monopolistic or oligopolistic market structure tend to keep some capacity idle to keep a hold over the market and also to keep a high margin by raising the price through lower volume of production.\(^2\) A low volume high margin attitude of monopolistic firms leads to lower rate of utilisation. On the contrary, competitive market structure provides an incentive to utilise capacity fully to survive effectively. In case of labour productivity and rate of mechanisation, positive relationship with capacity utilisation is assumed. In both these characteristics, the basic theoretical reasons for positive relationship are associated with accruing of the economies of scale.

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In Marris' terms of analysis, higher labour productivity (through capital deepening) shows higher elasticity of mechanisation and utilisation, if shift differential is small.\(^8\) In the initial period of adjustment with a higher wage rate, the firm may have lower labour productivity and lower utilisation, if the shift differential is high. The same holds in case of the rate of mechanisation. Higher modernisation in production techniques also assumes larger scale of production which naturally enjoys economies of scale hence higher utilisation of capacity. In Marris analysis, thus, higher elasticity of mechanisation is associated with higher elasticity of utilisation given the small shift differential. Though Marris has applied his theory to U.K. manufacturing data, the implications of his theory however, also have importance in understanding unutilised capital stock/capacity in developing countries like India.

Another kind of theoretical explanation for intended idleness of capital stock is based on depreciation of capital stock with an increase in its use. Though this model has not been tested empirically,

it postulates that an increase in the levels of capacity utilisation reduces capital costs, but increases some other costs such as depreciation cost, which may not be offset by the reduction in capital cost with higher utilisation, hence, it is optimal for a firm to leave the plant idle part of the time, to avoid high costs of depreciation. This theory has not been tested empirically. In contrast, it is argued that the continuous use of capital stock reduces wear and tear so the theory has not much relevance in the explanation of unutilised capital stock.9/

Unintended Idle Capacity

The theories developed by Marris are concentrated on idleness of capital stock or capacity which is planned ex-ante, but unforeseen events and misfortunes may occur after a plant is built up, which may prevent the entrepreneurs from utilising the capital stock fully. These events may come either from demand or from supply side. As far as demand is concerned, it provides an incentive to an industry to grow, but,

the investment decisions which take into account not only the immediate demand but also the level of demand likely to emerge in future, creates planned excess capacity which also means some degree of underutilisation. Besides this planned excess capacity if the product is not demanded either because of the Keynesian type of economic situation or because of some other reasons e.g. changes in tastes, firms are forced to keep capacity idle. The demand is governed largely by the demand for end products of industry by the households, which in turn depends on rate of growth of per capita income. Thus, deficiency in demand for industrial products may be taken as a major factor contributing to under-utilisation of industrial capacity.

On the other hand, if demand for industrial production is there, but the bottleneck in utilising capacity may be created by the shortage of critical inputs. Inadequate supplies of several inputs may be due to both low level of domestic production as well as difficulties in filling the deficiency by importation in a short period. A quick and timely availability of major inputs and spare parts, either indigenously produced or imported, always gears up production. Some policy variables also influence rate of capacity utilisation. Government policy respect to allocations of raw materials, su
power, grant of import licenses, may operate in practice differently between industries/firms, thereby creating inter-industry or inter-firm disparity in the rate of capacity utilisation. Imports and exports policies are very important in this regard in which, the former may operate in such a way that the extent of competing imports permitted for different product groups may vary and that affects utilisation of industrial capacity. In this sense, greater dependence on imported raw material and/or spare parts, may affect capacity utilisation adversely.\[10\] Similarly, under-export promotion policy, the scope offered for different industries to utilise their capacity in order to push their products abroad may vary.\[11\] The impact of effective rates of protection (ERP) may be associated with variation in capacity utilisation in different industries. It is asserted that high levels of effective protection enable inefficient industries to


\[11\] Ibid., Samuel Paul.
to thrive even though they may not be capable of utilising their capacity adequately. An unbalanced licensing policy may also be responsible in creating excess capacity in some industries and shortage of capacities in other. Another aspect of policy which creates capacity without ensuring its full utilisation, is specific project aid.

Besides these obvious but unforeseen factors, a small degree of underutilisation may be due to the surplus capacity which may be created due to technological factors, which may make it inevitable that minimum possible expansion may be more than what is warranted by the demand factor. Also some teething troubles like time lag between commissioning and realising production may create excess capacity for the time being. Some degree of underutilisation of industrial capacity can be explained by labour troubles.


14/ Ibid.
National Council of Applied Economic Research (NCAER) and by R.K. Koti of Gokhale Institute of Economics and Politics. The NCAER, studies reasons for underutilisation of capacity for 17 groups of industries for the working period of 1955 to 1964. According to this survey the causes for underutilisation as so far as the respondent firms were concerned, were (i) shortage of raw materials (ii) shortage of foreign exchange and (iii) labour troubles. According to this survey among the 129 respondent firms, 103 firms complained of shortage of raw materials, 53 of shortage of spares and 50 of shortage of machinery. Eightyseven complained of shortage of foreign exchange and 49 had labour troubles. R.K. Koti's detailed investigation is for a point of time i.e. for the year 1967-68. Out of 618 factories surveyed by him, 418 factories responded fully. The following derivation from Table 3 of Koti's monograph presents summary information on the factors affecting capacity utilisation during the period under observation.


leading to work stoppages. Of course, this reason of capacity underutilisation could be avoided by improving industrial relations.

**Indian Experience in Industrial Capacity Utilisation:**

An explanation for India's chronic problem of under-utilisation of industrial capacity will have to take into account factors noted above viz. shortage of input supplies, deficiency in demand for industrial products, inter-industry imbalances, policy variables; peculiarities of industries, industrial relations, faulty investment allocation and weaknesses in plan implementation. All these factors which are in a way interdependent may be taken to have operated in different degree in the different industries in India and only a detailed investigation into working of industrial units can show how much of underutilisation in Indian industries are due to each. It is difficult to go into details of firm wise analysis for each industry, the following empirical studies attempt to explain underutilisation in Indian industries at different levels of aggregation over a different period of time. The benchmark in studies on firmwise analysis are by
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Factors affecting</th>
<th>Symbol</th>
<th>No. of Products affected</th>
<th>Unutilised capacity (Rs. '000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lack of demand</td>
<td>a</td>
<td>56</td>
<td>411035</td>
</tr>
<tr>
<td>2</td>
<td>Shortage of raw materials and/or components only</td>
<td>b</td>
<td>53</td>
<td>641730</td>
</tr>
<tr>
<td>3</td>
<td>Other reasons</td>
<td>c</td>
<td>45</td>
<td>1133815</td>
</tr>
<tr>
<td>4</td>
<td>No reasons given</td>
<td>d</td>
<td>14</td>
<td>95610</td>
</tr>
<tr>
<td>5</td>
<td>Lack of parts causing idleness of machinery</td>
<td>e</td>
<td>2</td>
<td>31550</td>
</tr>
<tr>
<td>6</td>
<td>a and b together</td>
<td>ab</td>
<td>19</td>
<td>1001064</td>
</tr>
<tr>
<td>7</td>
<td>a and c together</td>
<td>ac</td>
<td>2</td>
<td>6051</td>
</tr>
<tr>
<td>8</td>
<td>b and c together</td>
<td>bc</td>
<td>9</td>
<td>111150</td>
</tr>
<tr>
<td>9</td>
<td>Total (1 to 8) unutilised capacity</td>
<td></td>
<td>200</td>
<td>3432005</td>
</tr>
</tbody>
</table>

The above table shows the most important reason as lack of demand, if viewed in terms of reported number of products but the category of "other reasons" which include power shortages, labour troubles etc., dominate the highest weightage in total unutilised capacity. A study by M.V. Raghavachari states shortage in supply of inputs like raw materials components and spare parts as major reasons for idle capacity in Indian industries.\textsuperscript{18} A study by V.R. Ramaswamy and D.G. Pfoutz also stresses that the shortage of foreign exchange for the imports of components, raw materials and spare parts were the most important factors limiting output in the industries studied.\textsuperscript{19}

An interesting study by S. Paul on factors affecting capacity utilisation in Indian industries at an aggregation level of 39 industrial sectors for the year 1965 draws a relationship between some

\textsuperscript{18} According to this study the shortage of Sulphur, imported tallow for soap industry and Benzene shortage for polyester and agricultural raw materials for agro-based industries were main reasons besides the shortage of power, skilled labour and transportation facilities as other variables. See M.V. Raghavachari, Excess Capacity and Production Potential in Selected Industries in India, Reserve Bank of India Bulletin, April 1969, p.11.

\textsuperscript{19} V.K. Ramaswamy and D.G. Pfoutz, Utilisation of Industrial Capacity, A Joint Pilot Study by the GOI and the USAID December 1965.
of the technical characteristics discussed above, such as size of firm (measured as ratio of fixed capital to man-hour and also as fixed capital per reporting unit), market structure (measured as number of reporting units in the sector) and capacity utilisation and also between demand (measured as change in peak output of an industry over 1960-64), import substitution (represented by imports as a per cent of total supply), effective rate of protection, raw material allocation (import content of production) and capacity utilisation. Following is the regression estimated by Samuel Paul.

\[
CU = 46.920 - 0.046 \text{ Ms} + 0.190 \Delta \text{Po} + 2.949 \text{K} - 1.224 \text{Is} - 0.025 \text{ ERP} - 0.430 \text{ IC} \\
(6.76)^* (2.22)^** (4.66) (5.21) \\
\]

\[
R^2 = 0.722 \quad I = 6.00 \quad DF = 16 \\
\]

* - ratios are given in the parenthesis.
** - significant at 5% level.

The results may be concluded as follows:


Notes: (i) Ms = Market structure.
(ii) Po = Demand
(iii) K = Size of firm (capital intensity)
(iv) Is = Import substitution
(v) ERP = Effective rate of protection
(vi) IC = Import content (raw material allocation).
(i) The negative sign of coefficient of market structure (MS), implies that in Indian industries case, firms face inelastic demand and product could only be increased by expanding output within a given range;

(ii) Demand (ΔPo) with positive sign contributes to fuller utilisation;

(iii) Industries with larger size of firm enjoy economies of scale, technical and/or managerial as discussed earlier hence they have higher utilisation rate.

(iv) Imports compete with indigenous production, hence tend to reduce utilisation;

(v) Higher effective rates of protection are associated with lower utilisation.21/

(vi) Larger the proportion of import content lower is the utilisation, as with pro-rata allocation policy, units with relatively higher import

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21/ This also corroborates with R.G. Nambiar's study, see R.G. Nambiar, Domestic Resource Cost and Key Sectors in Indian Economy, Economic and Political Weekly, January 11, 1977, pp.954-962 also see op.cit., V.R. Panchmukhi.
content will get more hurt because their additional requirements may not be met from the open market.

Similar study for Pakistan industrial capacity utilisation by G.C. Winston draws a significant relationship between technical characteristics and capacity use.²²

The above theories and policy variables for explanation of the level of capital/capacity utilisation are applicable to the micro level like a firm but subject to obvious aggregation difficulties, these factors may also be tested at an industry or industrial sectoral level, which the present study attempts in

²² See G.C. Winston, Capacity Utilisation in Economic Development: A Case Study of Pakistan, The Economic Journal, March 1971, pp. 36-60. The following is the estimated regression at an aggregation level of 26 industrial groups for the years 1965-66.

\[
U = 29.20 - 0.366M + 0.23X + 2.40 K/V + 0.9373S \\
\quad + 0.0314N - 1.256L \\
R^2 = 0.9042 \text{ I = 20.5}
\]

where \( M = \) import content, \( X = \) Exports, \( K/V = \) rate of mechanisation, \( S = \) Size of firm, \( N = \) Market structure and \( L = \) labour productivity.
the following pages with help of regression analysis. At the outset, it should be noted that though Harris' analysis, discussed earlier is based on multishift operations, the concept of capacity applied in this study estimates potential output on the basis of peak output approach which is different from the estimates of capacity based on the desirable shifts. It can be argued, however, that the production possibility frontier is set by technical and economic factors. The concept of peak output sets limits by such factors. Within these production limits, the factors listed by Harris' analysis would still be operative for determining capacity use.

Keeping in mind the heterogenity which prevails in our industrial sectors, different explanatory variables have been tried to estimate determinants of capacity use for different industrial sectors under the study. The following are the broad hypothesis associated with theories and policy variables discussed above which have been tested in this chapter.

(i) **Size of the firm**: Larger the size of firm higher will be the capacity utilisation, as larger firms can have scale and/or managerial economies or in a country like India socio-political influence is prominent to get scarce
raw material, which may be a constraint in utilising capacity fully.

(ii) **Market Structure:** Concentrated or monopolistic market adversely affects capacity utilisation or competitive market structure induces fuller capacity utilisation.

(iii) **Labour Productivity:** Positive relationship with capacity utilisation is assumed.

(iv) **Degree of Mechanisation:** It is asserted that greater is the modernisation of the technique of production greater is the scope for better utilisation. Operationally, it is assumed that higher the capital labour ratio higher will be capacity utilisation.

(v) **Input Availability:** Better is the availability of scarce major inputs, either imported or indigenously produced, better is the potential utilisation, if demand is not a constraint.

(vi) **Demand:** Higher the present demand for products or anticipated demand in future, more is the incentive for fuller utilisation if raw material is not a constraint.

(vii) **Exports:** Since exports are nothing but international demand for the products and since exports incentives are given, a positive relationship between growth of exports and potential utilisation is asserted.
(viii) **Imports:** Imports are discouraged in developing countries as a policy. A negative relationship is asserted if the production depends on imported raw materials or spare parts. This is because an import substitution policy is strongly recommended in developing countries, so the output of domestically produced goods largely dependent on raw material may also be subject to licensing constraints. In this way it affects capacity utilisation adversely, if the production process depends largely on imports.

II

As already noted earlier, the present study covers the period 1960 to 1973. The base of official index of industrial production changed after 1973 hence no estimates of potential production and utilisation could be made available after 1973.

The regression analysis in the present Chapter deals with twenty seven industrial sectors in the fourteen years period from 1960 to 1973, under observation. Many variables may affect rate of capacity utilisation at a time but since the number of observation are limited (fourteen only), the following procedure has been adopted to select variables discussed above,
which are classified under two sets viz. technical characteristics and "other variables" for each industrial sector under the study. A stepwise regression has been estimated first. The first correlation matrix of stepwise regression gives correlation of all the independent variables with dependent variable. To select variables for estimating regression for a particular sector, the independent variables with higher correlation estimates with dependent variables have been selected from each set of variables viz. technical characteristics and variables from "other variables" category. The following are the variables under aforesaid two sets which are considered for step-wise regression.

(i) Size of firm measured as,
(A) output per reporting unit (Ou)
(B) ratio of fixed capital to manhour (Fm)
(C) fixed capital per reporting unit (Fu)

(ii) labour productivity measured as value added per manhour (L)

(iii) rate of mechanisation measured as ratio of fixed capital to value added (K/V)

(iv) market structure (N) measured as number of reporting units in the industry. This definition may not capture accurately the prevailing market structure but in the absence of measures like concentration ratio it has been treated
as a proxy variable.

The variables under set II, which are referred as "other variables", include all the variables which are not strictly technical characteristics and for which data are available. Since, variables under this category differ from industry to industry, the following may be classified as common variables in all industrial sectors under the study.

(i) Availability of major inputs (In), measured either as trend of production of that input/inputs or as capacity utilisation in input supplying sectors whichever the case may be. The latter in this case also exposes the structural dependence if any in utilising capacity in the sector under the case.

(ii) Demand (D) for the products, expressed as the proportion of private final consumption expenditure on the commodity to the total private final consumption expenditure.

(iii) Exports (E) from industrial sector is measured as a proportion of export from that sector to the total domestic production.
(iv) **Imports (M)** content in the sector measured as proportion of imports to the total supply, where the latter means domestic production plus imports minus exports.

As far as these policy variables are concerned, effective rate of protection (ERP) and raw material allocation which is not practically defined, could not be incorporated in this regression model because of lack of data at an industrial sectoral level. Samuel Paul considers these two variables where he uses Panchmukhi's estimates of ERP and imports content in the sector as a proxy for raw material allocation. Since this study takes imports in a sector as a proportion of total supply, it captures import substitution over a period of time rather than that of raw material allocation policy.

The following are the regression equations to be estimated for industrial sectors in the study:

**Set I**

\[ C_u = a + b_1 O_u + b_2 Pm + b_3 Fu + b_4 K/V + b_5 L + b_6 N \]

where

\[ C_u = \text{capacity utilisation in the sector under the case} \]

Gu = size of firm - output per reporting unit
Fm = size of firm - fixed capital per manhour
Fu = size of firm - fixed capital per reporting unit

K/V = Degree of mechanisation: ratio of fixed capital to value added
L = labour productivity - value added per manhour
N = Market structure - number of reporting units in the industry and 'a' is a constant, and \( b_1, b_2, b_3, b_4, b_5 \) and \( b_6 \) are the parameters to be estimated.

Set II

\[ Cu = a + b_1 \text{In} + b_2D + b_3E - b_4M \]

where

Cu : capacity utilisation in the sector
In : Input or inputs availability
D : Demand for the product
E : Exports from the sector
M : Imports content in the sector

a is constant and \( b_1, b_2, b_3 \) and \( b_4 \) are the parameters to be estimated.
Data:

The regression analysis in this chapter is based on data from secondary sources. For technical characteristics described above, data have been collected from Annual Survey of Industries (hereinafter ASI) 1960 to 1973. Since the period under observation is 1960 to 1973 for which estimates of potential utilisation are available but detailed values of ASI are not available after 1970, the 53 sectors have been aggregated at three digit level, for which ASI information is available. The aggregated sectors are twentyseven, hence the regression analysis is confined to these twenty seven sectors in the present exercise.

The fixed capital, output and value added from ASI, have been deflated by price indices from the Index Number of Wholesale prices. The given price

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25/ Ibid.

index based 1961-62, has been changed to base 1960-61 and using those indices the values of different technical variables collected from ASI, have been deflated. The price index for machinery (base 1960 = 100) has been used to deflate fixed capital from ASI. The output and value added of all the sectors under the study have been deflated by using the price index base 1960-100 of a corresponding commodity. Since it is difficult to get a separate price index for inputs of different industries, in many cases the commodity price index - based 1960-61 has been used to deflate the value added series of the sector. Unfortunately, the ASI data is not available for the years 1971 and 1972 or it is available in a discrete series, so for these two years fixed capital, output and value added in each sector, have been interpolated by using some norms. For example, for fixed capital, the change in rate of capital formation in manufacturing between 1970-71 and 1971-72 have been used as a norm and the available deflated figures of fixed capital for the year 1970 has been adjusted proportionately to get it for the year 1971 and 1972.

27/ Ibid.
Similarly the change in official index number of industrial production (base 1960 = 100), has been taken as a norm to interpolate the output and value added series of different industries of ASI under the study.  

The ratio of (i) fixed capital to manhours (ii) fixed capital to value added (iii) fixed capital per reporting unit (iv) output per reporting unit (v) ratio of value added to man-hour worked, have been worked out for the sectors in the study for the years 1960 to 1973. The man-hours worked and number of reporting units of different industrial sectors for 1971 and 1972 for which ASI information is not available, have been interpolated on the basis of observed growth of those two variables during the period 1960 to 1970.

For variables under the category of "other variables" the necessary data have been collected from different published and unpublished sources.

(i) Data for private final consumption expenditure on commodity concerned and total private final consumption

expenditure have been collected from National Account Statistics 1960-61 to 1973-74. This information is available at 1960-61 prices.

(ii) Input availability to particular sector has been measured in the following two ways.

(A) From $1^{44} \times 1^{44}$ input-output table the major inputs of the industrial sector under the study have been classified according to their proportion in total inputs used. The potential utilisation (in an input supplying sector under consideration) estimated by the present study, has been treated as another measure of input availability to the receiving sector under the case.

(B) Basic statistics relating to Indian Economy of CSO, gives production of different commodities in physical units. For some industrial sectors the production of inputs (e.g. coal) have been used from that source and have been


31/ Ibid.


33/ Govt. of India, Central Statistical Organisation, Basic Statistical Relating to the Indian Economy, 1950-51 to 1975-76.
multiplied by price per unit which has been collected for the years 1960 to 1973 from DGTD office, New Delhi (unpublished) to arrive at estimates in value term.

For policy variables such as imports and exports, the basic data have been collected from different issues of Basic Statistics Relating to Indian Economy, which give such information in quantity and value (at current prices). Since information on exports and imports are not available in quantity for all the years under the study, such information in value (at current prices) have been collected from the same sources and have been deflated by using the Unit value Index of Imports and Exports at 1960-61 base given in Reports on Currency and Finance for the years 1960 to 1973. Since these unit indices are available only for a limited number of industrial sectors these two variables could not be tested for some sectors in the study.

34/ Ibid.

III. Analysis

An Appendix Table (at the end of Chapter) gives the first correlation matrix of stepwise regression of independent variables with the dependent variables in each industrial sector. Before we discuss, the following symbols will be used for the variables used in the regression analysis.

Ist Set:

\[\begin{align*}
\text{Cu} &= \text{Size of firm defined as output per reporting unit.} \\
\text{Fm} &= \text{Size of firm defined as fixed capital per man hour.} \\
\text{Fu} &= \text{Size of firm defined as fixed capital per reporting unit.} \\
\text{L} &= \text{Labour productivity.} \\
\text{K/V} &= \text{Degree of Mechanisation.} \\
\text{N} &= \text{Market Structure.} \\
\text{GU} &= \text{Capacity utilisation in the sector.}
\end{align*}\]

IInd Set:

\[\begin{align*}
\text{In} &= \text{Input/Inputs availability.} \\
\text{D} &= \text{Demand for the product.} \\
\text{E} &= \text{Exports.} \\
\text{M} &= \text{Import content.}
\end{align*}\]

Let us examine the results obtained for 27 industrial sectors.
Leather Footwear

From correlation matrix of Appendix Table, Fm and N are having higher correlation with Cu, hence they have been selected from first set of variables and In₄, i.e. production of leather which is the main input in leather footwear, has been selected from IInd set of variables.

There is a multicollinearity between N and In. Each has been dropped one at a time. The results are as follows:

\[ Cu = 53.7463 - 2.3945 \times Fm + 0.000633 \times In₄ \]
\[ (-2.4745)** (3.7378)* \]

\[ R² = 0.7606 \]

** Significant at 5% level.

* Significant at 1% level.

The size of firm (Fm) measured as fixed capital per manhour and production of raw leather, are statistically significant variables and explain about 76% variation in capacity utilization in leather footwear during the period under observation. Now as far as the production of leather, which is the major input in this sector is concerned, it shows a positive relationship between its availability and
potential utilisation, which is expected. It is also significant at 1% level which shows a statistically good fit. The size of firm on the other hand, is negatively related with capacity utilisation which is a rejection of the theoretical postulation between these two variables. Viewing them in Indian leather footwear making industrial sector, one can justify the negative relationship, as it is comprised of small manufacturing firms and since it is a consumer good, they may be more efficient than the large firms. Second, this is not a technically more mechanised sector, hence, with labour intensive technique of production, the economies of scale on which the positive relationship is based has little relevance.

(2) Paints and Varnishes

Three variables viz., rate of mechanisation \( (K/Y) \) from 1st set and capacity utilisation in Chemicals and Chemical products \( (I_{n_1}) \) and capacity utilisation in metal products \( (I_{n_2}) \) (from 2nd set), have been selected as they have higher correlation with dependent variable. Since there is a multicollinearity between \( I_{n_1} \) and \( I_{n_2} \), as shown in correlation matrix (Appendix Table), each of them has been dropped one at a time.

(1) \( Cu \) with \( K/V \) and \( I_{n_2} \)

\[ K/V = \text{rate of mechanisation} \]

\[ I_{n_2} = \text{utilisation in Metal Products} \]
The following is the result,

\[ Cu = 80.0725 - 15.9712 \text{ K/V} + 0.2361 \text{ In}_2 \]

\[ (-3.1951)^* (3.6243)^* \]

\[ R^2 = 0.7895 \]

* Significant at 1% level.

\[(11) \quad Cu \text{ with K/V and In}_4 \]

\[ \text{In}_4 = \text{capacity utilisation in chemicals and chemical products} \]

The following is the result,

\[ Cu = 29.6191 - 20.7133 \text{ K/V} + 0.8171 \text{ In}_1 \]

\[ (-3.6210)^* (2.2154)^* \]

\[ R^2 = 0.6807 \]

** Significant at 1% level.
* Significant at 5% level.

Input availability which is measured here in the context of interdependent loss of output, in the sense that metal products and chemicals and chemical products are the major input supplying sectors, dominate the explanation of the variation in capacity utilisation in paints and varnishes, as they are statistically significant at 1% and 5% levels respectively, in the above two regressions and explain about 79 and 68 percent variation respectively along with the rate
of mechanisation i.e. $K/V$. The negative relationship of rate of mechanisation, significant at 1% in both the regressions, needs some clarification. It is postulated that higher the rate of mechanisation higher is the productivity per unit of output and hence higher is the capacity utilisation, but the negative significant relationship between these two variables in this particular sector could arise out of imbalance in the capital structure; a problem found in many cases in Indian industries.

(3) **Iron and Steel Basic Industries**

Among technical variables of the 1st set, $O_i$ i.e. size of firm, measured as output per reporting unit, shows the highest correlation with $C_i$ (as shown in correlation matrix given in Appendix Table). From 2nd set of variables $I_n$, i.e. Production of manganese ore, has the highest positive correlation with $C_i$, hence it has been selected for the following regression estimates.

The regression results are as follows:

$$C_i = 28.6531 + 0.47269O_i + 4.7397I_n$$

$$(3.9809)** (2.2738)*$$

** Significant at 1% level.
* Significant at 5% level.

$R^2 = 0.5909$

These two variables show a meaningful explanation for variation in capacity utilisation in this very crucial
industrial sector of the Indian economy, as it is a major input supplying sector. The size of the firm measured as output per reporting unit, captures mainly the managerial scale economies rather than technical factors. Since it is positively related with utilisation rates, it has an expected theoretical relevance, especially the sector as iron and steel basic industries has multiple product mix at the aggregation level taken here. The positive relationship between availability of manganese ore, defined as production during 1960 to 1973 and capacity utilisation in this sector is meaningful.

(4) Non-electrical Machinery

The correlation matrix of 1st set of variables in Appendix Table shows serious multicollinearity problem among many independent variables. The size of firm (FM) measured as fixed capital per man hour and market structure (N), show higher correlation compared to other variables in this set with Cu, hence they have been selected for regression estimation. Among the variables under IIInd set In2, i.e. capacity utilisation in Iron and Steel industries, has the highest correlation with Cu; it has been selected and the following regression has been estimated. There is no problem of multicolinearity among these variables. The following is the regression result:

\[ Cu \cdot Q_1 = -23.6404 + 0.3950 FM - 0.0030 N + 1.3638 In_2 \]
\[ (-0.0819) \ast (-2.1530) \ast \ast (+1.9663) \ast \ast \]

\[ R^2 = 0.5520 \]

** Significant at 10% level.
* Not significant
Ba is not significant hence it has been dropped and a second regression has been estimated as follows:

$$\text{Cu} = -20.4226 - 0.002783 \cdot N + 1.2803 \ln N$$

$$(-2.0587)** \quad (1.8947)**$$

$$R^2 = 0.5219 \quad ** \text{Significant at 10\% level.}$$

The negative significant relationship with market structure (N) which is measured as number of reporting units in the industry, seems paradoxical compared to its theoretical assumed positive relationship. This shows, the monopolistic hold in industrial market structure in this industry. It may be true in case of some Indian industries that a lesser number of producing units in an industry may be more influential in getting scarce raw materials which is a major constraint in utilising capacity, monopolistic rather than competitive market structure seems better for improving capacity utilisation in sector like non-electrical machineries.

An expected positive relationship is again seen, for the input availability variable in this sector. Since Iron and steel is the major input contributor in this sector, the rate of capacity utilisation in iron and steel has been taken as a proxy in the absence of direct information of quantum of iron and steel as an input in this sector. A positive significant relationship shows availability of iron and steel which is a crucial factor for the variation in capacity utilisation in this sector.
There is multicollinearity among many variables but since Fu is having the highest correlation with Ou, it has been selected for estimating the following regressions:

Regression results are,

(i) \[ C u = 81.7709 - 0.0297 \times Fu + 0.0909 \times In_1 \]
\[ (-0.7346) \quad (1.2292) \]
\[ R^2 = 0.5862 \]

In_1 is capacity utilisation in Metal Products sector.

None of the variable is significant. There is a problem of multicollinearity between Fu and In_1; hence, In_1, has been dropped in the following regression;

(ii) \[ C u = 83.0835 - 0.0597 \times Fu + 0.1533 \times In_2 \]
\[ (-3.2273)* \quad (2.1556)** \]

In_2 is capacity utilisation in vegetable oil producing sector.

\[ R^2 = 0.6691 \]

* Significant at 1% level.
** Significant at 10% level.

Second regression gives a good fit. About 67% of variation in capacity utilisation in this sector has been explained by these two variables. Both of them are statistically significant and also there is no problem of multicollinearity.
The above results for chemicals and chemical products again focus on the imbalance of capital structure and size of firm measured as fixed capital per reporting unit, shows a negative significant relationship with Cu. This also specifically applies to this industrial sector, since the process of production is on a continuous basis, vegetable oil is a major input in this industrial sector.

(6) **Electrical Machinery**

Observing the correlation matrix of independent variables with Cu, there is multicolinearity. None of the technical variables show a positive expected correlation with Cu. However, Cu and L i.e. size of firm and labour productivity respectively, are highly correlated with Cu and have been selected for the analysis.

Among the second set of variables, In₁ i.e. capacity utilisation in iron and steel industry, which is one of the major input supplying sector in electrical machinery producing sector, has been selected. Cu and L have been tested alternatively along with In₁ in the following two regressions, as there is a problem of multicolinearity between them.

Regression Results are,

(1) \[ Cu = 31.5157 - 0.3448 \hat{Cu} + 0.1969 \text{ In₁} \]

\[ \hat{R}^2 = 0.6139 \]

* Significant at 1% level.

** Not significant
Here, in case of this sector, technical variables namely size of firm (Ou) measured as output per reporting unit and labour productivity (L), dominate the explanation of variation in capacity utilisation, as in both the above regressions, about 61% of variation is explained by them but only technical characteristics show negative significant relationship with Ou, while the input availability (Iu) variable is not significant.

Now the negative sign of the coefficients of Ou and L, imply the negation of the theoretical assumed relationship with Ou. As far as the size of firm (Ou), measured here as an output per reporting unit is concerned, as already noted, captures mostly managerial scale economies. It may be explained that the significant negative relationship proves the limitation of indivisibility of managerial factor, which may be true particularly in this sector, as an aggregation at three digit level of electrical machineries producing sector consists of small as well as large types of units. The negative relationship between labour productivity and capacity utilisation in this sector, may reflect the shortage of skilled labour (as it is defined as value added per manhour)
which may be true in the case of selected Indian industries. This relationship may also be explained in terms of Marris' analysis, where it is explained that when the firms are in initial stage of adjustment with higher wages, it is possible to have low wages and low productivity with higher rate of utilisation.

(7) Sugar Refining

Among the first set of variables, the size of firm (fm) has highest correlation with Cu, but it is negatively correlated; the other measure of size of firm (Cu), has been selected as it has a positive correlation with Cu. Also rate of mechanisation i.e. K/V, shows higher correlation with Cu, hence it has been selected for estimating the following regressions.

The correlation matrix of the IIInd set of variables shows, the demand for sugar (D) and exports of sugar (E), have higher positive correlation with Cu. Both of them have been included in the following regressions.

(1) Estimated regression is,

\[ Cu = 37.1433 + 14.5513 K/V + 16.1453 D + 12.5605 E \]

\((-2.2965)** (1.9362)* (0.3445)**\)

\[ R^2 = 0.6474 \]

** Significant at 5% level
* Significant at 10% level
*** Not significant

sugar refining. As far as the technical variable i.e. K/V is concerned, its negative significant relationship may be explained in terms of production technique of sugar. Since it is not a very modernised sector, the labour intensive production technique may be suitable to it.

The positive significant relationship between demand for sugar and variation of capacity utilisation, does not need any explanation as it is an expected result i.e. increase in demand for sugar provides an incentive to utilise potential capacity of sugar production.

(3) Manufacture of Motor Vehicles

Observing the correlation matrix of independent variables given in Appendix, Ou and L have been selected from the I st set of variables, as both of them are highly positively related with Cu. From the II nd set of variables the given correlation matrix, does not show any positive high correlation with Cu, hence none of the variables has been selected for estimation from II nd set of variables.

The regression results are,

\[ \text{Cu} = 46.4448 + 0.1454 \text{ Ou} + 3.1647 \text{ L} \]

\[ (2.7852)*** \quad (1.4718)** \]

\[ R^2 = 0.4741 \]

*** Significant at 2\% level.

** Not significant.
47% of variation is explained by this regression, in which size of firm measured as output per reporting unit, shows positive and significant relationship with variation in capacity utilisation in this sector. While labour productivity (L) measured as value added per man hour, is significant and has an expected positive sign.

The positive significant relationship between size of firm (Ou) and variation in capacity utilisation (Cu), can be explained as far as motor manufacturing is concerned. It is a highly mechanised sector and size of firm measured in this manner, shows more of managerial economies.

(9) Paper and Paper Products

The correlation matrix of the independent variables of first set in this sector, shows that size of firm (Fu) measured as ratio of fixed capital per reporting unit has the highest positive correlation with Ou, hence it has been selected to estimate the regression.

The variables under IIInd set do not give any positive correlation of inputs availability factors with Ou, in this sector, hence none of them have been tested. Imported raw-material dependence (M), which is measured as imports of paper and products as a proportion of total supply, is correlated with Ou with expected negative sign, hence it has been taken in the regression estimates.
There is no multicollinearity problem and this regression explains about 65% of variation in capacity utilisation in Sugar refining sector. First two variables i.e. K/V and D, show a statistical significant relationship in which case former is negatively related, which is not in accordance with the posulated relationship, while the latter is positively related which is the assumed relationship.

In second regression, size of firm measured as Cu which is found positively correlated with Cu, has been taken in place of variable E, which is not found significant in the earlier regression.

The regression estimates are as follows:

\[
\text{Cu} = 25.9262 + 0.0215 \text{Cu} - 13.3994 \frac{K}{V} + 17.6378 \text{D} \\
(0.2408)*** (-2.0976)* (2.4906)**
\]

\[ R^2 = 0.6459 \]

* Significant at 10% level  
** Significant at 5% level  
*** Not significant

The degree of mechanisation (K/V) negatively and demand for Sugar which is expressed as private final consumption expenditure on sugar as a proportion of total private final consumption expenditure, positively and significantly explain the variation in capacity utilisation in
The regression results is,

$$ Cu = 74.6772 + 0.3594 Fu - 30.8257 N $$

$$(2.8932)*** (-1.8892)**$$

$$ R^2 = 0.4577 $$$$

*** Significant at 2% level.

** Significant at 10% level.

46% of variation of capacity utilisation has been explained by Fu and N in this regression. The coefficients of the variables under test are significant with expected signs.

(10) Cement

Unfortunately, the major inputs like coal and limestone in this sector show negative correlation with Cu which is not an expected relationship (See Appendix Table). The selected variables from the 1st set are size of firm (Fu) measured as fixed capital per reporting unit and market structure (N). The following regression was estimated by taking only technical variables, i.e. Fu and N.

The regression result is:

$$ Cu = 103.2964 + 0.01715 Fu - 0.4765 N $$

$$(0.3022)** (-4.4763)*$$

$$ R^2 = 0.7103 $$$$

* Significant at 1% level

** No significant

About 71% of variation of capacity utilisation in cement producing sector, is explained by Fu and N in this
regression estimation in which, only one variable i.e. market structure (N) gives a negative significant relationship, which may result from the monopolistic structure. In the Indian cement industry's case, a few big companies with their hold over the market may be successful in getting scarce raw-material like coal and limestone. The other variable i.e. size of firm (F) is not significant.

(11) Rubber Products

This sector has many independent variables which are highly correlated with its capacity utilisation. Two variables namely size of firm (Ou) measured as output per reporting unit and market structure (N) from Ist set and input variables In₁ and In₂ i.e. capacity utilisation in other textiles and capacity utilisation in chemicals and chemical products respectively, have been selected from set IIInd to estimate the following regressions.

The regressions have been estimated taking the selected variables alternatively to take care of multicollinearity problem.

The regression results are,

\[ O_u = 89.8487 - 0.09550 O_u - 0.0693 N + 0.0896 I_n \]
\[ (-2.2542)** (-1.7347)*** (0.5625)*** \]

\[ R^2 = 0.7047 \]

** Significant at 5% level.
*** Not significant
This result explains 70% of variation in Cu in rubber products, but only size of firm (Ou) is significant. Also there is a problem of multicollinearity between N and In1, hence each one of them has been dropped alternatively in the following regressions:

(ii) \[ Cu = 68.5776 - 0.0865\ Ou - 0.0760\ N + 0.3323\ In2 \]
\[ (-2.2388)** (3.1274)* (1.1430)*** \]
\[ R^2 = 0.7306 \]
** Significant at 5% level.
* Significant at 1% level.
*** Not significant

Here, about 73% of variation is explained by this regression result, where Ou and N are highly significant, but with negative sign while the third variable is positive but not significant.

(iii) \[ Cu = 59.5742 - 0.0600\ Ou + 0.3135\ In1 \]
\[ (-1.4874)** (3.1460)* \]
\[ R^2 = 0.6159 \]
* Significant at 1% level.
** Not significant

(iv) \[ Cu = 22.8842 - 0.0575\ Ou + 0.7133\ In2 \]
\[ (-1.1430)** (2.0155)* \]
\[ R^2 = 0.4671 \]
* Significant at 10% level.
** Not significant.
\[ (v) \quad C_2 = 30.4997 - 0.0630 N + 0.6664 \ln_2 \]
\[ (-2.2838) ** (2.2866) ** \]
\[ R^2 = 0.5955 \quad ** \text{Significant at 5% level.} \]

The second result shows that about 73% of variation explained by size of firm (Ou) and market structure (N) and \( \ln_2 \). But Ou & N are highly significant, but they have negative relationship with Ou, which again contradicts the assumed theoretical relationship with Ou. The explanation could be that, many rubber products like cycle tubes are usually produced in smaller firms and if the proportion of this type of smaller firms are higher in total sectoral structure, then a negative relationship may be possible. The negative relationship between market structure (N) and Ou again shows a possibility of monopolistic hold in the industry.

Regression IIIrd and Vth explain about 60% of variation in capacity utilisation in rubber products, where \( \ln_1 \) i.e. capacity utilisation in other textiles and \( \ln_2 \) i.e. capacity utilisation in chemicals and chemical products respectively, have been tested along with size of firm (Ou) and with market structure (N) respectively. In both these regressions the technical variables under test are not significant, but input variables are highly positively significant which corroborates with the hypothesis that greater availability of inputs encourages better utilisation in this industrial group.
Market structure (N) from first set of variables and In₁ measured as capacity utilisation in basic metal industries not elsewhere classified, have high correlation with Cu hence they have been tested in the following regression.

The regression result is,

\[ Cu = 125.4564 - 1.2717N - 0.3249In₁ \]

\[ (-3.9016) \times (0.7162)** \]

\[ R^2 = 0.6463 \]

* Significant at 1% level.
** Not significant.

About 65% of variation is explained by this result, but market structure (N) gives a negative significant relationships, which again shows a monopolistic hold in market structure of this industrial sector. The other input variable (In₁) is negative but not significant.

(13) Structural Clay Products

Labour productivity (L), rate of mechanisation (K/V) from the Ist set and In₁ i.e. production of other minerals which is one of the major input in this sector, from the IIInd set which has higher correlation with Cu have been selected. Since there is multicollinearity between L and K/V, between L and In₁ and K/V and In₁, each of these variables has been tested separately in the following regressions:
(i) \[ Cu = 74.8012 + 12.3799 L \]
\[ (2.4023) \]
\[ R^2 = 0.3248 \quad * \text{Significant at 5% level.} \]

(ii) Regression result is,
\[ Cu = 83.3797 + 0.00083 \ln L \]
\[ (1.3378) \]
\[ R^2 = 0.1298 \quad * \text{Not significant.} \]

The third variable \( K/Y \) has not been tested, as it has a negative correlation with \( Cu \).

Labour productivity (L), which is measured as value added per man hour, explains about 32% of variation of capacity utilisation in this sector. It is also positive and highly significant which shows the theoretically assumed relationship between the two. But, the input availability measured as production of other minerals which is the main input in this sector, does not explain the variation in \( Cu \).

(14) **Cycles**

In this industry size of the firm is measured as output per reporting unit. Market structure and exports have been used as independent variables in the following regressions, as they were found to be highly correlated with \( Cu \). Since there is a multicolinearity problem between them, they have been used separately.
The above results reveal that, these regressions do not explain much variation in capacity utilisation in this industry, as the value of $R^2$ is very low, but the size of firm ($Ou$) in first regression and exports ($E$) in the third regression, are positively significant which is in accordance with the assumed theoretical relationship. This shows that, larger size units of the cycle producing industry, enjoy economies of scale particularly managerial economies of scale, as $Ou$ is measured here as output per reporting unit. The increasing exports of cycles had provided an incentive to utilise capacity fully during the period under the observation i.e. 1960 to 1973. The third variable viz. market structure ($N$) does not seem to be significant.
In the results discussed until now the regression results give some explanation for variation in capacity utilisation in the sector under consideration. However, in the remaining sectors the regression analysis did not lead to any statistically significant results. The estimates are reported for the record. Many of the variables, although insignificant, do have the correct signs.

(1) **Textile Products**

The estimated regression is,

\[\text{Cu} = 10^{4.9609} - 7.3433 \text{ Fu} + 0.000056 \text{ In}_1 - 0.1893 \text{ In}_2\]

\[(-1.5330)^* (0.00412)^* (-1.378)^*\]

where \(\text{In}_1\) = production of raw cotton

\(\text{In}_2\) = production of power

\[R^2 = 0.7341\]

* Significant at 1% level.

** Not significant

About 73% of variation is explained by this regression but only the power variable (\(\text{In}_2\)) is highly significant, but a negative relationship is unexplainable.

(2) **Pottery Goods**

The regression result is,

\[\text{Cu} = 10^{5.2608} - 1.1403 \text{ Fu} - 0.001213 \text{ In}_1\]

\[(-1.3004)^* (-1.1066)^*\]
where $\text{In}_1$ = production of Minerals

\[ R^2 = 0.4476 \quad * \text{Not significant} \]

(3) **Sugar Confectionary**

The result is,

\[ \text{Cu} = 90.1683 - 10.7152 \text{Fm} + 5.0873 \text{L} \]

\[ (-1.2310) \quad (1.4390) \]

\[ R^2 = 0.5109 \quad * \text{Not significant.} \]

(4) **Glass and Glass Products**

Regression result is,

\[ \text{Cu} = 107.9974 - 8.1006 \text{Fm} - 0.08703 \text{N} \]

\[ (-0.8374) \quad (-0.7144) \]

\[ R^2 = 0.3311. \]

(5) **Dyes and Dyestuff**

The regression result is,

\[ \text{Cu} = 25.1916 + 0.5159 \text{In}_1 - 0.0294 \text{M} \]

\[ (0.8402) \quad (1.6391) \]

where $\text{In}_1$ = Chemicals and chemical products

\[ R^2 = 0.1992 \quad * \text{Not significant} \]
(6) **Electric Fans and Lamps**

Regression result is,

\[ Cu = 81.9943 + 30.5614 \times E \]

\[ \phi (0.2360)* \]

\[ R^2 = 0.4621 \quad * \text{Not significant.} \]

(7) **Fertilisers**

In this case, production of sulphuric acid which is the major input (In\(_1\)) in the production of fertilisers and domestic consumption of fertilisers, is treated as the demand.

The regression result is,

\[ Cu = 93.5429 + 0.0055 \times In_1 - 0.01380 \times D \]

\[ (0.6760)* \quad (-0.9435)* \]

\[ R^2 = 0.2602 \quad * \text{Not significant} \]

(8) **Jute Textiles**

The regression result is,

\[ Cu = 7.4190 + 61.5129 \times E + 0.0009727 \times In_1 + 0.3406 \times In_2 \]

\[ (0.9473)* \quad (0.3315)* \quad (0.8562)* \]

where \( In_1 \) - production of raw-jute and \( In_2 \) - capacity utilisation in other textiles.

\[ R^2 = 0.4849 \quad * \text{Not significant} \]
(9) **Plastic Products:**

The regression estimated is,

\[ Cu = 76.9228 + 0.10094 \ln_1 \]

\[(1.6431)\]

where \( \ln_1 \) = capacity utilisation in metal products.

\[ R^2 = 0.1837 \quad * \text{Not significant} \]

(10) **Flour Milling:**

The regression result is,

\[ Cu = -26.6262 + 4.6843 D - 0.00022 \ln_1 \]

\[(1.1169)\quad (-0.6059)\]

where \( \ln_1 \) = production of food grains.

\[ R^2 = 0.1045 \quad * \text{Not significant} \]

(11) **Petroleum Products:**

The regression result is,

\[ Cu = 1116.6837 + 0.2325 \ln_1 + 0.002197 \ln_2 - 107.6828 \]

\[-2.6195\quad (-2.1452)\quad (-1.7092)\]

where \( \ln_1 \) = capacity utilisation in metal products & \( \ln_2 \) = production of crude oil.

\[ R^2 = 0.4359 \quad ** \text{Significant at 2\% level} \]

* **Significant at 10\% level

*** \text{Not significant}

About 44\% percent of variation is explained by this estimated regression and \( \ln_1 \) and \( \ln_2 \) i.e. input variables,
are also statistically significant but unfortunately their signs are unexplainable. The third variables i.e. M is not significant.

(12) **Tobacco and Tobacco Products**

The regression is,

\[
\text{Cu} = 100.8914 + 0.82250 \text{ Ou} - 0.03650 \text{ N} \\
(0.16618)* \quad (-1.6178)*
\]

\[ R^2 = 0.2502 \quad * \text{Not significant.} \]

(13) **Commercial Office and Household Machines**

The estimated regression is as follows:

\[
\text{Cu} = 168.2255 + 3.5065 \text{ D} - 1.1542 \text{ In}_1 \\
(0.9157)* \quad (-2.7042)**
\]

where \( \text{In}_1 \) capacity utilisation in Iron and steel.

\[ R^2 = 0.5336 \]

**Significant at 5% level**

* Not significant

Here about 53% of variation is explained by above regression. Only the input variable (\( \text{In}_1 \)) is significant, the negative relationship is again questionable.

**Entire Manufacturing Sector**

Apart from the sectorwise analysis of factors affecting capacity utilisation, the following regressions have been
estimated for the entire manufacturing sector, covered in the study. Capacity use is taken as the dependent variable and the independent variables are, gross fixed capital formation, mandays lost, and index of industrial profits. These variables have been examined to test the following hypothesis.

(1) The increase in gross fixed capital formation implies fuller capacity utilisation, as new addition in capital stock is only desirable, if and only if the existing capital stock is utilised fully.

(2) The labour trouble in our industrial sector is a managerial problem, so it cannot be treated as an economic variable but it certainly affects the rate of utilisation.

(3) Industrial profit is an incentive to produce more. Though this factor in fact should be tested industrial sectorwise, but due to lack of information this could not be possible. An index of industrial profit (1960-61 base), was available for the years under the study, for the manufacturing sector as a whole. The terminology is as follows:

\[
\begin{align*}
Gfc &= \text{Gross Fixed Capital Formation (in Rs. lakh at 1960-61 price)} \\
Mdl &= \text{Man-day lost (in 000)} \\
Iip &= \text{Index of Industrial Profit (1960 = 100)}
\end{align*}
\]

The following regressions have been estimated.
(i) \[ Cu = 93.1300 - 0.000649 \, \text{Gfc} - 0.000649 \, \text{Mdl} - 0.0440 \, \text{Up} \]
\[
(0.18073)** (-4.3234)* (-1.1984)**
\]
\[ R^2 = 0.8767 \]
* Significant at 1% level.
** Not significant.

This regression explains about 88% of variation in capacity utilisation in the manufacturing sector. Only Mdl is significant at 1% level and the negative sign is expected. There is multicolinearity between Gfc and Mdl, hence Gfc has been dropped in the following regression.

(ii) \[ Cu = 93.3948 - 0.0006708 \, \text{Mdl} + 0.04757 \, \text{Up} \]
\[
(-7.4620)* (-1.5976)**
\]
\[ R^2 = 0.8763 \]
* Significant at 1% level.
** Not significant

This regression also explains about 88% of variation in Cu and again Mdl is highly significant and also shows an expected negative relationship. There is no problem of multicolinearity. Thus, it can be concluded, that at an aggregate level, higher man-days lost during the period 1960-1973 had determined capacity utilisation.

Overall Evaluation of Results:

The following table summarises the factors affecting capacity utilisation in 14 industrial sectors (out of 27 sectors considered for the regression analysis).
Size of the firms:

The economies of scale play an important positive role in determining the level of capacity utilisation, but it is difficult to distinguish which economies prevail at an aggregate level like an industrial sector. Of course, similar tests in other countries have been conducted at higher levels of aggregation in case of studies of India, Pakistan and Bangladesh. Three different measures of the size of firm, i.e., output per reporting unit (Ou), fixed capital per man hour (fm) and fixed capital per reporting unit (fu) were used in our regressions.

This analysis shows that managerial scale economies reflected in the size of firm measured as output per reporting unit, determines capacity in more sectors than the other two measures. In case of electrical machinery, leather products, chemicals and chemical products and rubber products, the negative significant relationship between size of firm, either managerial or technical, and capacity utilisation, imply indivisibility of a theoretical limitation of the size of firm and economies of scale or simply it may be explained that in those sectors production at smaller scale had been more effective.

### Summary Table - Capacity Utilisation and Factors Affecting it in Estimated Regressions: 1960-1973

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Sector</th>
<th>$(u)$</th>
<th>$(p_m)$</th>
<th>$(p_u)$</th>
<th>$L$</th>
<th>$(K/V)$</th>
<th>$(M)$</th>
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<tr>
<td>1</td>
<td>Leather Footwear</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>2(i)</td>
<td>Paints and Varnishes</td>
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<td></td>
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<td>(ii)</td>
<td>Paints</td>
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<td>3</td>
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<td>4</td>
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<td>Paper and Paper Products</td>
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<tr>
<td>1</td>
<td>Cement</td>
<td>- (1%)</td>
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<td>2</td>
<td>(1) Rubber Products</td>
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</tr>
<tr>
<td>3</td>
<td>(11)</td>
<td>- (5%)</td>
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<td>4</td>
<td>(111)</td>
<td>- (5%)</td>
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<tr>
<td>5</td>
<td>(A)</td>
<td>- (1%)</td>
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<td>6</td>
<td>12 Watches and Clocks</td>
<td>+ (1%)</td>
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<tr>
<td>7</td>
<td>13 Structural Clay Product</td>
<td>+ (5%)</td>
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<td>8</td>
<td>15 All Industries</td>
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<th>Sr. No.</th>
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<th>Demand (D)</th>
<th>% R2</th>
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<tr>
<td>2</td>
<td>Metal products + (1%)  (ii) Chemicals &amp; Products + (5%)</td>
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<td>13</td>
</tr>
<tr>
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<td>Ore + (5%)</td>
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</tr>
<tr>
<td>4</td>
<td>Production of Manganese</td>
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<td>13</td>
</tr>
<tr>
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<td>Iron and Steel + (10%)</td>
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<td>13</td>
</tr>
<tr>
<td>6</td>
<td>Vegetable oil + (10%)</td>
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<td>13</td>
</tr>
<tr>
<td>7</td>
<td>Iron and Steel + (1%) (ii)</td>
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<td>13</td>
</tr>
<tr>
<td>8</td>
<td>(ii)</td>
<td>12</td>
<td>13</td>
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<td>(ii)</td>
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Summary Table continued.

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<td>73</td>
<td>61</td>
<td>64</td>
<td>60</td>
<td>65</td>
</tr>
</tbody>
</table>

Notes: Figures in the brackets show levels of significance and signs attached, show the signs of coefficients in the estimated regressions.
Market Structure:

Out of the fourteen industrial sectors in the above table, in five sectors market structure shows a statistical significant relationship with capacity utilization, but all of them have negative co-efficients which is not expected. In Indian industries, the constraints are mainly on the supply side (which is also revealed by this study), so the industries which face inelastic demand cannot increase profits by expanding output within a given range. In this situation, an industrial sector with greater market concentration can probably get the scarce raw material with greater ease and, thus, can release the supply constraint.

Labour Productivity:

Labour productivity measured as ratio of value added to manhour worked, shows a positive significant relationship in case of structural clay products and a negative significant relationship in case of electrical machinery with capacity utilization. A positive relationship is assumed, but the negative relationship may be explained in two ways: First in the context of Harris' theory of intended excess capacity. In this sense, in the process of adjustment to the increased real wages, the industry comprising of firms may have low wages, low productivity and high utilization.

The second explanation may be in context of skilled labour constraints in developing countries like India. This is on the basis of argument that the ratio of value added to man-hour simply measures labour skill and in a labour surplus economy like India, it is a known fact that skilled labour is scarce.

(4) **Degree of Mechanisation:**

A positive association between degree of mechanisation and rate of utilisation is expected. Unfortunately, this variable was not found effective in explaining capacity utilisation in this study. A negative significant relationship is seen in case of paints and varnishes and sugar refining.

In short, the economic variables described as technical characteristics did not prove the most effective variables in explaining variation in capacity utilisation in Indian industries. The importance of other variables which reflect input shortage, demand and trade factors has been analysed below.

(5) **Inputs availability:**

The regression analysis testing the effects of input availability on variation in capacity utilisation has proved to be the most effective variable. Out of 21 regressions estimated for 14 industrial sectors, in eleven regressions it gives positive significant relationship with capacity utilisation. Two groups of inputs are found as constraints in most of the sectors viz. iron and steel and chemicals and chemical products.
As far as agricultural and allied inputs are concerned, only raw leather was found as a constraint in leather footwear at a significant level. No other inputs such as rubber (in rubber products), cotton (in cotton textiles), jute and sugar cane (respectively in jute textiles and sugar refining), proved as a constraint in capacity utilisation in the respective sectors. Domestic availability of major inputs mainly non-agricultural inputs were the major constraints in capacity utilisation in the sectors under study during 1960 to 1973.

(6) Trade Factors:

In case of Indian industrialisation, Governmental policies play an important role in determining the level of capacity utilisation in industrial sectors, mainly policies concerning imports and exports.

Imports:

Imports as a proportion of total supply was examined in regression analysis in case of paper and products, petroleum products, rubber products, fertilisers and jute textiles. Unfortunately, except in case of paper and paper products, in which it gave a negative significant relationship which is in accordance with the assumed relationship, in none of the other sectors, it was found as a determining variable.

Exports:

Only the cycles producing sector showed a positive and significant relationship between exports and level of capacity utilisation.
A positive relationship between demand for the product and capacity utilisation is expected. Since the data on private final consumption expenditure reflecting demand is available for some of the consumer goods only, those sectors could be considered in examining this variable in our regression analysis. In these sectors, this variable determined capacity use in leather footwear and sugar.

The last remark on the regression analysis made in this chapter, may be that with the limitations of data and level of aggregation of sectors of the study, the major constraints in utilising capacity during the period under observation, seem to be supply factors i.e. availability of major inputs; so policies which assure the timely and adequate availability of scarce inputs would have helped in utilising the unutilised potential during the period 1960 to 1973.
Appenlix

Leather Footwear

Correlation Matrix

<table>
<thead>
<tr>
<th>Symbols</th>
<th>(X_1)</th>
<th>(X_2)</th>
<th>(X_3)</th>
<th>(X_4)</th>
<th>(X_5)</th>
<th>(X_6)</th>
<th>(X_7)</th>
<th>(X_8)</th>
<th>(X_9)</th>
<th>(X)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cm) (X_1)</td>
<td>0.7804</td>
<td>0.9323</td>
<td>0.8300</td>
<td>-0.2751</td>
<td>0.4213</td>
<td>0.1046</td>
<td>-0.0550</td>
<td>0.4040</td>
<td>-0.2769</td>
<td>0.0048</td>
</tr>
<tr>
<td>(Fm) (X_2)</td>
<td>0.7937</td>
<td>0.8933</td>
<td>0.2199</td>
<td>0.6664</td>
<td>-0.4351</td>
<td>0.2570</td>
<td>-0.6262</td>
<td>0.6664</td>
<td>-0.0687</td>
<td>0.0048</td>
</tr>
<tr>
<td>(D) (X_3)</td>
<td>0.8031</td>
<td>0.9615</td>
<td>0.5407</td>
<td>0.0090</td>
<td>-0.7579</td>
<td>0.2570</td>
<td>-0.4067</td>
<td>0.6664</td>
<td>-0.0687</td>
<td>0.0048</td>
</tr>
<tr>
<td>(L) (X_4)</td>
<td>0.3040</td>
<td>0.5973</td>
<td>-0.3279</td>
<td>0.2068</td>
<td>0.5859</td>
<td>-0.5006</td>
<td>0.0048</td>
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</tr>
<tr>
<td>(K/V) (X_5)</td>
<td>0.0315</td>
<td>-0.0117</td>
<td>-0.4005</td>
<td>-0.1206</td>
<td>-0.0476</td>
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<tr>
<td>(H) (X_6)</td>
<td>-0.7440</td>
<td>0.5589</td>
<td>0.9388</td>
<td>-0.8238</td>
<td>0.0048</td>
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<tr>
<td>(In) (X_7)</td>
<td>-0.7355</td>
<td>-0.7680</td>
<td>0.7920</td>
<td>0.6545</td>
<td>-0.4575</td>
<td>0.0048</td>
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<td>(D) (X_8)</td>
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<td>(E) (X_9)</td>
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</tbody>
</table>

\[ U = 92.8994 - 44.4518 \]

(99)

0.7278 | 0.7051 | 2.0407 | 32.0872*

a Significant at 1% level. (In1) - Production of leather
* Significant at 1% level.

Notes: (1) The figures in the brackets are the standard errors of coefficients.
(2) The symbols at the head of coefficients are the serial numbers of independent variables found significant.
### Paints and Varnishes

#### Correlation Matrix

<table>
<thead>
<tr>
<th>Symbols</th>
<th>$X_1$</th>
<th>$X_2$</th>
<th>$X_3$</th>
<th>$X_4$</th>
<th>$X_5$</th>
<th>$X_6$</th>
<th>$X_7$</th>
<th>$X_8$</th>
<th>$X_9$</th>
<th>$Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cu) $X_1$</td>
<td>0.4751</td>
<td>0.5023</td>
<td>0.7739</td>
<td>0.1084</td>
<td>0.5058</td>
<td>-0.5490</td>
<td>-0.4534</td>
<td>-0.4192</td>
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<tr>
<td>(Fm) $X_2$</td>
<td>0.9652</td>
<td>0.5706</td>
<td>0.8710</td>
<td>0.9714</td>
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<td>-0.5505</td>
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<td>(Fu) $X_3$</td>
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<td>0.7959</td>
<td>0.9761</td>
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<td>-0.5148</td>
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<td>(L) $X_4$</td>
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<td>0.6220</td>
<td>-0.5541</td>
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</tr>
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</table>

\[
U = 80.0725 - 15.9712 + 0.2361 = 0.9955 \quad (0.0651)
\]


| | 0.7895 | 0.7513 | 2.5149 | 20.6332 |

Notes:
1. The figures in the brackets are the standard errors of coefficients.
2. The number at the head of coefficients are the serial numbers of independent variables found significant.

* Significant at 1% level.  
(1) Cu. Utilisation in vegetable oil.  
(2) Cu. Utilisation in metal products.  
(3) Cu. Utilisation in Chemicals and chemical products.
### Appendix contd.

#### Iron and Steel Basic Industries

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<thead>
<tr>
<th>Symbols</th>
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<th>$X_7$</th>
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<td>(Fm)</td>
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<td>0.8816</td>
<td>0.3019</td>
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<td>0.0490</td>
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<td>(L)</td>
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</table>

**Correlation Matrix**

$$U = 29.0283 + 0.4771 + 0.5271$$

(0.1189) (2.0870)

- M. Cor. Sq. 0.5945
- Co.M. Cor. Sq. 0.5207
- D.W. Statistics 2.2399
- F-Ratio 8.0624*

**Notes:**
- Significant at 1% level. (In1) - Production of electricity.
- Significant at 5% level. (In2) - Production of manganese ore.
- Significant at 1% level.

**Notes:**
1. The figures in the brackets are the standard errors of coefficients.
2. The number at the head of coefficients are the serial numbers of independent variables found significant.
### Non-Electrical Machinery

#### Correlation Matrix

<table>
<thead>
<tr>
<th>Symbols</th>
<th>$X_1$</th>
<th>$X_2$</th>
<th>$X_3$</th>
<th>$X_4$</th>
<th>$X_5$</th>
<th>$X_6$</th>
<th>$X_7$</th>
<th>$X_8$</th>
<th>$Y$</th>
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<tbody>
<tr>
<td>(Cu) $X_1$</td>
<td>0.1097</td>
<td>0.0848</td>
<td>0.1544</td>
<td>0.0985</td>
<td>0.0673</td>
<td>0.0774</td>
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<td>(Fm) $X_2$</td>
<td>0.9401</td>
<td>0.5014</td>
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<tr>
<td>(Fu) $X_3$</td>
<td>0.2421</td>
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<td>0.6932</td>
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<td>-0.0075</td>
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<td>(K/V) $X_5$</td>
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<td>-0.1935</td>
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</table>

$$U = -91.5887 + 0.3780 - 3.3098 + 2.3372 - 8.3766 + 0.4388 + 0.0058$$

$$(0.1541) - (1.0347) - (0.2352) - (0.8123) + (0.4388) + (0.0058)$$

---

**M. Cor. Sq.** **Co. M. Cor. Sq.** **D.W. Statistics** **F. Ratio**

0.8899 0.7954 1.8285 9.4252*

c Significant at 5% level.  
e Significant at 2% level.  
b Significant at 20% level.  
a Significant at 1% level.  
* Significant at 1% level.

**Notes:** Figures in the brackets are the standard errors of coefficients.  
2. Numbers at the head of coefficients are the serial no. of independent variable found significant.

(In1) - Cu. Utilisation in Iron and steel industries.  
(In2) - Production of timber.
Appendix contd.

### Chemicals and Chemical Products

<table>
<thead>
<tr>
<th>Symbols</th>
<th>$x_1$</th>
<th>$x_2$</th>
<th>$x_3$</th>
<th>$x_4$</th>
<th>$x_5$</th>
<th>$x_6$</th>
<th>$x_7$</th>
<th>$x_8$</th>
<th>$x_9$</th>
<th>$x_{10}$</th>
<th>$x_{11}$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cu)</td>
<td>0.7429</td>
<td>0.8162</td>
<td>0.7664</td>
<td>0.4879</td>
<td>0.5721</td>
<td>-0.0116</td>
<td>-0.6954</td>
<td>-0.3745</td>
<td>-0.5540</td>
<td>0.6981</td>
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<td>(Mn)</td>
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<td>0.8909</td>
<td>0.8450</td>
<td>0.8865</td>
<td>-0.0891</td>
<td>-0.9043</td>
<td>-0.2688</td>
<td>-0.6401</td>
<td>0.9523</td>
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<td>(Ru)</td>
<td>0.8061</td>
<td>0.7725</td>
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<td>0.0614</td>
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<td>(L)</td>
<td>0.5314</td>
<td>0.7958</td>
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<td>-0.6793</td>
<td>-0.0439</td>
<td>-0.4461</td>
<td>0.8533</td>
<td>-0.4939</td>
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<tr>
<td>(Ni)</td>
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<td>-0.1204</td>
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<td>0.9141</td>
<td>-0.4605</td>
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<tr>
<td>(In₁)</td>
<td>-0.0085</td>
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<td>(In₂)</td>
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<td>(In₃)</td>
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<td>(In₄)</td>
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</tr>
</tbody>
</table>

\[ U = 0.0020 + 0.3081 (7) + 0.8641 (10) \]

\[ \text{b = Significant at } 20\% \text{ level.} \]

\[ \text{a = Significant at } 1\% \text{ level.} \]

Notes:

1. The figures in the brackets are the standard errors of coefficients.
2. The number at the head of coefficients are the serial numbers of independent variables found significant.

Synbol:

- **Cu**: Utilisation in salt refining industry.
- **Mn**: Utilisation in metal products industry.
- **Ru**: Utilisation in vegetable oil industry.
- **L**: Production of other minerals.
- **K/V**: Utilisation in vegetable oil industry.
- **Ni**: Production of chemicals.
- **In₁**: Production of other minerals.
- **In₂**: Production of chemicals.
- **In₃**: Production of other minerals.
- **In₄**: Production of other minerals.
- **In₅**: Production of other minerals.

*Significant at 1% level.

**Chemicals and Technical Products**

<table>
<thead>
<tr>
<th>M COR Sq</th>
<th>C.H. COR. SQ</th>
<th>D.W.</th>
<th>R Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9005</td>
<td>0.8824</td>
<td>1.8894</td>
<td>49.7962*</td>
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*Significant at 1% level.
### Electrical Machinery

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<th>$x_2$</th>
<th>$x_3$</th>
<th>$x_4$</th>
<th>$x_5$</th>
<th>$x_7$</th>
<th>$x_8$</th>
<th>$x_9$</th>
<th>$x_{10}$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cu) $x_1$</td>
<td>0.6885</td>
<td>0.7019</td>
<td>0.7264</td>
<td>0.7019</td>
<td>0.6614</td>
<td>-0.0408</td>
<td>-0.3030</td>
<td>0.2226</td>
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<tr>
<td>(In) $x_2$</td>
<td>0.9757</td>
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<td>0.9757</td>
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<td>(Ri) $x_3$</td>
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<td>1.0000</td>
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<td>(L) $x_4$</td>
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<td>(In$_1$) $x_7$</td>
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<td>(In$_2$) $x_8$</td>
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<td>0.2676</td>
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<td>(In$_3$) $x_9$</td>
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<td>(In$<em>4$) $x</em>{10}$</td>
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<td>0.5756</td>
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</table>

(U = $-7.3540 \cdot x_1 + 6.5082 \cdot x_2 + 1.2130 \cdot x_3 + (0.9581 \cdot x_4$ + (0.3578 \cdot x_5$)

Notes:
1. The figures in the brackets are the standard errors of coefficients.
2. The numbers at the head of coefficients are the serial numbers of independent variables found significant.
3. a - Significant at 1% level.
4. * - Significant at 1% level.
### Correlation Matrix

<table>
<thead>
<tr>
<th>Symbols</th>
<th>$X_1$</th>
<th>$X_2$</th>
<th>$X_3$</th>
<th>$X_4$</th>
<th>$X_5$</th>
<th>$X_6$</th>
<th>$X_7$</th>
<th>$X_8$</th>
<th>$X_9$</th>
<th>$X_{10}$</th>
<th>$Y$</th>
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<tbody>
<tr>
<td>(C) $x_1$</td>
<td>0.1284</td>
<td>0.6763</td>
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<td>-0.3642</td>
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<td>(M) $x_2$</td>
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<td>0.5330</td>
<td>0.1330</td>
<td>0.3590</td>
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<td>-0.5003</td>
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<td>-0.6840</td>
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<tr>
<td>(U) $x_3$</td>
<td>-0.1672</td>
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<td>-0.0276</td>
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<td>(L) $x_4$</td>
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<td>0.0730</td>
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<tr>
<td>(K/V) $x_5$</td>
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<td>0.3339</td>
<td>-0.3756</td>
<td>-0.3698</td>
<td>0.0640</td>
<td>-0.6505</td>
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<tr>
<td>(N) $x_6$</td>
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<td>(I) $x_7$</td>
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<td>(I) $x_8$</td>
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<tr>
<td>(D) $x_9$</td>
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<td>(E) $x_{10}$</td>
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</tbody>
</table>

\[
U = 154.9587 + 0.1140 \times 13.4970 + 13.9357 + 48.3009 \\
(0.0594) (1.7926) (2.0160) \]

(1) - Cu. Utilisation in jute textiles.
(2) - Production of sugar cane.

**Notes:**
- The figures in the brackets are the standard errors of coefficients.
- The number at the head of coefficients are the serial numbers of independent variables found significant.
Appendix contd.

**Manufacture of Motor Vehicles**  

<table>
<thead>
<tr>
<th>Symbols</th>
<th>$X_1$</th>
<th>$X_2$</th>
<th>$X_3$</th>
<th>$X_4$</th>
<th>$X_5$</th>
<th>$X_6$</th>
<th>$X_7$</th>
<th>$Y$</th>
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<tbody>
<tr>
<td>(ou) $X_1$</td>
<td>-0.7621</td>
<td>-0.0528</td>
<td>-0.0010</td>
<td>-0.3782</td>
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<td>0.4433</td>
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<tr>
<td>(nu) $X_3$</td>
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<td>0.5252</td>
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<td>-0.1520</td>
<td>0.5411</td>
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<td>(l) $X_4$</td>
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<tr>
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<td>-0.4433</td>
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<tr>
<td>(n) $X_6$</td>
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<td>(in) $X_7$</td>
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\[ U = 56.5570 + (0.2712 + 3.7146 - 0.7532) \times (0.0637 + 1.4743 + 0.1785) \]  

(1) Cu Utilisation in iron and steel industries.

<table>
<thead>
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<th>M.COR.SQ.</th>
<th>0.7738</th>
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<tr>
<td>CO.M.COR.SQ.</td>
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<td>D.W. Statistics</td>
<td>2.6921</td>
</tr>
<tr>
<td>R. Ratio</td>
<td>11.4015*</td>
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</tbody>
</table>

(OU) - Symbols

a - Significant at 1% level.  
c - Significant at 5% level.  
* - Significant at 1% level.  
Notes: (1) The figures in the brackets are the standard errors of coefficients.  
(2) The number at the head of coefficients are the serial numbers of independent variables found significant.
### Correlation Matrix

<table>
<thead>
<tr>
<th>Symbols</th>
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<th>$X_5$</th>
<th>$X_6$</th>
<th>$X_7$</th>
<th>$X_8$</th>
<th>$X_9$</th>
<th>$X_{10}$</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>-0.0645</td>
<td>0.8130</td>
<td>-0.8259</td>
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\[ U = 132.4718 - 0.0023 - 0.0074 (\text{In1}) - \text{Cu Utilisation in chemicals and chemical products.} \\
(0.0006) (20.9111) (\text{In2}) - \text{Production of coal.} \\
(\text{In3}) - \text{Production of electricity.} \]

M.COR.SQ. CO.M.COR.SQ. D.W. Statistics F. Ratio

|      |      |      |      |      |
|------|------|------|------|
| 0.5771 | 0.5002 | 2.0030 | 7.5043* |

$^a$ - Significant at 1% level.  
$^\#$ - Significant at 1% level.

Notes: (1) The figures in the brackets are the standard errors of coefficients. 
(2) The number at the head of coefficients are the serial numbers of independent variables found significant. 

---

**Appendix contd.**

**Paper and Paper Products**

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The number at the head of coefficients are the serial numbers of independent variables found significant.

Notes: (1) The figures in the brackets are the standard errors of coefficients.
(2) The number at the head of coefficients are the serial numbers of independent variables found significant.

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Cement Utilisation in jute textile industry.
Production of coal.
Production of limestone.

$U = 133.3480$

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<th>CO2% COR.SQ.</th>
<th>D.W.</th>
<th>F.Ratio</th>
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Notes: (1) The figures in the brackets are the standard errors of coefficients.
(2) The number at the head of coefficients are the serial numbers of independent variables found significant.

$U^*$ Significant at 1% level.

$U^{**}$ Significant at 5% level.
### Appendix contd.

#### Rubber Products

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<th>$x_8$</th>
<th>$x_9$</th>
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### Correlation Matrix

$U = 76.7164 \pm 5.5810 - 2.1201$  
$(2.4546) \quad (0.0369)$

$M_{COR.SQ.} = 0.8128$  
$M_{COR.SQ.} = 0.7788$  
$D.W. Statistics = 3.0962$  
$F-ratio = 23.8879^*$

- **c** - Significant at 5% level.  
- **a** - Significant at 1% level.  
- ***** - Significant at 1% level.

#### Notes:

1. The figures in the brackets are the standard errors of coefficients.
2. The number at the head of coefficients are the serial numbers of independent variables found significant.
**Correlation Matrix**

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<th>( X_2 )</th>
<th>( X_3 )</th>
<th>( X_4 )</th>
<th>( X_5 )</th>
<th>( X_6 )</th>
<th>( X_7 )</th>
<th>( X_8 )</th>
<th>( Y )</th>
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\( \bar{U} = 96.6508 - 1.1258 = 24.92 \)  
M. Cor. Sq. 0.6298
Co.M. Cor. Sq. 0.5990
D.W. Statistic 1.3706
F. Ratio 20.4157*

*a* Significant at 1% level  
* Significant at 1% level.

Notes: (1) The figures in the brackets are the standard errors of coefficients.  
(2) The number at the head of coefficients are the serial numbers of independent variables found significant.
### Correlation Matrix

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<th>Symbols</th>
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<td>0.0105</td>
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<tr>
<td>(In1) $X_7$</td>
<td>0.7766</td>
<td>0.0090</td>
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<tr>
<td>(In2) $X_8$</td>
<td>0.3606</td>
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</table>

\[ U = 135.4076 - 4.5404 - 0.1052 + 0.0015 \]
\[ (1.1975)(0.0254) \]

\[ (8)^c \]

- (In1) - Production of coal.
- (In2) - Production of 'other minerals'.

### Notes:
1. The figures in the brackets are the standard errors of coefficients.
2. The number at the head of coefficients are the serial numbers of independent variables found significant.
### Cycles

<table>
<thead>
<tr>
<th>Symbols</th>
<th>( X_1 )</th>
<th>( X_2 )</th>
<th>( X_3 )</th>
<th>( X_4 )</th>
<th>( X_5 )</th>
<th>( X_6 )</th>
<th>( X_7 )</th>
<th>( X_8 )</th>
<th>( Y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cu)</td>
<td>(-0.3968)</td>
<td>(-0.5684)</td>
<td>(0.9153)</td>
<td>(-0.8556)</td>
<td>(0.6961)</td>
<td>(-0.5138)</td>
<td>(0.7684)</td>
<td>(0.5081)</td>
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<tr>
<td>(Fm)</td>
<td>(0.4041)</td>
<td>(-0.3619)</td>
<td>(0.5677)</td>
<td>(-0.1221)</td>
<td>(0.0313)</td>
<td>(-0.2380)</td>
<td>(-0.3174)</td>
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<tr>
<td>(Fu)</td>
<td>(-0.7678)</td>
<td>(0.7926)</td>
<td>(-0.8996)</td>
<td>(0.4025)</td>
<td>(-0.8152)</td>
<td>(-0.4144)</td>
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<tr>
<td>(L)</td>
<td>(-0.9390)</td>
<td>(0.8610)</td>
<td>(-0.5018)</td>
<td>(0.8784)</td>
<td>(0.3868)</td>
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<tr>
<td>(K/V)</td>
<td>(-0.8119)</td>
<td>(0.6316)</td>
<td>(-0.8195)</td>
<td>(-0.5031)</td>
<td>(-0.3978)</td>
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<tr>
<td>(N)</td>
<td>(-0.3798)</td>
<td>(-0.8675)</td>
<td>(0.4209)</td>
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<tr>
<td>(In1)</td>
<td>(-0.2177)</td>
<td>(-0.1495)</td>
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</tr>
</tbody>
</table>
| (E)     | \(0.5145\) 

\( U = 83.0037 + 109.0848 \)  
\( (48.5031) \)

**Notes:**
1. The figures in the brackets are the standard errors of coefficients.
2. The number at the head of coefficients are the serial numbers of independent variables found significant.
Note: Symbols in the correlation matrix have following meaning

\( Ou \) = Output per reporting unit
\( Fm \) = Fixed capital per man-hour
\( Fu \) = Fixed capital per reporting unit
\( L \) = Value added per man-hour
\( K/V \) = Ratio of fixed capital to value added
\( N \) = Number of reporting units
\( D \) = Demand
\( E \) = Exports
\( M \) = Imports
\( In \) = Input/Inputs availability