CHAPTER VI

DETERMINANTS OF INDUSTRIALISATION:
AN ECONOMETRIC APPROACH

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6.1 **INTRODUCTION:**

This doctoral research has been pursued to determine the impact of incentives on industrialisation in Orissa. During the plan periods, industrial development of Orissa has been accelerated by means of a number of policy and institutional measures initiated by the government and specialised financial institutions. These measures include investment incentives in the form of fiscal concessions, concessional finance, investment subsidy, provision for cheap credit, availability of industrial infrastructure and liberal industrial licensing, etc. In the previous chapters, a thorough discussion has been made to identify the various policies and institutional measures that have been instrumental to secure industrial development in Orissa. But a study of this type remains incomplete unless it includes analysis of available secondary data with the help of well-known econometric techniques. Hence, this Chapter attempts to formulate and estimate econometric models to determine the cause and effect relationship between industrialisation and various incentive measures.

Economic theory suggests hypothesis that can be put into mathematical form. In economic analysis usually models are developed. A model is an abstract of reality. An economic model is a set of prepositions or hypothesis purported to describe and/or predict the behaviour of an economic unit. It can be cast in the form of an equation. The conventional economic theory postulates exact relationship between variables. However, historical data do not support this idea. Therefore, to establish cause and effect relationship between a dependent variable and several independent variables an
A econometric model is formulated. All econometric models are stochastic and not deterministic. Econometric is concerned with quantification. It describes the functional relationship between dependent and independent variables. Such a relationship can be described by tables or graphs but they are best described by equations. A functional relationship containing two or more independent variables is called a multiple regression model. In a general multivariate linear regression model, the dependent variable Y is hypothesised to be a function of several independent X variables as is given below:

\[ Y = f(X_1, X_2, X_3 \ldots \ldots \ldots X_n) \]

### 6.2 DETERMINANT OF INDUSTRIALISATION: THE MODELS

In a backward state like Orissa Industrial Development is dependent on many factors like effective policy measures provided by the government, suitable institutional measures provided by specialised organisations created for the purpose and many other social and political variables. In this research, it is hypothesised that industrialisation depends on policy and institutional measures to a considerable extent. In this section an attempt is made to formulate stochastic models to identify important determinants of industrialisation. Although incentives provided by government and specialised institutions are very much required for industrialisation, these are only necessary conditions for industrial growth but not sufficient conditions. As such in this chapter an attempt is made to find out the impact of various determinants of industrialisation along with incentive measures. In addition to policy and institutional measures; industrial development is also a function of variables like industrial finance,
industrial consumption of electricity, availability of efficient and skill industrial workers, level of infrastructure development, urbanisation, literacy, availability and utilisation of raw materials, marketing facilities and government policies etc.

In a state like Orissa, where agriculture occupies an important position in economy, it is difficult to determine the level of industrial development, as there is no unique measure of industrialisation. Some of the accepted indicators used in this study to measure the levels of industrialisation are number of registered factory units, gross industrial output from organised factory sector, value added by manufacture, number of person employed in the industrial sector and productive capital investment in industry. All these factors are separately taken as dependent variables. Some of these dependent variables are explained in respect of several independent variables.

6.2.1 **Formulation of Model**:

In order to determine the relationship between industrialisation and its various determinants, a multiple regression model is specified hypothesising a functional relationship between them. Regression consists of a body of methods for summarising quantitatively, the relations between two or more variables. A study of the dependence of one variable upon other variables is mainly used for estimation and prediction. A functional relationship containing two or more independent variables is known as multiple regression equation. In this study industrialisation is hypothesised to be a function of many variables. A multiple regression model of the following type is specified.
\[ Y = f(L, K, F_b, F_d, E, U, S) \] - - - (1)

Where

\[ Y = \text{Value of gross output in manufacturing (Q) or value added by manufacturing (V) (Rs. in lakhs) or number of registered factories (N).} \]

\[ L = \text{Employment in manufacturing (No. of persons).} \]

\[ K = \text{Productive capital employed in manufacturing (Rs. in lakhs).} \]

\[ F_b = \text{Commercial Bank Credit (Rs. in Lakhs).} \]

\[ F_d = \text{Financial assistance disbursed by Orissa State Finance Corporation (Rs. in lakhs).} \]

\[ E = \text{Industrial consumption of electricity (Million Kwh).} \]

\[ U = \text{Proportion of urban population total population (\%).} \]

\[ S = \text{Proportion of literate to total population (\%).} \]

\[ f = \text{Partial derivative of function 'f' with respect to the nth independent variables.} \]

### 6.3 ESTIMATES FOR ORISSA:

In order to determine the level of industrialisation and its various determinants, this study has been pursued with the help of time series data pertaining to the state, secondary data relation to the organised factory sectors in Orissa for a period of ten years; i.e., 1985-86 through 1994-95 has been collected and processed with computer runs. The sources of data are Annual survey of Industries (ASI), Economic Survey of Orissa (various issues) and publications of Bureau of statistics and economics. The collected data provides information on number of registered factory units in the manufacturing sector, gross output from the factory sector, value added by manufacture,
number of persons employed, productive capital investment, industrial consumption of
electricity, financial assistance provided by Orissa State Financial Corporation (OSFC)
and commercial banks and the level of urbanisation and literacy. An attempt has been
made to find out the cause and effect relationship between industrialisation and its various
determinants by formulating and estimating multiple regression models provided in Table
6.1.

**T.6.1. DETERMINANTS OF INDUSTRIALISATION (Factory Sector)**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Constant</th>
<th>Independent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.1.1</strong> N = 6710.4052 + .0071 L + .0752 Fd + 652.5494 U + 4.4964 S - .2254 E</td>
<td>(1.786) (1.602) (3.715) (1.222) (-1.901)</td>
<td>R² = 0.9983 R² adjusted = 0.9926</td>
</tr>
<tr>
<td>N = 10</td>
<td>**** **</td>
<td>DF = 4</td>
</tr>
</tbody>
</table>

| **6.1.2** Q = -9428636.4744 + 5.2942 L + 71.0252 Fd + 772579.8011 U | (1.791) (4.554) (1.554) (1.222) | R² = 0.9912 R² adjusted = 0.9803 |
| N = 10 | **** | DF = 4 |

| **6.1.3** V = -88335.3757 + 2.4965 L + 52.4731 Fd + 959.1177 S - 170.5841 E | (1.797) (4.554) (1.554) (1.222) | R² = 0.9912 R² adjusted = 0.9803 |
| N = 10 | **** | DF = 4 |

| **6.1.4** L = -268506.4237 + .0078 K + 1.4884 Fd + 32223.6056 U + 50.7874 S | (1.586) (1.616) (2.646) (1.53) | R² = 0.9954 R² adjusted = 0.9896 |
| N = 10 | ** | DF = 4 |

| **6.1.5** K = -7777207.7291 - 38.0308 E + 640891.4936 U | (1.593) (7.281) | R² = 0.9680 R² adjusted = 0.9589 |
| DF = 7 | * | N = 10 |
Time series data on organised factory sector and other related socio-economic information has been tabulated and processed with the help of computer under Ordinary Least Square (OLS) method. Gross output (Q) and value added by manufacturing (V), number of registered factories (N) and employment (L) has been tried as alternative dependent variables. Various permutations and combination of the independent variables included in equation - (1) under sub-section 6.2.1 above were attempted in different equations. The theoretical model is estimated with the help of computer run. Several alternative specifications both in terms of the functional forms and the grouping of independent variables of equation - 1 were estimated. In some cases it was found that the signs of the regression coefficients were not in conformity with the theory. In some other cases a high degree of inter correlation was noticed among some of the explanatory variables in the regression equation. Under such a condition, known as multicollinearity, the regression procedure tended to yield highly unreliable estimates of regression coefficient. As such it became difficult to determine the separate influences of each of the explanatory variables on the dependent variable. All such specifications were rejected. The estimation results of the selected form of equation -1 are given in what follows.

The numbers in parentheses indicate the corresponding 't' values of the regression coefficients. $R^2$ is the coefficient of determination that indicates the explanatory power of the model. $R^2$ adjusted provide a better estimate to indicate explanatory power of the independent variables. Regression coefficients are tested for 1%, 2.5%, 5% and 10%
level of significance with the help of 't' statistic from the 't' values (two tailed test). The 't' values are marked by one star at 1% level significance and two stars at 2.5% and three stars at 5% and four stars for 10% respectively.

On examining equations of Table 6.1 it can be seen that all coefficients of the determinants of industrialisation have their apriori signs and some of them are statistically significant at one percent or two and half percent or five percent or ten percent level. The explanatory power of the estimated equations as indicated by the coefficient of determination \( R^2 \) varied from 0.96 to 0.99. Thus the equations have very high explanatory power.

By examining the equation 6.1.1 it is found that percentage of Urban Population denoted as \( U \) has played a very important role in explaining the number of factory units established during the period under study. The next important variable has been identified as employment in the organised factory sector denoted as \( L \). It can be said that due to low labour cost and easy availability of labour in Orissa the explanatory factor \( L \) makes a very positive contribution towards the growth of number of factories. The third explanatory variable is finance from OSFC denoted as \( Fd \). This variable has entered into the equation with significant 't' statistics (at 10% level) which explains clearly about the significant contribution of OSFC towards growth of number of factories. The fourth explanatory variable in the equation is literacy that has also made positive contribution to industrialisation. But its contribution is not as significant as other variables i.e. urbanisation, employment and finance from OSFC.
An alarming feature relating to the findings in equation 6.1.1 is the negative contribution of industrial consumption of electricity denoted as \( (E) \). Consumption of electricity is an indicator of industrial development, but what worries us are its negative impact on number of factory units. The researcher has undertaken extensive investigation of the problem and has come to the conclusion that non-availability of much needed electrical power, availability in less quantity then needed and frequent load shedding and break down have been responsible for such a state of affairs. However, the overall finding in the equation under study is good. The equation has a very high explanatory power as the \( R^2 \) assuming the value of 0.9983.

In equation No. 6.1.2 of the table (T-6.1), gross output by manufacturer (Q) has been taken as dependent variable. It is seen that all the three independent variables have positive contributions. The coefficient of determination \( (R^2) \) is very high (0.9812). Thus, the equation explains 98% variability in the dependent variable Q. The 't' statistics has assumed positive value and they are also significant at 10% level. It is seen that the financial assistance provided by Orissa State Financial Corporation has made a positive contribution to gross output from the industrial sector. The two other explanatory variables in this equation, namely urbanisation and employment have also made positive contribution to the dependent variable. Thus, financial assistance from OSFC, employment in the industrial sector and development of towns and semi urban areas are three important factors for the rapid development of industries in Orissa.
After analyzing equation No. 6.1.3 in T-6.1 where value added by manufacturer (V) has been taken as dependent variable, it is observed that all the independent variables have positive contribution except electricity. The $R^2$ is very high and explains, 99.12 per cent variability in the dependent variables and $R^2$ adjusted has also stood at 98.03 per cent. It is seen that contribution of independent variable $Fd$ (Financial assistance from OSFC) has turned out to be a highly significant variable in explaining V (value added by the manufacturer). The 't' statistic is significant at 1% level. It is seen that an increase of rupees one lakh in $Fd$, would bring about an increase of Rs.52.47 lakhs in V. Thus, it can be concluded that the financial assistance by OSFC has made a tremendous contribution to industrial development in Orissa. The second explanatory variable employment ($L$) also makes positive contribution and the 't' value is significant at 10% level. This finding suggests that workforce is efficient and there is industrial peace in the state of Orissa. The third, explanatory variable literacy ($S$) is also positively related to value added by the manufacturer though the influence is marginal. But surprisingly, industrial consumption of electricity makes a negative contribution to value added by a manufacturer. The researcher attempted to find out the reasons for such a bad state of affairs. During the period under study, the electric tariff has been raised the concessions provided to the entrepreneurs have been withdrawn. As a result electricity could not make much contribution.

By analyzing equation No. 6.1.4. where employment ($L$) has been taken as dependent variable, it is observed that all the four independent variables, i.e., K, $Fd$, U and
S have made positive contributions to employment. $R^2$ is very high and explains 99.54 percent variability on dependent variable. $R^2$ adjusted has also stood at 98.96 percent that provide better explanatory power of the independent variables. The explanatory variable urbanisation denoted as $U$ makes a highly significant contribution to employment in the industrial sector. This is significant at ten per cent level. Such a finding suggests that there is a higher degree of correlation between urbanisation and employment. Other independent variables like productive capital investment in the factory sector, financial assistance provided by OSFC and literacy has also made positive contribution towards employment in the industrial sector.

In equation No. 6.1.5 productive capital investment has ($K$) been taken as dependent variable. In this equation, both $R^2$ and $R^2$ adjusted have stood at 0.9680 and 0.9589, respectively. This indicates that the equation has a very high explanatory power and the dependent variable is explained by the independent variable upto 97% which is very encouraging. Another important finding relates to the contribution of urbanisation to productive capital investment. It has been found out that development of urban areas encourages flow of capital to industrial sector that is sine-qua-non of industrialisation in any country. As in case of other equations, it is also seen in this case that the electricity variable has made a negative contribution. Theoretically, availability of electrical power encourages flow of capital to the industrial sectors. But in case of a backward state like Orissa just the reverse has happened. Non-availability of electricity, frequent breakdowns and excessive load sheddings are some of the explanations to the prevent state of affairs.
6.4 PRODUCTION FUNCTION IN THE INDUSTRIAL SECTOR OF ORISSA:

In the previous section, an attempt has been made to determine the quantitative relationship between industrialisation and its various determinants. In this section it is desired to fit a production function of the Cobb-Douglas type to the industrial sector of the state without which the study perhaps remains incomplete. The general equation for the production function is

\[ Q = f(L, K) \] \hspace{1cm} (1)

This function defines the maximum rate of output (Q) per unit of time obtainable from a given rate of capital and labour input. A production function is really an engineering concept. That is, it simply relates output and input rates. Economists use a variety of functional forms to describe production. The multiplicative form, generally described as Cobb-Douglas production function is widely used in economics because it has properties representative of many production processes.

In their first studies of production function, Cobb and Douglas used a power function of the form:

\[ Q = \beta_0 L^\beta K^{1-\beta} \] \hspace{1cm} (2)

Where \( \beta_0 \) and \( \beta \) are parameters to be estimated and Q, L and K are indexes of output, labour input and capital input, respectively. Because the exponents of L and K variables sum to unity such a model assumes that there is constant returns to scale. In latter studies by Cobb and Douglas and others this assumption was relaxed by employing a function of the form,
\[ Q = \beta_0 \beta_1 K^{\beta_2} \] \hspace{1cm} \text{(3)}

Where \( \beta_1 \) and \( \beta_2 \) are completely independent parameters that do not necessary sum to one. The non-linear Cobb-Douglas production function can be transformed into linear relationship by taking logarithms of all the variables. The log linear model for several input variables and for the alternative definition of output \( (Y) \) can be written as follows:

\[ \log Y = \log \beta_0 + \beta_1 \log L + \beta_2 \log K + \beta_3 \log F + \beta_4 \log F_{d} + \beta_5 \log E + \beta_6 \log U + \beta_7 \log S \] \hspace{1cm} \text{(4)}

Where, \( \beta_1, \beta_2, \beta_3, \ldots, \beta_7 = \text{Constant} \) and other variables have the same meanings as in section 6.2.1. The estimation results of the selected term of equation are as follows:

6.4.1 \( \log Q = -15.6177 + 0.4413 \log L + 0.8827 \log F_{d} \)
\hspace{1cm} \( (0.095) \) \hspace{1cm} \( (1.497) \)
\hspace{1cm} \( + \ 21.2434 \log U + 0.8123 \log S \)
\hspace{1cm} \( (1.506) \) \hspace{1cm} \( (1.126) \)

\( R^2 = 0.9860 \)
\( R^2 \text{ adjusted} = 0.9688 \)
\( \text{Df} = 5 \)
\( \text{N} = 10 \)

6.4.2 \( \log V = -10.3479 + 4.1066 \log L + 3.4325 \log F_{d} \)
\hspace{1cm} \( (2.498) \) \hspace{1cm} \( (6.083) \)
\hspace{1cm} \(- 4.7066 \log E + 0.1562 \log S \)
\hspace{1cm} \( (-3.345) \) \hspace{1cm} \( (0.279) \)

\( R^2 = 0.9912 \)
\( R^2 \text{ adjusted} = 0.9801 \)
\( \text{Df} = 4 \)
\( \text{N} = 10 \)
By examining equation 6.4.1. above, it is seen that the exponents of all the input variables assume positive values. The value of the co-efficient of determination or $R^2$ is very high (.9860) and $R^2$ adjusted has also stood at 0.9686. Hence, the independent variables explain the changes in the dependent variable up to 98%. It is found from the equation that the financial assistance by OSFC (Fd) and urbanisation (U) has turned out to be highly significant at ten per cent level. In a Cobb-Douglas production function, elasticities are constant over the sample period and they are given directly by the regression co-efficient. Therefore, the estimated production function as reported in equation 6.4.1. can be used to analyze factor elasticities of output. It has been found that financial assistance by OSFC (Fd) and Urbanisation has turned to be very significant input variables in the production function. The elasticity of output with respect to finance is 0.8827 and with respect to urbanisation is 21.2434. Thus, the elasticity of output with respect to urbanisation is higher than that of finance. The elasticity of output with respect to literacy is 0.8123 and in relation to labour is 0.095. It is thus observed that urbanisation, finance and literacy inputs explain a very high degree of variation in the value of gross output from industrial sector.

On examination of equation 6.4.2 it is seen that the of all input factors assume positive values except electricity. The value of co-efficient of determination or $R^2$ is 0.9912 and that of $R^2$ adjusted is 0.9801. This reveals that the explanatory power of the model is very high. The regression co-efficient of finance and employment is turned to be significant at 5 percent level of significance by the two tail 't' test. This indicates that
financial assistance by OSFC (F_d) and employment (L) has turned out to be highly significant in production function. The co-efficient of literacy variable is also positive and significant. The elasticity of value added by manufacturing with respect to input variables finance, (F_d) is 4.4325, that of employment (L) is 4.1066 and that of literacy is 0.1562. However, the exponent of electricity has assumed negative value. This negative contribution may be attributable to non-availability of electricity in required quantity, frequent power cuts and high cost of electric power.

6.5 Measure of Returns to Scale:

In the Cobb-Douglas form of production function, the sum of the elasticities of output with respect to various inputs to production indicates the type of returns to scale. The return to scale are increasing, constant or decreasing, depending upon whether this sum exceeds unity, is equal to unity or is less than unity, respectively. To examine the impact of input variable on the return to scale, the sums of factor elasticities have been worked out separately for gross output (Q) and value added by manufacturing (V). The sum of various elasticities of gross output- with respect to all independent variables is greater that one, i.e., 23.3797. Similarly the sum of various elasticities of value added by manufacturing with respect to input variables labour, finance and literacy are 7.6953. The elasticity of value added by manufacturing with respect to elasticity input is - 4.7066. Thus, the net sum of various elasticities of value added by manufacturing with respect to all independent variables has been worked out to be 2.9887 (7.69533 - 4.7066). This sum
also exceeds unity. So this finding suggests that as industries in Orissa are operating under increasing returns to scale and there is greater scope for industrialisation in the state.

6.6 CONCLUSION:

The foregoing analysis of the computerised data relating to various determinants of industrialisation in Orissa indicates that the input factors have shown positive contribution to industrial development. The explanatory power of the models' relation to both gross output and value added by manufacture is very high. The 't' statistics have also revealed encouraging result. It is seen that input factors like urbanisation, literacy and finance have made considerable contribution to the industrial development of the state. The role of Orissa State Financial Corporation has been particularly impressive in respect of both gross output and value added by manufacture. However, the negative contribution of electricity variable is a very discouraging feature. Such a finding provides a feedback to the policy makers to improve the performance of the power sector in the state. This study reveals that industries in Orissa are operating under increasing returns to scale. Such a finding suggests that, there is greater scope for industrial development in Orissa than other backward areas. Hence, the government and development banks should come forward with liberal policy and institutional measures to develop industries in Orissa.
NOTES AND REFERENCES:


5. Ibid, p. 321