CHAPTER 6

OPTIMUM LOCATION OF INDUSTRIES ON ENERGY BASIS

The regional energy efficiency both in physical and value terms has been discussed in the earlier chapters. It is found that while there are certain regions which are generally energy efficient, there are some others which are mostly energy inefficient on physical or cost basis or both. Further, in some cases indications about industry specific energy efficient regions are obtained.

Normally locational models are formulated with a view to minimize the transport costs. Energy which was not earlier considered as an important locational determinant is likely to play a major role in the location of industries in future. To our knowledge, so far there has been no study in location with a view to minimize the energy costs. In this chapter we have formulated a model which gives the most efficient locations solely from the viewpoint of minimizing energy inputs.

6.1 Linear Programming Model

With the aim to save maximum energy in the inter-industry use, the present model tries to specify the regional allocations of industrial activity, such that both inter-industry and final demand requirements of the entire economy are satisfied.

Let the economy be divided into 'm' sectors and 'n' regions. The above requirement of the problem leads to the usual input-output relationships as:

$$\sum_s X_i^s - \sum_s \sum_j a_{ij}^s \; X_j^s \quad ;$$

where X_i^s is the output of i^{th} sector in s^{th} region and $\sum_s \sum_j a_{ij}^s \; X_j^s$ is the inter-industry demand of i^{th} sector in the said region, which is the production available for the final use in the economy.

The regional variability between the technical coefficients (a_{ij}^s) is really not so much due to the substitutability between the raw material inputs, but is basically due to the product-mix variation in these regions. Thus, the existing differences in the regional technical coefficients are largely due to the variation in the regional product mix, which however is assumed to be homogeneous across regions for the present problem. A deletion of this assumption leads to confounding of the energy saving effect with that of the regional technology, the isolation of which would be difficult. On the other hand, due to inter-fuel substitutability and variation in the availability of fuels, there exists a real variation in energy requirements to produce the same product across regions. To avoid the impact of the variation in technical coefficients and to get an industrial allocation pattern, which is related to energy minimization alone, the technical coefficients are assumed to be same across regions for all sectors except those for energy.

As a result, the demand constraints work out as

$$\sum_{s=1}^{n} X_i^s - \sum_{s=1}^{n} \sum_{j=1}^{m} a_{ij} X_j^s \geq F_i \quad \text{[for i = 1,2, ..., m (except energy)]}$$

and

$$\sum_{s=1}^{n} X_i^s - \sum_{s=1}^{n} \sum_{j=1}^{m} a_{ij}^s X_j^s \geq F_i \quad \text{(for energy sector)}$$

It is likely that some regions may not get any industries in the optimum pattern. Clearly this is undesirable, as in that case a region cannot grow industrially at all and the important consideration of regional development should not be ignored. Therefore, we have to set some restrictions on the regional industrial income levels such that though a region does not improve its industrial income, at least its position does not deteriorate. The requirement that at least the present industrial income levels of regions are maintained, is developed on the basis of the value added coefficients as follows -

$$1 - \sum_i a_{ij}^s = v_j^s$$

where v_j^s is the value added coefficient of j^{th} sector in s^{th} region. The variation in each 's' for the same 'j' is due to differential energy input coefficient alone. Then $\sum_j v_j^s X_j^s$ is the total industrial income of the region 's' if X_j^s are the sectoral production levels for s^{th} region. If V^s is the existing industrial value added of the s^{th} region, then the above constraint becomes -

$$\sum_j v_j^s X_j^s \geq V^s \qquad \text{(for } s = 1, 2, \ldots, n)$$

It may be noted that the primary sectors such as agriculture, mineral extractions are natural resource based sectors, where no such reallocation is feasible and meaningful too. Therefore the model also has to supply the constraints towards this end. Hence, minimum regional output levels are provided exogenously for such sectors as follows -

$$X_j^s \geq \hat{X}_j^s$$

There are certain industries which do not exist in certain regions for the year under study. The knowledge of the reallocation of industries in these regions is also of interest from the planning point of view. However, for the inclusion of such sectors in such regions a knowledge about their energy coefficients becomes a prerequisite. Since we do not have such data at our disposal, we could not consider this aspect in our model.

6.2 Data Source and Adjustments

The model also is worked out for the year 1970 to synchronize with the data base of the other analysis in this study.

The regional economies are divided into 18 sectors. Out of these, one relates to the primary activities comprising of agriculture, allied activities and mining, while another relates to the sector 'others', which contains transport and construction activities. However, out of the entire mineral extraction activity, Coal has been separated and combined with the energy sector. The total industrial activity is divided into sixteen sectors, where fourteen HFU industries are separately distinguished of which one pertains to energy. The rest of the industries are clubbed into two categories, one pertaining to those of Division 2 manufacturing and the other to that of Division 3. The model covers fifteen regions of which fourteen are major States and the fifteenth region covers all residual ones of the country.

The following data are required for the model -

1) All India input coefficient matrix of order 17 x 18 (except energy row).

2) Regional energy input coefficient estimates.

3) Regional value added coefficients.

4) Final demand estimates at all India level.

5) Regional value added estimates for the industrial sector.

6) Output estimates for the primary and 'other' sectors.

7) Output estimates for Basic Iron and Steel industry for certain regions.

Since the data-requirements of the model are quite extensive and in some cases the direct data are not readily available, we discuss the data sources and adjustments, if necessary, in the following.

(i) Input Coefficient Matrix: In developing the L.P. model, it is already mentioned that if product-mix across regions is assumed to be the same, it is reasonable to assume that the regions have the same technical coefficients except those for energy sector. This assumption leads to the same technical coefficient matrix except for the energy row for all the regions. The uniform technical coefficients are assumed to be those of all India. Since the all India input coefficient matrix for the year 1970 is not available, the 1968-69 input coefficient matrix has been used. The relative price changes between inputs and outputs from 1968-69 to 1970 are of negligible order and have been ignored. Energy coefficients have been estimated for 1970. The 77 x 77 transaction table for

1968-69 prepared by Central Statistical Organization[1] (C.S.O.) has 49 sectors which cover the production activities to which alone the present exercise relates. This 49 x 49 transaction matrix is then reduced to the above-stated 18 sector input coefficient matrix from which the energy row has been excluded.

(ii) Regional Energy Inputs: The energy input coefficients are estimated for each region under study by using the energy consumption data for the large scale industrial sector available in the A.S.I. reports for 1970. However, the regional energy consumption data for the remaining sectors are not available and the regional input-output tables for 1970 are also not available. Hence we have made use of the 8 x 8 Regional Input-Output tables, which relate to the year 1965.*

The regional energy input coefficients for the 'primary' sector and 'others' sector are taken from these Input-Output tables and are adjusted for price changes. To arrive at the regional energy input coefficients for the energy sector, the regional energy inputs of the three energy sectors viz. Coal, Petroleum Products and Electricity, are added together with 1970 production levels as their weights.

(iii) Regional Value Added Coefficients: The regional value added coefficients are estimated for the industrial sector alone by subtracting all the inputs from unity. As the income

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1 'Inter-Industry Transactions 1968-69', National Accounts Statistics, January 1978. C.S.O., Government of India, New Delhi, p. 123.

* The details regarding these tables are given in Chapter 7.

constraints are restricted to the industrial sector alone, there is no need to have the value added coefficients for the remaining sectors.

(iv) Final Demand Estimates: Final demand estimates at the national level for the year 1970 are not readily available. As the nearest transaction matrix available is that of 1968-69, the direct estimates of final demand are available for the same year. The 1970 final demand estimates are then obtained by distributing the total national income pro-rata on the 1968-69 sectoral final demand composition.

(v) Regional Value Added Estimates: The regional value added estimates for the broad economic sectors are provided by C.S.O. for 1970-71.[2] The addition of the value added for the entire manufacturing sector and electricity, gas and water supply, has provided the required regional value added estimates.

(vi) Regional Output Estimates: As noted, there are certain sectors which are mostly natural resource based, whose output levels cannot be shifted from region to region by planning. For such sectors, information in the L.P. model is provided exogenously. In the present situation, while 'primary' and 'others' sectors are treated as entirely exogenous sectors, Basic Iron and Steel industry is treated as partially exogenous, where some minimum output levels for certain regions are specified.

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2 National Accounts Statistics, January 1979. C.S.O., Government of India, New Delhi, Appendix A2.2.

For the 'primary' and 'others' sectors, the regional output estimates are not directly available. The output estimates are based on the C.S.O.[3] value added estimates and are obtained by inflating them by value added coefficients, obtained above.

In the case of Basic Iron and Steel sector, some minimum output levels are specified for certain regions. The specified four States are Bihar, Madhya Pradesh, Orissa and West Bengal; whose minimum output estimates are based on their 1970 production levels reported in the A.S.I. reports.

As already mentioned, if an industry's output level is zero in a particular region in 1970, in the model, constraints are imposed that the regional output should be zero.

The L.P. Model, thus discussed above, can be written as - To minimize the energy consumption with the objective function as -

$$\sum_{s=1}^{15} \sum_{j=1}^{18} a^s_{ej} X^s_j \quad ;$$

where a^s_{ej} is the energy input in j^{th} sector of s^{th} region and X^s_j is the output of j^{th} sector of s^{th} region. The sets of constraints are as follows:

$$\sum_{s=1}^{15} X^s_i - \sum_{s=1}^{15} \sum_{j=1}^{18} a_{ij} X^s_j \geqslant F_i \qquad \text{for } i=1,2,\ldots 17 \text{ (except energy)}$$

and

$$\sum_{s=1}^{15} X^s_{18} - \sum_{s=1}^{15} \sum_{j=1}^{18} a^s_{18,j} X^s_j \geqslant F_{18}$$

(for energy sector where 18 is the energy sector number)

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3 Ibid.

$$\sum_{\substack{j=2 \\ j\neq 17}}^{18} v_j^s X_j^s \geq V^s \qquad \text{for } s=1, 2, \ldots, 15 \qquad \text{II}$$

$$X_j^s \geq \hat{X}_j^s \qquad \text{for certain 'j' and 's'} \qquad \text{III}$$

$$X_j^s = 0 \qquad \text{for certain 'j' and 's'} \qquad \text{IV}$$

The above model thus has 77 constraints and 270 (15x18) unknowns. However, the 34 known outputs and 13 'zero' output levels are provided exogenously, thus giving ultimately 223 unknowns in the L.P. model.

6.3 Limitations of the Model

Before discussing the results of the above model, we may note the limitations of the same. The model is developed solely in terms of minimization of energy costs. While energy is becoming increasingly important, this cannot be the sole determinant of the industrial location. The optimum pattern of magnitudes thrown out by the model should not be interpreted as the actual desirable magnitudes of those locations. But the model will be useful in indicating the directions of energy efficient regions. It would have been more useful to incorporate in the objective function the cost of energy due to the transportation of both inputs and outputs from and into different regions. But this is beyond the scope of the present study. The model could have been also formulated in physical energy coefficients minimizing the energy in physical units. Our limited resources prevented us from undertaking this aspect of the study.

6.4 Results of the L.P. Model

The solution of the above model has given the optimal allotments of the industries in different regions and also the minimum energy cost, required to satisfy the 1970 final demand of the entire economy. The last row of the solution represents the industrywise regional cost coefficients, which provides the information of the additional cost required to be paid if the industry is operating in the said region with its present energy use. These results are discussed below.

6.4.1 Optimum Industrial Locations

The optimal locations for each industry along with the production levels, obtained from the above model, are presented in Table 6.1. Table 6.2 abstracts the necessary information from Table 6.1 for the following discussion.

We observe from the Table 6.2 that West Bengal is optimal location for three HFU industries while Maharashtra and Haryana are optimal in the case of two. Uttar Pradesh and Rest of India are not found optimal for any of the HFU industries. All the remaining locations (States) are found to be optimal ones for one of the HFU industries.

In Chapter 5, for each industry, we have identified the State for which the energy cost is minimum per thousand rupees worth output as observed in 1970. The model by and large picks up those States for which the energy cost is minimum for a given industry as detailed in Table 5.15 as is to be expected. However, there are a few exceptions. Other Chemicals [311(R)], Cement (334) and Other Iron and Steel [341(R)] get located in

Table 6.2 : Industrywise Optimal Locations for 1970

	Industry	Optimal Location
211	Alcohol	Andhra Pradesh
231	Textiles	Orissa, Punjab
271	Paper and Paper Products	Maharashtra
311.1.1	Chemical Fertilizers	Tamil Nadu
311.2	Heavy Chemicals	West Bengal
311(R)	Other Chemicals	Kerala
331	Structural Clay Products	Bihar, West Bengal
332	Glass and Glass Products	Haryana
333	Pottery—China-Earthenware	West Bengal
334	Cement	Madhya Pradesh
341(R)	Iron and Steel (Other than Basic)	Haryana
342	Non-Ferrous Metals	Maharashtra, Rajasthan
511*	Energy	Karnataka, Haryana

* This includes the three energy sources viz. Coal, Petroleum Products and Electricity.

Kerala, Madhya Pradesh and Haryana respectively while the minimum energy cost is in Tamil Nadu, Andhra Pradesh and Uttar Pradesh for 311(R), 334 and 341(R) respectively. This is because of the constraint that each State should produce a minimum income from the industrial sector which we have postulated in the L.P. model.

6.4.2 Energy Saving by Optimal Allocation of Industries

The solution of the model has provided the minimum energy cost to satisfy the inter-industry demand of 1970, which amounts to Rs.119803 lakh. The actual energy cost to satisfy the same 1970 inter-industry demand with the existing allocation of industries is Rs. 155667 lakh, evaluated on the basis of the relation $(I-A)^{-1} F = X$.* This results into energy saving to the tune of Rs. 35864 lakh, which is equivalent to 23 per cent saving of energy for inter-industry use alone. As a consequence of this energy saving, there will be an additional reduction in the use of other inputs that are used by the energy sector. This saving works out to Rs. 20310 lakh.

6.4.3 A Classification of Regions for an Industry on the Basis of Additional Energy Cost

It is not feasible to allocate one industry in only one region to minimize the energy cost. Also the cost of energy cannot be the only criterion in selecting a location of the industry. Further, that an industry should be located only in one or two regions is not desirable for other reasons. Hence, in order to know the other acceptable regions for an industry, the last row of the L.P. solution, which provides the cost coefficients for different regions, is used. The cost coefficients provide the additional cost required to be paid if the industry is operating in the region. The lower the cost coefficient, the higher is the acceptability and vice-versa. A broad classification of the regions on the basis of the high and the low values of these cost coefficients for various HFU industries is developed below. The regional cost coefficients for each industry** are presented in Table 6.3. We may now try

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* The Gross output estimate of the energy sector worked out as Rs.172994 lakh where the 1970 final demand estimate is Rs.17327 lakh. This gives inter-industry demand as Rs.155667 lakh.

** The cost coefficients do not exist for those sectors for which output levels are provided exogenously.

Table 6.3 : Industrywise Regional Cost-Coefficients for 1970 (on L.P. Model Basis)

State / Sector	Andhra Pradesh	Bihar	Gujarat	Kerala	Madhya Pradesh	Tamil Nadu	Maha-rashtra	Karna-taka	Orissa	Punjab	Raja-sthan	Uttar Pradesh	West Bengal	Haryana	Rest of India
Manufacturing Division 2	-	0.0046	0.0012	0.0024	-	-	-	0.0039	0.0220	-	0.0067	-	0.0069	0.0023	0.0055
Manufacturing Division 3	0.0137	0.0014	-	-	0.0107	0.0080	0.0008	0.0035	0.0158	0.0125	0.0936	0.0779	0.0112	0.0014	0.0077
Alcohol	-	-	-	-	0.0680	-	-	-	-	-	-	0.1676	-	0.0436	0.1024
Cotton Textiles	0.0008	0.0003	0.0153	0.0035	0.0067	0.0011	0.0176	0.0017	-	-	0.0025	0.0105	0.0022	-	0.0123
Paper and Paper Products	0.0869	-	0.1334	-	0.0157	0.0513	-	0.0883	0.0643	-	-	0.0845	0.0505	0.0519	0.0530
Chemical Fertilizers	0.0067	0.0723	0.0243	-	-	-	0.0391	-	-	-	-	-	-	-	0.0375
Heavy Chemicals	0.1197	0.1956	0.0517	0.0057	-	0.1120	0.0006	-	-	-	-	0.0903	-	-	0.0367
Chemicals (other than 311.1.1 and 311.2)	0.1267	-	0.0407	-	-	0.0400	0.0577	0.0002	-	-	-	-	0.0568	-	0.0597
Structural Clay Products	-	-	0.0421	0.0543	0.0172	0.0450	0.0006	0.0415	0.0840	-	-	-	-	-	0.0105
Glass and Glass Products	-	0.0023	-	-	-	-	0.0131	-	-	-	-	0.1032	0.0196	-	0.0597
Pottery-China and Earthenware Products	0.0787	-	0.0751	-	0.0806	-	-	-	-	-	-	0.1595	-	0.0343	0.0099
Cement	0.0278	-	0.1390	-	-	0.0811	-	0.0751	-	-	0.0708	-	-	-	0.0581
Basic Iron and Steel	0.0371	-	-	-	-	0.0084	0.0202	0.2842	-	0.0165	-	0.0604	-	0.0370	0.0896
Iron and Steel (other than Basic)	0.0722	0.1209	0.0276	-	0.1188	0.0468	0.0445	0.0737	0.1749	0.0628	0.0843	0.0293	0.0578	-	0.0547
Non-Ferrous Metals	-	0.0458	0.0034	-	-	0.0467	-	0.0820	-	-	-	-	0.0086	-	0.0694
Energy	0.1236	0.1152	0.1894	0.0009	0.1105	0.0977	0.0538	-	0.0676	0.0069	0.0290	0.2928	0.1262	-	0.1362

to indicate the acceptable regions for the industry such that if situated in these locations, the increase in the energy cost is not substantial. Also we try to indicate those locations which are energy cost inefficient.

In the case of the Alcohol industry, though Andhra Pradesh is the optimal location, it produces only 15.75 per cent output in 1970. On the contrary, Uttar Pradesh, with the highest cost coefficient, produces the highest Alcohol output (55.03 per cent). Thus the solution suggests the promotion of the above industry in Andhra Pradesh as also in Haryana and Madhya Pradesh.

In the case of the Textile industry, a number of States are found with very small order cost coefficients, thereby indicating that the location can be widespread for this industry. But surprisingly, Maharashtra and Gujarat turn out to be the most inefficient locations along with Uttar Pradesh as they have uniformly high cost coefficient values.

The existing regional allocation for the Paper industry is found reasonably good by the criterion of its production share (67.22 per cent) in those States which are either energy efficient or with very low cost coefficients.

For the Fertilizer industry, the two States viz. Maharashtra and Bihar, with higher cost coefficients produce more than 40 per cent share of industry's output against the most efficient State of Tamil Nadu which produces around 10 per cent output. Hence it seems desirable to expand this industry in Tamil Nadu as well as in Andhra Pradesh and Gujarat on their cost coefficient basis. The present regional allocation of the

Heavy Chemical industry is desirable though the most efficient State viz. West Bengal has a production share of 6.02 per cent only. In the case of Other Chemicals, to our surprise, Kerala comes up as an optimal location with a very low output share (1.24 per cent). The State of Karnataka is found as the lowest cost efficient State which also produces a negligible output. On the other hand, Maharashtra, being last but one on the ascending ranking of the States, produces more than 60 per cent output of Other Chemicals. Hence, there seems to be some scope for promoting the Other Chemicals industry in Kerala and Karnataka.*

In the case of Structural Clay Products, industry of the Non-metallic mineral products group, Bihar and West Bengal are the optimal locations from the solution of the L.P. model, wherein Bihar produces more than one-fifth of the industry's output while there is a considerable scope to expand the same in West Bengal. Maharashtra and Madhya Pradesh are the other two locations where the above industry can be promoted, particularly in Madhya Pradesh where the present output share is less than by even 5 per cent. For the Glass and Glass Products industry, Haryana is the most efficient location though it produces only 9.68 per cent of the industry's output. The two locations, having low cost coefficient values, are Bihar and Maharashtra where Maharashtra produces about 40 per cent of the industry's output against a negligible output in Bihar. On the contrary

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* However, in interpreting the results of this industry, it should be noted that Kerala and Karnataka produce only mixed-fertilizer products while other States produce entirely different products.

Uttar Pradesh, with the highest cost coefficient, produces more than one-fifth of the industry's output. Hence, on the basis of cost coefficient, Bihar and Haryana are the possible locations for promoting the Glass and Glass Products industry. West Bengal is found as the optimal location for the China-Pottery and Earthenware industry which is already producing about one-third of the industry's output. On the cost coefficient basis, Haryana comes next to West Bengal producing about 20 per cent output of it. The production of the Cement industry is not highly concentrated in any of the locations. As Madhya Pradesh and Bihar are found optimal locations for the same, the industry can have a significant scope for its expansion from energy cost point of view. Similarly, Andhra Pradesh and Rajasthan are two other locations which can be encouraged to promote the Cement industry.

The Basic Iron and Steel industry is considered as natural resource based industry whose output levels are provided exogenously. Hence the comparison of cost coefficients is not valid for this. The principal production locations of the Iron and Steel (other than Basic) industry have more or less the same cost coefficients in the middle range. Haryana turns out to be cost efficient followed by Gujarat and Uttar Pradesh.

In the case of Non-Ferrous Metals industry, Maharashtra and Rajasthan are found to be the optimal locations wherein Maharashtra is already producing substantially high output (36.82 per cent) while Rajasthan produces only 2.66 per cent of the industry's output. Considering the low cost coefficient of Gujarat the Non-Ferrous Metals industry can be promoted in Rajasthan and Gujarat.

Table A6.1 : Input Coefficient Matrix of India for 1968-69 (Excluding Energy Row)

Sector	1	2	3	4	5	6	7	8	9
1. Primary	0.129725	0.320876	0.035297	0.028651	0.260254	0.049518	0.023504	0.020837	0.065280
2. Manufacturing Division 2	0.005161	0.122641	0.018599	0.011484	0.031947	0.034351	0.014653	0.044682	0.084821
3. Manufacturing Division 3	0.000524	0.017845	0.169597	0.026632	0.009140	0.020127	0.039234	0.060205	0.031745
4. Alcohol	0.0	0.000040	0.000395	0.002950	0.0	0.0	0.002422	0.0	0.000280
5. Cotton Textiles	0.003730	0.018089	0.001775	0.0	0.210016	0.000778	0.0	0.0	0.007876
6. Paper and Paper Products	0.000006	0.020574	0.003694	0.005512	0.002951	0.081492	0.000119	0.000139	0.021174
7. Chemical Fertilizers	0.021972	0.000015	0.000423	0.0	0.0	0.0	0.045215	0.0	0.000301
8. Heavy Chemicals	0.0	0.002931	0.011895	0.244662	0.005322	0.034064	0.034360	0.058877	0.069203
9. Chemicals (other than 311.1.1 and 311.2)	0.001786	0.016159	0.030254	0.021507	0.021436	0.017585	0.009360	0.010488	0.144556
10. Structural Clay Products	0.0	0.000307	0.003615	0.032766	0.0	0.0	0.0	0.0	0.010238
11. Glass and Glass Products	0.0	0.000307	0.003615	0.032766	0.0	0.0	0.0	0.0	0.010238
12. Pottery-China and Earthenware Products	0.0	0.000307	0.003615	0.032766	0.0	0.0	0.0	0.0	0.010238
13. Cement	0.0	0.000060	0.000003	0.0	0.0	0.004345	0.000059	0.001538	0.000020
14. Basic Iron and Steel	0.0	0.001929	0.100856	0.0	0.000698	0.000163	0.000029	0.002447	0.001664
15. Iron and Steel (other than Basic)	0.0	0.001929	0.100856	0.0	0.000698	0.000163	0.000029	0.002447	0.001664
16. Non-Ferrous Metals	0.0	0.001139	0.074062	0.0	0.000150	0.000081	0.000029	0.030417	0.009728
17. Others	0.007960	0.045797	0.055015	0.210032	0.036748	0.058905	0.057386	0.079994	0.046166

(continued)

Table A_6.1 : (continued)

Sector	10	11	12	13	14	15	16	17	18
1. Primary	0.031322	0.031322	0.031322	0.104614	0.037030	0.037030	0.033341	0.052030	0.000019
2. Manufacturing Division 2	0.004214	0.004214	0.004214	0.148019	0.002831	0.002831	0.002564	0.058963	0.003298
3. Manufacturing Division 3	0.013179	0.013179	0.013179	0.035503	0.024699	0.024699	0.031171	0.062475	0.016539
4. Alcohol	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000001	0.0
5. Cotton Textiles	0.000290	0.000290	0.000290	0.0	0.0	0.0	0.0	0.0	0.0
6. Paper and Paper Products	0.003420	0.003420	0.003420	0.002949	0.000717	0.000717	0.002367	0.000482	0.0
7. Chemical Fertilizers	0.0	0.0	0.0	0.006005	0.0	0.0	0.0	0.0	0.0
8. Heavy Chemicals	0.007162	0.007162	0.007162	0.000316	0.001560	0.001560	0.040148	0.0	0.0
9. Chemicals (other than 311.1.1 and 311.2)	0.004489	0.004489	0.004489	0.000105	0.001660	0.001660	0.004241	0.004551	0.002311
10. Structural Clay Products	0.026481	0.026481	0.026481	0.0	0.008543	0.008543	0.0	0.078509	0.0
11. Glass and Glass Products	0.026481	0.026481	0.026481	0.0	0.008543	0.008543	0.0	0.078509	0.0
12. Pottery-China and Earthenware Products	0.026481	0.026481	0.026481	0.0	0.008543	0.008543	0.0	0.078509	0.0
13. Cement	0.007406	0.007406	0.007406	0.007690	0.0	0.0	0.000049	0.011934	0.000038
14. Basic Iron and Steel	0.006337	0.006337	0.006337	0.027391	0.160780	0.160780	0.007447	0.041027	0.0
15. Iron and Steel (other than Basic)	0.006337	0.006337	0.006337	0.027391	0.160780	0.160780	0.007447	0.041027	0.0
16. Non-Ferrous Metals	0.000183	0.000183	0.000183	0.0	0.039547	0.039547	0.256128	0.0	0.0
17. Others	0.040744	0.040744	0.040744	0.179204	0.159824	0.159824	0.071763	0.044196	0.035352

Note : Sector 18 relates to Energy.

Table A_6.2 : Statewise Sectoral Total Energy Coefficient (Rs./000 Rs. Output)

Industry / State	01 (1)	20 (2)	30 (3)	211 (4)	231 (5)	271 (6)	311.1.1 (7)	311.2 (8)	311 (R) (9)
Andhra Pradesh	0.002432	0.016841	0.034022	0.010440	0.035923	0.135277	0.074881	0.202788	0.130028
Bihar	0.003493	0.017578	0.018653	-	0.032048	-	0.134025	0.273242	-
Gujarat	0.003922	0.022581	0.024423	-	0.054172	0.186700	0.099488	0.142622	0.049769
Kerala	0.000455	0.015041	0.017026	-	0.034979	-	-	0.083537	0.000350
Madhya Pradesh	0.000731	0.016660	0.030938	0.077431	0.041596	0.064736	-	-	-
Tamil Nadu	0.007141	0.016227	0.027965	-	0.035635	0.099375	0.067272	0.194387	0.043788
Maharashtra	0.002639	0.014163	0.019009	-	0.050260	0.045512	0.102749	0.080845	0.059308
Karnataka	0.001478	0.016701	0.020602	-	0.033299	0.131533	-	-	0.000686
Orissa	0.000388	0.036908	0.034641	-	0.033550	0.110643	-	-	-
Punjab	0.002618	0.012702	0.029489	-	0.031446	-	-	-	-
Rajasthan	0.001450	0.026796	0.115113	-	0.040650	-	-	-	-
Uttar Pradesh	0.001940	0.018228	0.098402	0.176438	0.046660	0.134762	-	0.175771	-
West Bengal	0.000221	0.019587	0.028229	-	0.033650	0.093688	-	0.077879	0.056949
Haryana	0.002618	0.014989	0.018467	0.050622	-	0.095084	-	-	-
India	0.002221	0.018203	0.024652	0.109276	0.043677	0.096135	0.098911	0.114445	0.059851

(continued)

Table A_6.2 : (continued)

Industry / State	331 (10)	332 (11)	333 (12)	334 (13)	341.1 (14)	341 (R) (15)	342 (16)	40 (17)	50 (18)
Andhra Pradesh	-	-	0.234292	0.219142	0.067133	0.092008	-	0.066652	0.130960
Bihar	0.149740	0.117937	-	0.225175	0.189472	0.137982	0.062429	0.067132	0.115448
Gujarat	0.203297	-	0.236720	0.330405	0.034303	0.051579	0.032216	0.045700	0.203858
Kerala	0.203420	-	-	-	-	-	-	0.043260	0.000947
Madhya Pradesh	0.172146	-	0.235866	0.191626	0.058377	0.137912	-	0.062904	0.117640
Tamil Nadu	0.198944	-	-	0.271547	0.038291	0.066518	0.067580	0.042654	0.104213
Maharashtra	0.152043	0.130466	-	-	0.048429	0.062712	0.018415	0.027853	0.056563
Karnataka	0.190813	-	-	0.264120	0.310443	0.090819	0.098244	0.014360	0.000287
Orissa	0.236033	-	-	-	0.221330	0.192642	-	0.042592	0.072155
Punjab	-	-	-	-	0.043541	0.079821	-	0.062110	0.006874
Rajasthan	-	-	-	0.263248	-	0.106179	0.027193	0.056998	0.044793
Uttar Pradesh	-	0.225388	0.313000	-	0.091131	0.050734	-	0.052647	0.300106
West Bengal	0.149271	0.134735	0.150443	-	0.052401	0.074874	0.024925	0.060229	0.125761
Haryana	-	0.115174	0.184611	-	0.064044	0.017274	-	0.062110	-
India	0.159770	0.174644	0.160293	0.247119	0.116419	0.071818	0.085446	0.056436	0.135717

Table A_6.3 : Statewise Sectoral Value Added Coefficients for 1970 (For Industrial Sector)

Industry / State	20 (2)	30 (3)	211 (4)	231 (5)	271 (6)	311.1.1 (7)	311.2 (8)	311(R) (9)
Andhra Pradesh	0.432214	0.352412	0.339832	0.384717	0.563151	0.698720	0.585141	0.354780
Bihar	0.431477	0.367781	-	0.388592	-	0.639576	0.514687	-
Gujarat	0.426474	0.362011	-	0.366468	0.511728	0.674113	0.645307	0.435039
Kerala	0.434014	0.369408	-	0.385661	-	-	0.704392	0.484458
Madhya Pradesh	0.432395	0.355496	0.272841	0.379044	0.633692	-	-	-
Tamil Nadu	0.432828	0.358469	-	0.385005	0.599053	0.706329	0.593542	0.441020
Maharashtra	0.434892	0.367425	-	0.370380	0.652916	0.670852	0.707084	0.425500
Karnataka	0.432354	0.365832	-	0.387341	0.566895	-	-	0.484122
Orissa	0.412147	0.351793	-	0.387090	0.587785	-	-	-
Punjab	0.436353	0.356945	-	0.389194	-	-	-	-
Rajasthan	0.422259	0.271321	-	0.379990	-	-	-	-
Uttar Pradesh	0.430827	0.288032	0.173834	0.373980	0.563666	-	0.612158	-
West Bengal	0.429468	0.358205	-	0.386990	0.604740	-	0.710050	0.427859
Haryana	0.434066	0.367967	0.299650	-	0.603344	-	-	-
India	0.430852	0.361782	0.240996	0.376963	0.602293	0.674690	0.673484	0.424957

Industry / State	331 (10)	332 (11)	333 (12)	334 (13)	341.1 (14)	341(R) (15)	342 (16)	50 (18)
Andhra Pradesh	-	-	0.561182	0.241671	0.317810	0.292935	-	0.811483
Bihar	0.645734	0.677537	-	0.235638	0.195471	0.246961	0.580905	0.826995
Gujarat	0.592177	-	0.558754	0.130408	0.350640	0.333364	0.611118	0.738585
Kerala	0.592054	-	-	-	-	-	-	0.941496
Madhya Pradesh	0.623328	-	0.559608	0.269187	0.326566	0.247031	-	0.824803
Tamil Nadu	0.596530	-	-	0.189266	0.346052	0.318425	0.575754	0.838230
Maharashtra	0.643431	0.665008	-	-	0.336514	0.322231	0.624919	0.835880
Karnataka	0.604661	-	-	0.196693	0.074500	0.294124	0.545090	0.942156
Orissa	0.559441	-	-	-	0.163613	0.192301	-	0.870288
Punjab	-	-	-	-	0.341402	0.305122	-	0.935569
Rajasthan	-	-	-	0.197565	-	0.278764	0.616141	0.897650
UttarPradesh	-	0.570086	0.482474	-	0.293812	0.334209	-	0.642337
West Bengal	0.646203	0.660739	0.645031	-	0.332542	0.310069	0.618409	0.816682
Haryana	-	0.680300	0.610863	-	0.320899	0.367669	-	-
India	0.635704	0.620830	0.635181	0.213694	0.268524	0.313125	0.557888	0.806726

Table $A_6.4$: Final Demand Estimates of India for 1970

Sector	Final Demand (Rs.lakh)
1. Primary	2012884
2. Manufactnring Division 2	442392
3. Manufacturing Division 3	186173
4. Alcohol	18802
5. Cotton Textiles	192441
6. Paper and Paper Products	1106
7. Chemical Fertilizers	-
8. Heavy Chemicals	-
9. Chemicals (other than 311.1.1 and 311.2)	19908
10. Structural Clay Products	2950
11. Glass and Glass Products	2950
12. Pottery-China and Earthenware Products	2950
13. Cement	737
14. Basic Iron and Steel	4424
15. Iron and Steel (other than Basic)	4424
16. Non-Ferrous Metals	-
17. Others	779347
18. Energy	17327