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Technical Report

LOCATION OF INDIAN CEMENT INDUSTRY

by
G.S. Gupta and Kirit Patel

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD

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A B S T R A C T

The paper examines four hypotheses about the location of the Indian Cement Industry, viz., (a) its location is not optimum, (b) it is not evenly distributed throughout the country, (c) its location is becoming more and more dispersed over time, and (d) recent changes in its location are towards the optimum location. These hypotheses are tested on the basis of various determinants of location, and on two measures of location, i.e. location quotient and coefficient of localisation. The findings have endorsed all the four hypotheses. In particular, we have found that the location coefficient has declined from around 0.53 in 1960 to around 0.46 in 1965. While Madras and Bihar were the leading States in cement production in 1947, the leading States in this respect in 1971 were Madras, Madhya Pradesh, Gujarat, and so on.

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LOCATION OF INDIAN CEMENT INDUSTRY

by
G.S. Gupta and Kirit Patel*

Decisions regarding industrial location have unique place in the fields of industrial management and regional planning. This is because location decisions have long term implications on the health and well-being of an economy and that they are almost irreversible. Most industries involve huge investments, which generate cash flows over a long period of time and the history testifies that the success of an industry depends significantly upon the appropriateness of its location, among other factors. Due to high cost of transfer of heavy machines and adjustments regarding already estalished fixed capital like land and buildings, location decisions are once and for all in most industries.

The purpose of this paper is to highlight the determinants of location, and to measure and analyse the trends in the location of cemtn industry in India. The hypothesas under testing are:

a) cement industry's location is not optimum. That is, locational advantage of a region is not indicated in that region's contribution to cement output in India;

b) cement industry is not evenly distributed over the whole country;

c) concentration of cement industry has declined over time;

d) recent locational trend in cement industry is twoards the optimum location.

FACTORS AFFECTING LOCATION

The optimum location of an industry depends upon demand in relation to supply for its product (market for the product), availability of raw-material, production cost, distribution cost (transport cost in particular), prospects for profit, managements' regional interest and government policy concerning regional development. It should be pointed out that all these factors are not quite mutually exclusive. Location A is better than location B for industry I if region A has bigger market, greater availability of raw material, lower production cost, lower transport cost, greater prospects for profit, greater favour from managements' regional interest and/or greater encouragement from government than region B. This is so simple a rule. However, in practice we do not find all factors in favour of a particular location. In the real world, while some determining factors favour a particular location, the other determining factors oppose such a location. This makes the locational decisions difficult and significant.

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Furthermore some determinants of locational advantage may have conflicting demands in termselves. For example, government policy regarding location is governed by twin objectives of balanced regional development and the optimum utilisation of natural resources, which are often conflicting. The regional planners endeavour to influence industrial location so as to provide reasonable justice to the backward regions in the short-run and to maximise social welfare in the long-run. As contrast to this, the individual entrepreneurs may be guided by the profitability criterion in their locational decisions.

Since the relevant data on transport cost, etc. are not published, it is not possible for us to work out the optimum location for cement industry in India. However, an examination of domand-production data, availability of raw-materials, production cost-profit data, amangement's interest and government policy in this respect will throw some light on relative locational advantage of different regions. This is attempted in the following section.

Regional Domand and Supply

The region-wise demand for, and capacity and production of cement in India in 1971, the latest year for which data available, are presented in Table 1. They indicate that domand is in excess of supply in Western and Southern regions, while quite the reverse is true for Eastern and Northern regions. An examination of the past data had indicated that this trend has been prevailing for long. Thus, the market criterion alone would argue for expansion of cement industry in Eastern and Northern regions and for its contraction in Western and Southern regions.

Availability of Raw-Material

Hitherto, we have seen that there are various determinants of the optimum location of a particular industry. However, these various determinants play varying role in the location of different industries. In cement industry, availability of raw-material and fuel, and transport cost play more significant role than the other factors because of its following features:

a) Cement is a weight losing product. One tonne of cement production requires about 1.5 tonnes of limestone and clay, about 0.3 tonne of coal, about 0.04 tonne of gypsum, and water, etc. Thus, Weber's material index (ratio of localised material to output) comes to more than 1.5 for cement.[1] This feature argues for location of cement factories near its raw-materials.

b) Cement is a bulky commodity. Its value in relation to its weight is low and so transport cost constitutes a significant fraction of the value of the product. This feature argues for location of cement industry near its market.

Although the bulkyness of cement argues for location near consumers,

yet this factor together with the factor of cement being a weight losing product favours location of cement firms near raw-materials. Due to this reason, cement factories are, in fact, located in close proximity to the sources of raw-materials. Most cement manufacturing units are established within a radius of 15 to 20 kilometers of the limestone deposits.

Limestone deposits are spread all over the country in fairly large quantities. Clay is always available nearby. However, the limestone deposits in order to be useful for manufacture of cement have to be tolerably near railheads. Thus, suitable deposits away from railway lines may not be useful till such time as railways develop in the area.

Three-fourths of total coal production in India is in Bengal-Bihar areas, the remaining one-fourth is in Orissa, Andhra Pradesh, Maharashtra and Madhya Pradesh. The alternative course of fuel, viz. diesel oil, has been costlier than coal in India.

Gypsum is available largely from Rajasthan, though its some quantity to cement industry comes from Saurashtra and Andhra regions also. Nevertheless, the availability of gypsum does not affect location, for its requirement is only about four per cent of the cement production.

Cement in most plants in India is manufactured through wet process and thus there is a need for large quantities of water. However, this does not affect location, for fortunately water is usually available in good quantities throughout our country.

Thus, since limestone and clay, and water are available throughout the country and gypsum use is rather small, their availability does not affect the location of cement industry in India significantly. The availability of coal, the only other raw-material, pulls the industry heavily in Bengal and Bihar, and lightly in Orissa, Andhra Pradesh, Maharashtra and Madhya Pradesh.

Production Cost and Profit Prospects

Cost for any industry is usually classified into fixed cost and variable cost. Fixed cost include costs of land, buildings, machines, etc. and variable cost comprises of costs of raw-materials, fuels, labour, transport cost etc. Buildings and machine costs are more or less same in different regions. Land cost varies over regions but it does not exert significant influence on locational decisions, for it is but an insignificant part of total cost. Variable cost is significant in locational decisions because it is influenced by the availability of raw-materials and labour, transport cost, etc.

The cost-profit data of cement industry for different regions, for which data are published, in the years 1947, 1955, 1960 and 1966, the latest year for which data are available, are provided in Table 2. These data are presented in terms of percentages of gross ex-factory value of output. In other words, these numbers indicate

Table 1: Demand, Capacity and Production of Cement in 1971

(lakh tonnes)

Region	Estimated Demand	Actual capacity	Actual Production
WESTERN REGION			
Gujarat		22.90	16.87 (11.28)
Maharashtra		4.00	4.65 (3.10)
Madhya Pradesh		26.97	21.31 (14.25)
Goa Daman & Diu		-	-
Dadra & Nagar Havali		-	-
Total	39.45	53.87	42.83 (28.63)
EASTERN REGION			
Assam		0.83	0.74 (.50)
Bihar		21.22	16.00 (10.70)
Orissa		8.01	6.61 (4.41)
West Bengal		-	-
Manipur		-	-
Nagaland		-	-
NEFA		-	-
Tripura		-	-
Total	30.38	30.06	23.35 (15.71)
NORTHERN REGION			
Chandigarh		-	-
Delhi		-	-
Haryana		4.93	4.96 (3.31)
Himachal Pradesh		-	-
Punjab		-	-
Rajasthan		19.38	13.99 (9.35)
Uttar Pradesh		6.60	4.26 (2.85)
Jammu & Kashmir		-	-
Total	51.07	30.91	23.21 (15.51)
SOUTHERN REGION			
Andhra Pradesh		18.52	16.13 (10.80)
Tamil Nadu		31.60	27.98 (18.72)
Mysore		17.38	15.36 (10.27)
Kerala		0.51	0.54 (.36)
Pondicherry		-	-
Andaman & Nicobar		-	-
Lacadive		-	-
Total	40.52	68.01	60.01 (40.15)
Grand Total	161.42	182.85	149.40 (100)

Source: Cement Manufacturers Association (1972): Replies to Questionnaire submitted to Tariff Commission.

Notes: (i) Numbers in parentheses indicate regional output as percentage of total output.
(ii) Blanks are due to data unavailability.

the share in rupees of a particular cost item in gross output worth Rs.100. For example, value of materials consumed accounted for Rs.37.9 per Rs.100 worth of gross output in Madras in 1947.

The data in Table 2 indicate that while Bihar had lower material cost than Madras in all the years, quite the reverse was true with respect to fuel cost. On the basis of these costs together, Madras had a little advantage over Bihar. The locational preference of Madras over Bihar is also reflected in the profit rate. Therefore, if profit is the decisive factor for location, raw-material and fuel cost together, as expected, have determining influence on location. On the profitability criterion, Madras, among all the regions for which individual data were available, enjoyed the maximum attraction for cement industry in 1947 and 1955. Madras was second to Punjab in 1960, and fourth to Andhra Pradesh, Gujarat and Mysore in 1966, in terms of profitability. In 1966, cement industry in Madhya Pradesh had the lowest profit of 16 per cent. During 1960 to 1966 the profit rate increased only marginally in Madras and Bihar and very significantly in Gujarat, Andhra Pradesh and Mysore. This could have had its effects on the location of this industry. Suffice it to point out here, Madras and Bihar were the two states accounting for 70 per cent of Indian cement industry in 1947 but that their share fell to 40 per cent in 1955, to 34 per cent in 1960 and to 30 per cent in 1966. This was caused by the dispersion of cement industry to other states, for high profitability in these regions. Thus, the cost-profit data would argue for greater dispersion of the industry under study and for more of it in regions like Andhra Pradesh, Gujarat and Mysore.

Managements' Interest

Management also exerts its influence on location of an industry. The choice of location of a new factory to a certain extent depends on the nature of management's interest regarding a particular region. If the management has country-wide industrial interest, perhaps this factor would not merit attention in location studies. However, if the management has regional or local industrial interest, this factor becomes one of the decisive factors in location. We find both these kinds of management's interest in Indian cement industry. On the one hand, we have Associated Cement Companies Ltd. (ACC) and Dalmia Cement (India) Ltd., whose interests are countrywide. On the other hand, there are cement firms run by state governments such as Andhra Cement, Madras Cement and Orissa Cement, whose interests are limited to its development within their own territories. Since South India possesses more regional entrepreneurs desirous to float cement factories at present, the Southern region continues to have more cement factories than other regions.

Government Policy:

For quarrying of limestone, the cement industry has necessarily to depend on the government for lease terms. Besides, encouragement and facilities or discouragement and hindrance from government do exert their influence on location. In the early days, the then princely states encouraged the expansion of cement industry in their territories. Thus, out of eleven factories existing in 1936 at the

Table 2: Cost-Profit Data as Percentages of Gross Exfactory Value of Output

(Percentages)

Region	Material cost				Fuel cost				Depreciation cost				Wages, Salaries, Benefits, etc.				Profit			
	1947	1955	1960	1966	1947	1955	1960	1966	1947	1955	1960	1966	1947	1955	1960	1966	1947	1955	1960	1966
Madras	37.9	30.2	36.7	37.8	27.0	19.0	26.6	27.2	5.7	8.1	6.0	4.0	21.8	10.9	10.6	7.9	7.3	36.7	18.5	19.1
Bihar	43.0	40.1	46.5	45.6	22.8	15.8	20.3	19.0	9.1	6.7	5.9	3.7	21.9	12.7	8.5	10.6	3.1	24.5	14.3	16.6
Bombay	-	35.7	-	-	-	24.2	-	-	-	12.1	-	-	-	12.3	-	-	-	16.7	-	-
Andhra Pradesh	-	-	41.8	36.9	-	-	22.6	21.4	-	-	9.8	6.5	-	-	10.5	8.2	-	-	12.7	23.5
Gujarat	-	-	40.0	30.3	-	-	31.5	31.1	-	-	6.4	5.9	-	-	12.5	8.4	-	-	6.1	21.3
Madhya Pradesh	-	-	33.2	36.8	-	-	25.0	22.0	-	-	12.5	9.5	-	-	12.3	10.4	-	-	14.5	16.3
Mysore	-	-	30.6	33.7	-	-	32.8	24.2	-	-	10.8	6.6	-	-	9.5	8.6	-	-	13.4	21.2
Punjab	-	-	31.0	-	-	-	26.0	-	-	-	6.2	-	-	-	10.1	-	-	-	23.9	-
Rajasthan	-	-	42.0	-	-	-	24.6	-	-	-	7.1	-	-	-	9.7	-	-	-	15.0	-

Source: Central Statistical Organisation: Census of Manufacturing Industries and Annual Survey of Industries (various issues)

Notes: 1) Blanks are due to data unavailability

2) Profit data are obtained by substracting wages, salaries, benefits, etc. from value added.

where LQ_{ij} = location quotient for industry i in region j

E_{ij} = number of workers employed in industry i in region j

n = total number of industries

m = total number of regions

Given the industry-wise and region-wise data on employment, location quotients can easily be computed with the aid of formula 1.

As will be seen in the formula, the numerator of the location quotient is the share of a region in total employment in an industry in the country. The denominator is the share of a region in total employment in all industries in the country. Thus, if employment is the measure of demand for and supply of the product of an industry, the location quotient provides a measure of the dispersion of that industry. In particular, if the location quotient of an industry equals one for all the regions, then that industry is evenly distributed throughout the country. If it is higher than one for a particular region, then that region has more of that industry than its average share, and vice versa. Larger is the location quotient from one, greater is the concentration or localisation of the corresponding industry in the corresponding region, and vice versa.

Florence use of the number of workers employed as a measure of demand for and supply of the product of an industry has been questioned on the ground of varying capital and labour intensities in different industries. Provided the regions under study have a reasonable mix of labour and capital intensive industries, this measure will be an appropriate one. In the absence of this, the location quotient will be over-estimated for the regions having a low proportion of labour intensive industries and it will be under-estimated for the regions having a high proportion of labour intensive industries. Since labour and capital intensities differ greatly among regions, alternative measures of the demand for and supply of industrial products have been suggested. Among these are value of fixed capital, ex-factory value of output and value added. These alternative measures are also subject to limitations. For example, value of fixed capital will be a poor indicator of productive activity unless there is no idle capacity and prices of capital goods do not differ over regions. Value added is also not an appropriate measure of demand and supply, for relative prices of industrial inputs vary over regions and thus it brings variations in value added. Since there is no universally acceptable measure of the demand for and supply of a product, we have used all these four alternative measures to compute the location quotient. The formula (1) is used in all cases, replacing number of workers employed by the alternative measure.

Coefficient of Localisation

Florence has introduced yet another concept for the measurement of industrial location. This concept is known as the coefficient of

time of formation of A.C.C. as many as five factories were in princely states and in case of one, viz. Punjab, the Provincial Government was directly interested in capital and management. Recently, the governments have evinced keener interest in developing cement industry in industrially backward states. This is facilitated through the policy of freight equalisation. Under this policy, cement is sold at an uniform price at all railway stations in the country. Recently, the government has decided to grant subsidies even for road transportation for districts having poor rail links.

Since the various location determining factors do not argue consistently for a particular location, it is not quite possible to clearly specify the locational advantages of various regions for cement industry. However, certain observations can be made. In terms of a region's share in national output of cement, in 1971, Tamil Nadu (Madras) enjoyed the first position (18.72 per cent), Madhya Pradesh the second position (14.25 per cent), Gujarat, the third position (11.28 per cent), Andhra Pradesh, the fourth position (10.80 per cent), Bihar the fifth position (10.70 per cent), Mysore the sixth position (10.27 per cent), Rajasthan the seventh position (9.35 per cent), Orissa the eighth position (4.41 per cent), Maharashtra the ninth position (3.10 per cent), and so on (vide Table 1). This distribution of output is inconsistent with most of the determinants of location, including the demand-supply criterion, the availability of raw-material criterion, and the production cost-profit criterion. This suggests that location of cement industry is perhaps not the optimum in India. This completes our analysis of the first hypothesis as posed towards the beginning of this paper. In order to examine the second hypothesis, viz., cement industry is not evenly distributed over the whole country, we need to compute measures of industrial location, to which we turn in the following sections.

Measures of Industrial Location

In the literature we find two measures of location, viz., the location quotient and the coefficient of localisation. It is pertinent here to define these measures, and to explain their rules for location.

Location Quotient

The concept of location quotient was first introduced by Florence.[2] Florence defines the location quotient for an industry in a region as a ratio of the regional proportion of workers employed in that industry to regional proportion of workers employed in all industries. Notationally, it is expressed as

$$LQ_{ij} = \frac{E_{ij} \Big/ \sum_{j=1}^{m} E_{ij}}{\sum_{i=1}^{n} E_{ij} \Big/ \sum_{i=1}^{n} \sum_{j=1}^{m} E_{ij}} \qquad (1)$$

$$i = \overline{1,n}$$

where $\sum_{i=1}^{n} e_{ij}$ = number of workers employed in all industries in the j^{th} region

$\sum_{i=1}^{n} E_{ij}$ = number of workers employed in all industries, which are covered in CMI and ASI data in the j^{th} region.

k_j = percentage coverage in CMI and ASI

Similarly, region-wise estimates of value of fixed capital, ex-factory value of output and value added data of all industries were adjusted. The underlying assumption behind this adjustment procedure is that uncovered group of factories has the same size distribution as that of covered group of factories, size being defined in terms of number of workers employed, value of fixed capital, ex-factory value of output, or value added. The computed results for the location quotient are provided in Table 3 and those for the location coefficient are presented later in Tables 4 and 5.

As expected, the location quotient (LQ) is subject to the base variable used in computation. For example, LQ for cement industry in Madras in 1947 is 2.64 if number of workers is assumed to represent the demand for and supply of cement. It is 2.60 if value of fixed capital is used, 2.14 if ex-factory value of output is used and 2.22 if value added is used as the base variable. A careful study of the results in Table 3 would indicate that no definite conclusions can be inferred regarding the over-or-under-estimation of LQ by one base variable in comparison to that by other base variables. This means that the choice of the base variable is significant in the study of industrial location. This paper is not to aim to enter into this definitional debate and therefore we shall only provide empirical inputs for those who wish to study this definitional problem (vide Table 3).

The necessary data for computation of LQ are not available for any period after 1966. Therefore, by present location, we shall have to mean location in 1966. The location quotient is found to be greater than unity in all the eight regions and as computed on the basis of all the four alternative variables in 1966. This indicates that all these eight regions have more than their average share of the cement industry. The exact value of this coefficient varies between 1.07 in Gujarat on the basis of ex-factory value of output and 3.49 in Andhra Pradesh on the basis of value added. A careful study of the numbers in Table 3 would reveal that Madhya Pradesh ranks the first, Andhra Pradesh the second and Gujarat the last in terms of the concentration of cement industry as indicated by LQ computed on the basis of all the four alternative variables. Thus, we conclude that at present (1965 or 1966) cement industry is having more concentration in Madhya Pradesh and Rajasthan than elsewhere and less concentration in Gujarat than elsewhere.

Coming to the locational trends over time, the results in Table 3 indicate that the concentration both in Madras and Bihar has declined between 1947 and 1966, the decline being more pronounced in Bihar

localisation for a particular industry in the country. It is defined as the sum of the positive or negative deviations of the regional proportion of workers employed in that industry from the corresponding regional proportion of workers employed in all industries. Mathematically, it is defined as

$$CL_i = (Y2) \sum_{j=1}^{m} \left| \frac{E_{ij}}{\sum_{j=1}^{m} E_{ij}} - \frac{\sum_{i=1}^{n} E_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{m} E_{ij}} \right| \qquad (2)$$

A comparison of formlae (1) and (2) would reveal that they use the same two variables but the former takes their ratio, while the latter takes their difference and sum their absolute values over regions and then divide the same by two. Thus the coefficient of localisation for an industry aggregates the regional location quotients in a single figure. Therefore, it provides a measure of the overall distribution of the corresponding industry over the country as a whole. A location coefficient of zero in an industry indicates that the over concentration of that industry in some regions is just balanced by under-concentration of the same in other regions. A non-zero value of the location coefficient means a lop-sided regional development of the corresponding industry. Larger the value of this coefficient, greater is the degree of inequality of distribution of that industry in the country.

The location coefficient in formula (2) is defined in terms of the number of workers employed. Again, for the reasons as before, the number of workers is not an unambiguous measure of the productive capacity and demand. Therefore, the coefficient under discussion is defined in terms of the value of fixed capital, gross ex-factory value of output or value added also. In the following section, we present the calculations of both the location quotient and the location coefficient for the cement industry in India.

PRESENT LOCATION AND PAST TRENDS

We have computed both the location quotient and the location coefficient for the Indian cement industry using all the four alternative indicators of the demand for and supply of cement in India. To recall, the four alternative indicators are (a) number of workers employed (b) value of fixed capital, (c) gross ex-factory value of output, and (d) value added. The data for this purpose were drawn from Central Statistical Organisation's publications, viz., Census of Manufacturing Industries (CMI) and Annual Survey of Industries (ASI). In these publications, the coverage in terms of the percentage of total units which provided data is different for different regions and in different years for data pertaining to all industries. However, it is the same for cement industry. Therefore, in order to make the results comparable, figures of all industries were adjusted to the coverage as follows:

$$\sum_{i=1}^{n} o_{ij} = \left(\sum_{i=1}^{n} E_{ij} \right) \left(\frac{100}{k_j} \right)$$

than in Madras. The decline in concentration also occurred in Madhya Pradesh, Punjab and Rajasthan between 1960 and 1966 or 1965. No unambiguous increase in any region's concentration between 1947 or 1960 to 1965 or 1966 is evident from our results. However, concentration of cement industry seems to have increased in Gujarat during 1960-1966. This might have occurred due to the recent availability of oil fields there. In other regions, viz., Andhra Pradesh, and Mysore, there are more evidences for a decline in concentration rather than an increase in concentration over time. Thus, the concentration in cement industry in general has declined over time. In other words, there was a more even distribution of cement industry in India in 1966 than in 1947. In short, Madras and Bihar were the two regions commanding a significant share of the industry in 1947-50, in 1965-66 dominance was divided among eight regions.

The country-wide concentration of an industry is also examined on the basis of the coefficient of localisation. The same has been computed for the years 1960 and 1965, the results of which are given in Tables 4 and 5 respectively. The localisation coefficient, like location quotient is found to be sensitive to the indicator of the productive capacity and demand. For 1960, it varies between 0.4627 and 0.5763, and for 1965 it varies between 0.4486 and 0.4782 depending upon the indcator used. As this coefficient is quite different from zero, cement industry is not evenly distributed in India. The location coefficient, computed on the basis of any of the four alternative variables but one, has declined between 1960 and 1965. Furthermore, the arithmetic mean of the four alternative location coefficients for 1960 comes to 0.5298 and that for 1965 comes to 0.4621. Thus, on the basis of the location coefficient also, we can conclude that the location of cement industry in India has become more dispersed in 1965 than in 1960. The past studies, covering earlier periods than ours, have also found the same trend. Mehta found a location coefficient in Indian cement industry of 0.83 in 1925, 0.74 in 1935 and 0.48 in 1945.[3] Hingorani computed this coefficient at 0.44 in 1951 and 0.45 in 1959.[4] Their results do not look quite consistent to ours, for we have a slight different regional classification than them, that we have computed the coefficient on the basis of four alternative measures as against their single indicator of the demand for and supply of cement and that we have adjusted the data for industry coverage, which they do not seem to have done.

LOCATIONAL TRENDS AND THE OPTIMUM LOCATION

Hitherto we have seen that the location of cement industry is becoming more and more dispersed over time. Furthermore, it was seen that the concentration has increased in Gujarat while it has decreased in all other seven regions, whose data are available. The decline is more pronounced in Madras and Bihar than in other regions. Cement production which was dominated by two regions, viz., Madras and Bihar only in 1947 is now spread over various regions to balance the demand for and supply of this bulky commodity. These trends are welcome, for Gujarat is now more suitable than it was before for cement industry due to the availability of oil-fields, and Madras and Bihar do not enjoy any significant locational advantage over other regions. Furthermore, the availability of raw-material criterion, the cost-profit criterion and the government policy argue for greater dispersion of the industry under study. From these findings we conclude that the trend in cement

Table 3: The Location Quotient in Indian Cement Industry

Region	Location quotient on the basis of: Number of workers employed					Value of fixed capital					Ex-factory value of output					Value added				
	1947	1955	1960	1965	1966	1947	1955	1960	1965	1966	1947	1955	1960	1965	1966	1947	1955	1960	1965	1966
Madras	2.64	2.24	2.12	1.58	1.56	2.60	1.17	1.96	1.84	2.00	2.14	2.27	2.21	1.92	2.14	2.22	2.82	2.57	1.70	2.11
Bihar	5.06	3.42	2.36	3.42	3.21	3.06	1.39	1.04	1.29	1.35	4.24	2.57	2.25	2.17	2.11	2.80	1.90	2.28	1.69	1.90
Andhra Pradesh	-	-	2.12	1.83	1.73	-	-	3.51	2.64	2.05	-	-	2.65	2.72	2.51	-	-	3.33	3.72	3.49
Madhya Pradesh	-	-	3.85	3.38	3.34	-	-	3.63	2.03	2.16	-	-	3.45	3.47	3.08	-	-	3.81	4.92	3.45
Gujarat	-	-	1.20	1.25	1.33	-	-	1.24	1.95	2.03	-	-	1.42	1.67	1.07	-	-	0.90	1.74	2.29
Mysore	-	-	2.32	1.82	1.67	-	-	2.85	3.09	3.45	-	-	2.74	2.07	1.97	-	-	2.43	1.43	1.54
Punjab	-	-	2.89	1.57*	-	-	-	1.79	1.59*	-	-	-	2.65	1.00*	-	-	-	5.42	1.44*	-
Rajasthan	-	-	8.83	6.59*	-	-	-	8.56	4.68*	-	-	-	12.50	4.77*	-	-	-	12.16	4.64*	-

Notes: Blanks are due to data unavailability.

*The location quotients for 1965 are computed using 1960 figures for cement industry and 1965 figures for all industries, for data unavailability.

Table 5: The Coefficient of Localization in Indian Cement Industry in 1965

Regions	Employment (No. of persons employed)			Value of fixed capital			Gross Ex-factory value of output			Value added		
	Regional proportion in cement industry	Regional proportion in all industries	Deviations	Regional proportion in cement industry	Regional proportion in all industries	Deviations	Regional proportion in cement industry	Regional proportion in all industries	Deviations	Regional proportion in cement industry	Regional proportion in all industries	Deviations
Andhra Pradesh	.0987	.0540	.0447	.1034	.0391	.0643	-.1044	.0384	.0660	.1123	.0302	.0821
Bihar	.1780	.0521	.1259	.1160	.0898	.0262	.1465	.0674	.0791	.1156	.0684	.0474
Gujarat	-.1059	.0045	.0214	.1245	.0639	.0606	.1319	.0788	.0531	.1423	.0020	.0603
Madhya Pradesh	.1233	.0365	.0868	.1811	.0894	.0917	.1261	.0363	.0898	.1443	.0293	.1150
Madras	.1361	.0864	.0497	.1590	.0863	.0727	.1601	.0832	.0769	.1475	.0870	.0605
Mysore	.0760	.0418	.0342	.1017	.0329	.0688	.0734	.0354	.0380	.0643	.0449	.0194
Punjab*	.0548	.0348	.0200	.0305	.0516	-.0211	.0306	.0308	-.0002	.0515	.0357	.0158
Rajasthan*	.1132	.0177	.0955	.1072	.0229	.0843	.0635	.0133	.0502	.0613	.0132	.0481
Jammu, Kashmir, Kerala, Orissa, Uttar Pradesh, Maharashtra	.1140	.3305	-.2165	.0766	.3006	-.2320	.1555	.3575	-.2020	.1607	.3700	-.2093
Rest of India	0	.2617	-.2617	0	.2155	-.2155	0	.2509	-.2509	0	.2393	-.2393
Total Deviations			.4702			.4606			.4531			.4406
			-.4702			-.4606			-.4531			-.4406
Coefficient of localization			.4702			.4606			.4531			.4406

*Figures for Punjab and Rajasthan taken here are of year 1960, for data unavailability.

Region	Employment (No. of persons employed)			Value of fixed capital			Gross ex-factory value of output			Value added		
	Regional Proportion in Cement industry	Regional proportion in all industries	Deviation	Regional Proportion in Cement industry	Regional proportion in all industries	Deviation	Regional proportion in Cement industry	Regional proportion in all industries	Deviation	Regional proportion in cement industry	Regional proportion in all industries	Deviation
Andhra Pradesh	.1034	.0487	.0547	.1363	.0394	.0989	.0952	.0359	.0593	.0889	.0267	.0622
Bihar	.1377	.0583	.0794	.1639	.1572	.0067	.1784	.0794	.0990	.1633	.0715	.0918
Gujarat	.1157	.0963	.0194	.0917	.0737	.0180	.1205	.0850	.0355	.0904	.008	-.0104
Madhya Pradesh	.1151	.0299	.0852	.1176	.0324	.0852	.0859	.0249	.0610	.0929	.0244	.0685
Madras	.1534	.0723	.0811	.1145	.0585	.0560	.1598	.0724	.0874	.1874	.0730	.1144
Mysore	.0655	.0366	.0487	.0946	.0332	.0614	.0775	.0282	.0493	.0716	.0295	.0421
Punjab	.0641	.0222	.0419	.0305	.0215	.0170	.0754	.0285	.0469	.1035	.0191	.0844
Rajasthan	.1324	.0150	.1174	.1353	.0158	.1195	.1238	.0099	.1139	.1230	.0101	.1129
Kerala, Orissa, and Uttar Pradesh	.0927	.1331	-.0404	.1056	.1127	-.0071	.0835	.1130	-.0303	.0790	.0900	-.0190
Rest of India	0	.4874	-.4874	0	.4556	-.4556	0	.5220	-.5220	0	.5469	-.5469
Total Deviations			.5278 -.5278			.4627 -.4627			.5523 -.5523			.5763 -.5763
Coefficient of Localization			.5278			.4627			.5523			.5763

industry location during 1947 through 1966 is towards its optimum location. The rate at which the present location is converging towards the optimum location can be speeded up through appropriate licensing policy, government development plans, railway transport facilities, etc.

CONCLUSION

If the quantitative data on all the determinants of location of an industry are available, one can apply the principal component method to prioritise various regions according to the suitability for location of that industry. In the absence of such detailed data, one has to be content with a qualitative examination of the suitability of various regions for an industry. In this paper, we have done such a qualitative analysis and have found that the present location of Indian cement industry is not the optimum. Our study of the present location and past trends has indicated that the cement industry is not evenly distributed in the country and that it is changing towards greater dispersion, which is consistent with the optimum location. In particular, we have found that the concentration is declining over time significantly in Madras and Bihar, and that it is increasing in Gujarat. While Madras and Bihar were the leading states in cement production in 1947, the leading states in this respect in 1971 were Madras, Madhya Pradesh, Gujarat, and so on.

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