PATTERNS OF RAILWAY FREIGHT IN INDIA: A REGIONAL ANALYSIS

SUBMITTED IN PARTIAL FULFILMENT
OF THE DEGREE OF MASTER OF PHILOSOPHY

YASH PAL AGGARWAL

CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT
SCHOOL OF SOCIAL SCIENCES
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI

1979

CENTRE FOR THE STUDY OF REGIONAL DEVELOPMENT
SCHOOL OF SOCIAL SCIENCES

JAWAHARLAL NEHRU UNIVERSITY

We certify that the dissertation entitled "Patterns of Railway Freight in India: A Regional Analysis" submitted by Mr. Yash Pal Aggarwal in partial fulfilment of the Degree of Master of Philosophy (M.Phil) of the University is a bonafide work, to the best of our knowledge and may be placed before the examiners for their consideration.

Harbir Singh Sidhu

(H.S.SIDHU)
Supervisor

Moonis Raza

(MOONIS RAZA)
Supervisor
1.9

Moonis Raza

(Moonis Raza)
Chairman
1.9

Forwarded to the Registrar

September, 1979
New Delhi

C O N T E N T S

ACKNOWLEDGEMENTS

I extent my sincere gratitude to
Professor Moonis Raza and Shri H.S. Sidhu for supervision and guidance
Professor G.S. Dhalla, for valuable suggestions
Mrs Kamla Aggarwal, my wife, for constant encouragement
Mr P.N. Tyagi for cartographic assistance
Mr Ajoy Roy of the Jawaharlal Nehru University, Computer Centre, for programming assistance
Mr Ashok Kumar Talwar for typing assistance
My friends associated with the transport project - Miss Indu Khurana, Mr Ajay Kumar, Mr Saifur Rehman and Mr O.D. Tyagi for constant help
The U.G.C. financed project of which this study is a component

Y.P. AGGARWAL

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER I

INTRODUCTION

I.1 Preamble

I.1.1 In its basic form, production and consumption are inseparable functions because one is the object of the other. Without production there cannot be any consumption, which, in its turn, is a precondition for survival. Within an economic system, the processes of production and consumption lead to inter-regional and inter-sectoral exchange of goods. While the development process has been mostly studied in terms of inter-sectoral relations with emphasis on the growth of the economy and of its sectors, the study of its interregional aspects have been, by and large, ignored. While the former type of analysis is related to the vertical dimension of the economic structure, the latter pertains to the horizontal dimension. Both of these are vitally important for a proper understanding of the functioning of the economic system. An attempt has, therefore, been made in this study to unravel the inter-regional aspect of such exchange and its relationship with the spatial and sectoral development of the Indian Economy.

I.1.2 Since the mobility of resources within a large country like India is far from perfect, the production

costs of different commodities vary spatially.

Within the limits imposed by transportation costs and political or cultural barriers, an individual region of the system is able to deliver such goods and services to other regions of the system which it can produce at a cost lower than that to be incurred by the latter in producing these goods and services. Goods and services can be freely exchanged within a system of regions; and a region can draw freely on the resources, products and technological development of other regions in its effort to develop its own production base with a view to compete with other regions of the system having their own specialisation. Each region thus specialises in the type of production in which it enjoys a comparative advantage and exchanges its specialities with other complementary regions of the system.[1]

I.1.3 The comparative advantage of a region is achieved by minimising two sets of costs, namely costs associated with production and those with exchange activities. The cost of production is constrained by the natural endowments of the region. Exchange costs of an area are the function

---

1. Ullaman E.L., American Commodity Flow, University of Washington, Seattle, 1957.

of its location relative to other complimentary and competing areas of the system. Since costs of exchange are mainly transport costs, therefore, an area is expected to exchange most heavily with areasnearest to it in order to minimise the transport costs.[2] Thus, if the per unit cost of production of commodity A in region 1 & 2 is P_1^a and P_2^a respectively, the exchange will take place only if $|P_1^a - P_2^a| > t_{12}^a$, where t_{12}^a is the per unit cost of moving commodity A from region 1 to 2.

I.1.4 It is clear from the above that the geographical specialisation of various areas leads, on the one hand, to surplus production of specialised commodities, which cannot be consumed in the area of production and on the other, to scarcity of various goods of consumption, which it cannot produce to meet its requirements. The surplus has to be transported to other areas and goods of consumption have to be brought from outside. This regular exchange of goods can be assured only by an efficient and cheap transport system. Thus the movement of any commodity from one point to others provides useful information on interregional trading pattern and spatial links of a region and consequently the role that it is playing in the process of regional and national economic development.

---

2. Isard Walter, Location and Space Economy, M.I.T. Press, Cambridge, 1956, pp. 1-9.

I.2 Commodity Flows and Regional Interdependence

I.2.1 The exchange of goods and services between various regions of a system leads to interdependence among regions. This interdependence will be direct if the commodities produced in a region are absorbed by the manufacturing industries or the final demand sector of the other. It would be indirect if connection between such inputs and outputs can be established through industries located in some other region. Thus the flow of commodities from one region to the other reveals the nature of the interdependence of one region on the other. Commodity flow studies thus seek to identify the manner and extent to which any region:

(i) can and does avail itself of the natural advantages of the other regions through imports; and

(ii) can and does compete with the other regions in the disposal of its products in the several regional and subregional markets.[3]

I.2.2 There is a direct correspondence between the degree of regional interdependence and the volume of inter-regional trade. Any increase in interregional trade leads to a proportionate increase in the degree of regional

---

3. Isard Walter, Methods of Regional Analysis: An Introduction to Regional Science, M.I.T. Press, Cambridge, 1960.

interdependence and to greater integration of the national economy.

I.2.3 One of the obvious difference between intra and international trade is that the latter, unlike the former, involves different currencies. In international trade, there is a balancing mechanism which operates through exchange rates and disequilibria in the external balances of a country give rise to changes in the exchange rates. In interregional trade, however, such a balancing mechanism does not exist. The lack of a balancing mechanism in interregional trade may lead to serious skewness in the movement pattern of commodities between different regions. It is possible to draw on the natural resources of a region without corresponding inflows of any type. Such an arrangement would lead to the persistence of backwardness in the region. This type of suction can lead to differential rates of growth of regional economies.

I.2.4 In order to study the interregional flow of commodities within the spatially differential development pattern of India, we chose the major mode for the movement of such goods e.g., railways. The Indian railways have been carrying about 70-75% of the total goods traffic during recent years; and in the Draft Five Year Plan for 1978-83 as well, great emphasis has been laid on the key position of the railways in the strategy of building up the infrastructure required for a growing

and diversified Indian economy.[4] Road transport, though becoming increasingly important is not the major mode of movement of long distance traffic which is the hallmark of unchecked skew movement of regional traffic originating from differential regional development.

I.3 Development of Indian Railways and Changing Structure of the Indian Economy

I.3.1 In order to understand the characteristics of inter-regional trade of India as it exists today, it is essential to delve into the history of railways development in the subcontinent. Trade, industry and agriculture had to face serious difficulties in the pre-railway period due to extremely poor communication facilities. Social and cultural contacts were also quite limited. With the growth of political power and expansion of their territories in the vast subcontinent, the British administrators realised the needs for improved means of communications.

I.3.2 The period when early ideas of rail construction in India were being conceived and discussed was the period of 'Railway Mania'. The railways had been started in 1825 in England, in 1829 in France and in 1830 in America and were

---

4. Govt. of India, Planning Commission, Draft Five Year Plan 1978-83, pp. 206.

functioning in those countries quite successfully. Naturally, therefore, the British administrators were tempted to introduce railways in India which was full of resources and wealth but without satisfactory means of communication. The early objects of expansion of cheap, speedy and adequate means of communication including railway and canal construction were proper administration and consolidation of British rule in India and the movement of military troops and equipment. Besides the political and military objects, the other considerations were to serve the interest of British investors and industries. British investors had invested in the railways in many other British colonies and had earned fabulous profits. They were, therefore, quite eager to invest in Indian railways also. In the wake of the Industrial Revolution the British industries needed raw materials and a wide market for finished products. They were, therefore, interested in the development of railways in India with a view to facilitate the collection of raw material for export, on the one hand, and for taking the finished goods to the nooks and corners of the consumption market, on the other.

1.3.3 The first railway engine steamed out of Bombay in 1853. Slowly and steadily the tentacles from the ports spread to the interior regions of cash crops and raw material production and an essentially centrifugal and

fragmented network emerged on the scene. It was easier for the towns and villages to send its products to the four metropolitan centres, Karachi, Bombay, Madras and Calcutta, than to each other or other settlements in the interior. The freight rates were biased towards ports and for commodities meant for export to England. Thus centripetal forces operated to funnel resources out of the country and strengthened the typical colonial economy.

I.3.4 Efforts were made to alter this structure after independence. The Railways were entrusted with the task of carrying goods needed most for the economic development of the country. The biased freight rates of the earlier period were modified. Transport was considered as an integral part of planning, as efficient and well developed system of transport is vital for economic development. Railway transport was, therefore, given the role of an important sector in all the Five-Year Plans for the rehabilitation and development of the country.

I.3.5 The growth of railway freight traffic during the last 25 years is a testimony to the leading role that the railways are playing in the development of various sectors of the economy. The special objective of the First Five Year Plan in this sphere was the rehabilitation of the over aged assets. Particular emphasis was laid in the Second Five Year Plan on enabling the railways to carry the traffic generated by the new steel plants and to cope with the increased traffic of coal. The main

stress in the Third Five Year Plan was laid on building additional carrying capacity which could otherwise act as a restraint on the economic development. Modernisation and improvement in the efficiency of operations was the focus during the Fourth Five Year Plan. In the Fifth Five Year Plan, cognisance was taken of the need for better utilisation of the existing track and rolling stock capacity and higher operational efficiency through maximising of movement in block rakes and reducing turn round time. As a result of the above measure there has been a significant improvement in the operational efficiency of the railways as measured by such indices as the utilisation of railway rolling stock in terms of wagon turn-round time, wagon/vehicle/engine kilometres per day, and net tonne kilometres moved per wagon/engine day. In the Draft Five Year Plan for 1978-83 as well, the key position of railways in the strategy of building up the basic infrastructure required for the growing and diversified economy of the country has been well recognised. It is expected that originating freight on the railways in 1982-83 will be of the range of 300-313 million tonnes as compared to 237 million tonnes in 1977-78. The bulk of this traffic would consist of coal, steel and raw materials to steel plants, cement, fertilisers, foodgrains and petroleum products.

1.3.6 The Indian Railways, like public utility organisations in other countries resolve the conflict between

social and private profitability by accepting financial loss. Indian railways, for example, are incurring heavy operational losses due to low rated freight and passenger traffic. During 1976-77, the total operational losses of Indian railways amounted to Rs. 183.43 crores. Nearly, 36 per cent of these losses were arising because of low rated freight and the remaining because of passenger traffic operations. Historically and traditionally, Indian railways have been financing some deficit services and other social costs through transfer of funds from within the organisation - i.e. through "cross subsidy". The burden of this "cross subsidy" in the past fell mainly on certain users of railways, for example, those who booked high-rated general merchandise. This was due to the monopoly enjoyed by the railways. But the extensive development of road transport and the changed production and distribution patterns in the country through development efforts have converted the railways into bulk carriers of low-rated heavy goods. While the bulk commodities accounted for 58.2 per cent of the revenue earning goods traffic of the railways in 1950-51, they now account for nearly 82 per cent of this traffic. The burden of 'cross subsidy' has thus fallen on the general finances of the railways.

I.3.7 It is clear from the above that the Indian railways are playing a vital role in the development process of the

Indian economy by moving men and material, sometimes even at subsidized rates. Railways are undoubtedly the wheels that keep our economy moving. Keeping the importance of the role of the railways in view, it is really surprising that only a little attention has been devoted to the study of railway freight in India.

I.4 Survey of Literature on Commodity Flows

I.4.1 While adequate attention has been paid to the study of the vertical dimension of the Indian economy, the spatial linkages have been, by and large, neglected in social science research. Only a small number of studies, based on the pattern of exchange of commodities have been undertaken. The work of Ullman,[5] on commodity flows in the United States is a significant work. Ullman has analysed commodity traffic by rail and water for 1948 and has clearly brought out the dominant role of the industrial belt of North-East in the flow patterns of various manufactured commodities in the United States. He has identified the gross features of the linkages that hold together the economy of the United States in terms of a series of interstate commodity flow maps. Duncan[6] and

---

5. Ullman E.L., op. cit.

6. Duncan O.P., et. al., Metropolis and the Regions, John Hopkins Press, 1960.

his associates describe the U.S. economy as comprising a set of metropolitan regions within which the exchange of commodities is dominated by the flows from and to the metropolitan centres. They have also brought out the fact that exclusive regional specialities in production result in the integration of the national market.

I.4.2 Significant studies regarding transportation in Germany are available in the 'Renn and Verknov Series'. The first volume examines the role of rail roads in economic development of Germany; the second is related to commodity flows; and the third volume is a collection of studies dealing with the relationships between economy, circulation and transportation. B.J.L. Berry has reviewed these studies, in an article on the role of transportation in the space economy.[7]

I.4.3 Theoretical as well empirical studies related to the flow of commodities and to the formation of economic regions are numerous in the Soviet literature on Regional Economics but only a few are available in English - Probst, Alampiev, Bedenkova and Kistanov.[8]

---

7. Berry B.J.L., Recent Studies Concerning the Role of Transportation in the Space Economy, A.A.A.G. Vol. 49, No. 3, 1959, pp. 328.

8. Probst A.E., 'Location of Industry under Socialism (Theoretical Essay)", EKONOMIZ AT MOSCOW, 1962. Alampiev P.M., "Economic Regionalisation of USSR", Economic Literature, Moscow, 1959. Bedenkova M.S., 'National Transport - Economic Link in the process

cont...

I.4.4 The work of Michael Chisholm and Patrick O'Sullivan[9] on freight flows in the British economy is a significant contribution. The study is based on Ministry of Transport survey data for 1964. The study examines, to begin with, some basic concepts from location theory and interaction studies. Questions of traffic generation, traffic distribution, modal split and transport costs have been examined in some detail. The most serious inadequacy of the study, however, was its limited survey data base.

I.4.5 Setsuko Mitsuhashi[10] examined broad patterns of spatial interconnections within the Japanese economy and comes to the conclusion that the amount of traffic is a function of demand, supply and the capacity of the existing transport network. Thirty-two major commodities in forty-six prefectures have been analysed into national, regional and local movements using factor analysis techniques.

---

cont...

of development of territorial division of labour in USSR, Location of Productive Forces and Development of Economic regions, Moscow, 1964. Kistanov V.V., "Complex Development Specialisation of the Economies of the Economic Regions, ECONOMIKA, Moscow, 1965.

9. Chisholm Michael and O'Sullivan Patrick., Freight Flows and Spatial Aspects of the British Economy, Cambridge University Press, Cambridge, 1973.

10. Mitsuhashi Setsuko, "Japanese Commodity Flows", Selected Papers, Vol. II, Economic Geography, 21st International Geographical Co., India, 1968, National Committee for Geography, Calcutta, 1970, pp. 177.

I.4.6 Attempts have been made in recent years by a number of geographers and economists to analyse the pattern of commodity flows between various regions in India. A number of studies on the exchange patterns of various cities in India have been undertaken. The majority of these studies have focussed on city-hinterland exchange patterns such as those of Benares[11] and Calcutta.[12] Some studies have also been conducted on the commodity exchanges within specific states such as Madras[13] and Mysore.[14]

I.4.7 The National Council of Applied Economic Research, has also undertaken a number of studies related to the role of transportation in the economic development of India. To start with appraisal of transport facilities was made as a part of the Techno-Economic Surveys of the different states. A separate study on the transport requirements of the Iron and Steel belt was completed in 1963.[15] Apart

---

11. Singh R.L., Benares: A Study of Urban Geography, Nand Kishore and Bros., Benares, 1955.

12. Kar N.R., "Economic Character of Metropolitan Sphere of Influence of Calcutta", Geographical Review of India, Vol. XXV, No. 2 (June 1963).

13. National Council of Applied Economic Research, Economic Atlas of Madras State, NCAER, New Delhi, 1962.

14. Indian Statistical Institute, Mysore State, ed. A.T.A. Learmonth and L.S. Bhat (ISI Series No. 13 & 16), 1961-62.

15. National Council of Applied Economic Research, Transport Requirements of Iron and Steel Belt, NCAER, New Delhi, 1963.

from focussing attention on the problems of transport in the iron and steel belt of India, this study also makes future projections of traffic.

I.4.8 Some of the other Indian studies are based on flow patterns of one or two commodities. Notable among these is the study based on the interregional flows of cement,[16] in which optimal flow patterns have been developed for the period 1954-59.

I.4.9 Studies based on foreign, coastal and Inland rail commodity flows associated with the three major ports of Bombay, Calcutta and Madras have also been undertaken.[17] It has been shown that these ports exhibit distinctive port-hinterland relationships. Within their larger economic regions, these major ports have established import and export commodities of the region.

I.4.10 Wallace D. Reed[18] has analysed the patterns of

---

16. Ghosh A., Efficiency in Location and Inter-regional flows: The Indian Cement Industry during Five Year Plans, North Holland, 1965.

17. Studies of commodity flows associated with the port of Calcutta and Madras include: David B. Longbrake, "The Regional Inter-regional Relations of the port of Madras", Unpublished Masters' dissertation, Deptt. of Geography, University of Chicago, 1964 and Berry B.J.L. and Reed W.E., "Calcutta's External Relations", Deptt. of Geography, University of Chicago, May 1962. Ahmed Qasi, Indian Cities Characteristics and Correlates, Department of Geography, University of Chicago, Research Paper No. 102, 1965.

18. Reed W.E., Areal Interaction in India: Commodity Flows of Damodar Bihar Industrial Area, Department of Geography, University of Chicago, Research Paper No. 110, 1967.

commodity flows for a non-metropolitan region of India; specializing in mining and industry for the year 1962. He has used data for a period of three months for originating and receiving freight in the case of 25 major stations falling in the study area. He has used potential and gravity type of models to study the commodity flows.

I.4.11 Berry has proposed a set of Indian Economic Regions,[19] on the basis of commodity flow matrices obtained for interstate and inter-metropolitan patterns of commodity exchanges. Berry's article on field theory provides the basic theoretical framework of the study.[20] His analysis of economic activities and their interstate exchange by rail confirms the hypothesis that India's space economy is composed of a system of four economic regions. He further concludes that agriculture is the predominant economic activity in each of these regions as in the case for India as a whole. Local industrial activity is oriented to local raw materials and markets and the interregional trade, integrating the four regions, consists primarily of the most specialized agricultural, mineral and industrial commodities of each region. The metropolitan dominance

---

19. Berry, B.J.L., Essays in Commodity Flows and Spatial Structure of the Indian Economy, Department of Geography, Research Paper No. 111, Chicago.

20. Berry, B.J.L., "A Synthesis of Formal and Functional Regions Using a General Field Theory of Spatial Behaviour" in B.J.L. Berry and D.F. Marble ed., Spatial Analysis: A Reader in Statistical Geography, pp. 419-28.

in the case of each of these regions is quite marked; and Bombay, Calcutta, Delhi and Madras dominate the economy of their respective regions. These nodes perform this functions of collection, processing, and storage of regional and extra regional products. In the third chapter of his essays on commodity flows, Berry and his associates have analysed the inter-regional inter-sectoral relations of the Indian economy using input-output techniques. A major limitation of Berry's work is that his data base relates to the Inland Trade Accounts.[21] These are available in the form of a matrix, one for each commodity, giving details of flows from and to each trade block. The matrices do not contain any information on intra trade block flows and all the intra-block flows have been taken as zero. The limitation does not only affect the overall results, but it also does not permit the analysis of intra-regional flows. The magnitude of this inadequacy may be gauged from the fact that a trade block is as big as a state in India.

I.5 Present Study

I.5.1 The survey of literature, as outlined above, clearly brings out the paucity of research in the field of commodity flows in relation to regional economic

---

21. Government of India, Department of Commercial Intelligence and Statistics, Accounts Relating to the Inland (Rail-River Borne) Trade in India, Calcutta.

development. No systematic attempt has been made so far to study the relationship between freight characteristics and economic development at the national, regional or subregional levels. The present study intends to empirically analyse the regional structure of the Indian economy by examining in detail the spatial interaction of various regions as reflected in commodity flows. Attempts will in particular be made to study the following patterns and relationships which constitute the initial hypotheses of this work:

(i) Increase in economic activity leads to increase in the interdependence of regions and hence to increase in railway freight; and the composition of the traffic reflects the nature of inter-dependence.

(ii) While the formation of geographically compact and technologically linked production complexes leads to decrease in the average lead; increase in the average lead of raw materials indicates the pulling in supplies from remote areas.

(iii) Variations in the economic base of different regions suggest that all regions do not participate in the inter-regional exchange to the same extent. The wide inter-regional inequalities in the magnitude of originating and terminating freight indicates that production and consumption activities are highly concentrated at a few nodes in space.

(iv) Production activities tend to be more unevenly distributed as compared to consumption. In a country like

India, where balanced regional development has been one of the objectives of planning, the gap between the concentration of production and consumption activities would tend to be larger in the case of commodities like cement, fertilizers, iron and steel, fuels and industrial products as compared to raw materials.

(v) In an economy actively engaged in production activities, high correspondence is expected between total shipments and total receipts. The movement pattern of complimentary commodities would be positively related, while the diversified commodities will show negative relationship. For an economy heavily dependent on imports of certain commodities, the above relationship does not hold good.

(vi) High concentration of production and consumption activities should lead to the formation of compact spatial clusters specializing in the production of various commodities.

(vii) In production activities, areas specializing in agriculture are at low level of industrial activity and areas specializing in industrial activity are at low level of agricultural activities.

(viii) Nature and composition of the terminating freight in a region would be a better indicator of its level of development as compared to the originating freight. Thus a significantly high correspondence between the levels of

development of a region and the level of activity in terms of its receipts is expected.

(ix) A correspondence between the levels of industrial activity (both shipment and receipts) and level of urbanization will show the leading role being played by the urban centres in production and consumption activities.

(x) The existence of a number of spatially separated production and consumption centres would suggest that the principle of distance decay would operate. The rates of distance decay will vary from commodity to commodity depending upon its bulk and location of production and consumption centres in space.

I.6 Data Base

I.6.1 The type of study as outlined above would naturally require huge volume of data about the transaction of commodities between various regions of the Indian economic system.

I.6.2 In any transaction matrix, the amount of data requirement increases in geometric progression with the increase in the size of the matrix. This makes it very difficult to handle large data matrices especially when the dimension of the matrix is very large. Let us take the example of India, which has approximately 10,000 nodes. Any analysis based on transaction matrix for these nodes will involve 10^8 bits of information. If the number of variables increase then the total data requirement will

get multiplied by the number of variables. For example, if there are 300 commodities and for each commodity we have three types of information — namely; weight, freight and distance — the data base will consists of $300 \times 3 \times 10^8$ bits of information. No doubt that many of the cells in such an huge matrix will be empty, but still the data requirement is enormous.

I.6.3 India offers a very rich data on commodity flows. Each zonal headquarter of Indian railways prepares a summary of goods originating from all stations falling in the zone. Information on originating station, receiving station, weights and commodity code is available from the goods summary data tapes. The basic data used for this study pertains to the year ending March 1974. The data was collected from the headquarters of all the 9 zones of the Indian Railways.[22] All railway zones record data on 'magnetic' computer tapes in different formats. The data was later standardised to a common format containing information on station to station flow of over 500 different categories of commodities.

I.6.4 In 1973-74, there were about 10,000 railway stations including sidings, city booking offices, city booking

---

22. Railway zones and their headquarters are:

1.	Central Railway	Bombay
2.	Eastern Railway	Calcutta
3.	Northern Railway	New Delhi
4.	North Eastern Railway	Gorakhpur
5.	Northeast Frontier Railway	Pandu (Gauhati)
6.	Southern Railway	Madras
7.	Southeastern Railway	Calcutta
8.	Western Railway	Bombay
9.	Southcentral Railway	Secunderabad

agencies and out agencies. The raw data collected from various railways zones could not be used as such for the present analysis. Each of the railway station was, therefore, matched against the appropriate census settlement, and in many cases a number of stations had to be aggregated to achieve this. As a result of this exercise, we were left with 6775 nodes. These were classified according to the administrative districts in which they fall and in terms of their rural/urban classification.

I.6.5 The above exercise resulted in a 6775 x 6775 flow matrix for each commodity. The number of commodity codes as given in the railway coding list is 544. With the existing computing facilities available, it is not possible to manage such a huge data matrix even on the largest computer system available in India. It was, therefore, considered necessary to aggregate the commodities in various homogeneous groups. With this in view in mind, all the commodities were aggregated into 7 internally homogeneous commodity groups. The detailed description of each commodity group is given in appendix I. The seven major commodity groups are:

1. Food Products
2. Raw materials from primary sources
3. Coal and fuel
4. Inputs into agriculture

5. Construction material

6. Industrial products

7. Miscellaneous commodities

For the purpose of analysis in the study, only these commodity groups have been used. Analysis of flow is based on station to station flow matrices for each of 7 commodity groups. Station to station matrices were further aggregated to get district to district flows. In addition to railway freight data, information available form other published sources has also been used.

I.6.6 Before embarking upon the detailed study, it would be necessary to bring out some of the limitations of the data being used. The results of this analysis would have become far more meaningful if the value of exchanges would have been taken into account. However, within the framework of existing statistics, no attempt has been made to record the money value of the commodity traffic originating on the Indian Railways. Attempts to estimate the money value of goods originating from a place, either from the above data or from other existing sets of data, may result in further distortions rather than bring out a comparable picture in terms of value of exchange.

I.6.7 Inspite of the fact that railways record the nature of commodity at each originating point, the differences in the variety and quality of the same commodity makes it difficult to approximate its value. For example, all types

of cloth are classified in the same category and any attempt to find out the value of cloth would be meaningless without knowing the exact nature and variety of cloth. The same is true for most of other commodities also. For example, it is very difficult to evaluate the cost of machinery by its weight. Thus, it was decided to proceed with weights rather than the value of exchange. Use of physical weights as a measure of analysis has its own advantage especially in the type of analysis indicated above.

I.7 Methodology

I.7.1 Empirical research on commodity flows has emerged on the academic scene only recently and methodologically significant works are particularly rare. For the purpose of this study various statistical techniques have been used to test the hypotheses as stated in section I.5.

I.7.2 Lorenz curve analysis and Ginni coefficients have been used to measure the regional diversities and disparities as reflected through originating and terminating freight for various commodities.

I.7.3 In an economic system the movement of one commodity is always influenced by the movement of many other commodities. For example, the receipts of raw materials and fuels at a place can be related to shipments between the movement of inputs and output. Thus the movement of various commodities is a highly interrelated phenomenon. The simplest way of capturing all

these interrelationships is through the analysis of correlations matrix. Wherever possible, correlations matrix have been used to explain the interrelationships between flows of various commodities.

I.7.4 Factor analysis techniques, wherein the sum of the squares of the correlations are minimized, have been used to identify regional clusters of production and consumption activities. Simple linear and log linear regression models have been used to examine the distance-freight relationships for various commodities. Cartographic methods have been used to portray the important results.

I.8 Organisation of the Study

I.8.1 The study has been organised into six chapters.

The first chapter deals with the relationship between economic interdependence and commodity flows, surveys the literature in the area, states the problem, presents the data base and the methodology utilised.

In the second chapter the growth of railway freight has been analysed and its relationship with economic development in India has been established.

In the third chapter the spatial patterns have been identified and inequalities in the distribution of originating and terminating freight have been analysed.

In the fourth chapter the inter-relationships between originating and terminating freight for various

commodities have been established and its relationship with levels of development has been examined. Clusters of industrial and agricultural activities have been identified with the help of commodity-wise originating and terminating freight.

In the fifth chapter, the principle of distance decay has been examined in detail and its applicability in the context of commodity flows in India has been examined. Rates of distance decay for various commodities have been worked out by using linear and log linear regression techniques.

In the last chapter, conclusions and summary of the findings have been presented. Following this, the appendices referred in the text are given before an alphabetically arranged bibliography.

CHAPTER II.3

ECONOMIC DEVELOPMENT AND FREIGHT CHARACTERISTICS

II.1 Rail Freight and Integration of the Space Economy

II.1.1 Any study based on interregional flows within a country should begin with an analysis of freight characteristics and its relationship with the overall economic development of the country. This chapter is, therefore, mainly devoted to a general analysis of railway freight characteristics and its relationship with the overall economic development in India during the last 25 years.

II.1.2 Railways are supposed to be most suited to carry bulk and heavy goods like raw materials, mineral products, foodgrains and industrial products and hence they occupy a dominant position, especially in countries like India, China, USSR or Canada, which have extensive plains and bulky traffic is to be carried over long distances. Railways with their high speed and large carrying capacity can meet the formidable challenge posed by the rapidly growing traffic in the process of economic development of a country.

II.1.3 The Indian railways today constitute Asia's biggest and the world's fourth largest railway system. As a part of the planning strategy since independence,

the Indian railways were entrusted with the task of carrying goods needed most in the development process. The draft Five Year Plan 1978-83 while emphasizing the role of railways in the national development process, stated that "Indian railway system has been and will continue to occupy a key position in the strategy of building up the basic infrastructure required for a growing and diversified economy."[1] In order to establish the fact that the Indian railways are playing a significant role in the national development process, the following hypotheses are proposed:

i) Increase in economic activity leads to strengthening of the interdependence among regions and hence to increase in railway freight.

ii) The composition of the traffic reflects the nature of increase in the interdependence.

iii) Changes in average lead may be due to

a) the emergence of largely self-sufficient geographically compact production complexes, which would imply a rise of short distance haulage and hence a fall in average lead of the total traffic,

---

1. Government of India, Planning Commission, Draft Five Year Plan 1978-83, p. 206.

b) the rise of inter-metropolitan movement of goods, which would result in the average lead rising because of India's port based colonial heritage, the metropolises being close to the extremities of India, or

c) since the raw material sources in the hinterland of the metropolitan region prove inadequate for the higher level of economic activity, the pulling in of more remote sources of raw materials results in the rise of average lead.

II.2 Railway Freight Statistics

II.2.1 Indian railways, usually compile two sets of statistics:[2]

i) The statistics prepared mainly for passenger traffic; and

ii) the statistics relating to the movement of goods traffic.

Since our aim here is to analyse the growth of goods traffic, only the statistics relating to the flow of goods traffic will be taken into account. Detailed information on indicators relating to the movement of goods traffic are compiled by the Indian railways. The indicators appropriate to this study are as follows:

---

2. Government of India, Ministry of Railways, Statistical Aid to Railway Operation, Technical Paper No. 350.

i) statistics relating to total volume of originating goods traffic both for revenue and non-revenue[3] earning traffic;

ii) statistics relating to the net tonne kms. both for revenue and non-revenue earning traffic; and

iii) statistics relating to average lead, which are derived from (i) and (ii) above.

II.3 Economic Activity and Rail Freight Elasticities

II.3.1 While indices of industrial production, mining output, agricultural production and national income are indicative of the level and nature of the economic activity in a country, rail freight reflects the level of activity of the railways. A correspondence or otherwise between the indicators of economic activity and of railway freight would indicate the nature and magnitude of inter-relationships between the two. If increase in economic activity leads to increase in freight then a high co-respondence between the indicators of economic activity and of railway freight is expected. This has been established by the following analysis.

---

3. Non-revenue goods are carried by the railways for their own use and for social welfare purposes.

II.3.2 Fig. II.1.1 and Table II.1.1 clearly brings out the relationship between the indices of rail freight, industrial production, mining output, agricultural production and national income.[4] All the figures relate to the base year 1950-51 taken as 100. A preliminary examination of the table reveals that all the four indices of economic development are positively related to the index of railway freight and hence move in the same direction. Correlation coefficients of railways freight index were calculated with the indices of industrial production, mining production, agricultural production and national income. It was observed that a very high correlation exists between the index of railway freight on the one hand and the indices of industrial production, mining production, agricultural production and national income (r = 0.90 to 0.98) on the other.

II.3.3 Changes in the freight index as a change in the indices of economic indicators have been worked out and the regression coefficients and freight elasticities w.r. to each economic indicator is given below in Table II.1.2.

---

4. Data obtained from Economic Surveys and Railway Board publications.

RAIL FREIGHT AND ECONOMIC INDICATORS

(BASE 1950-51 = 100)

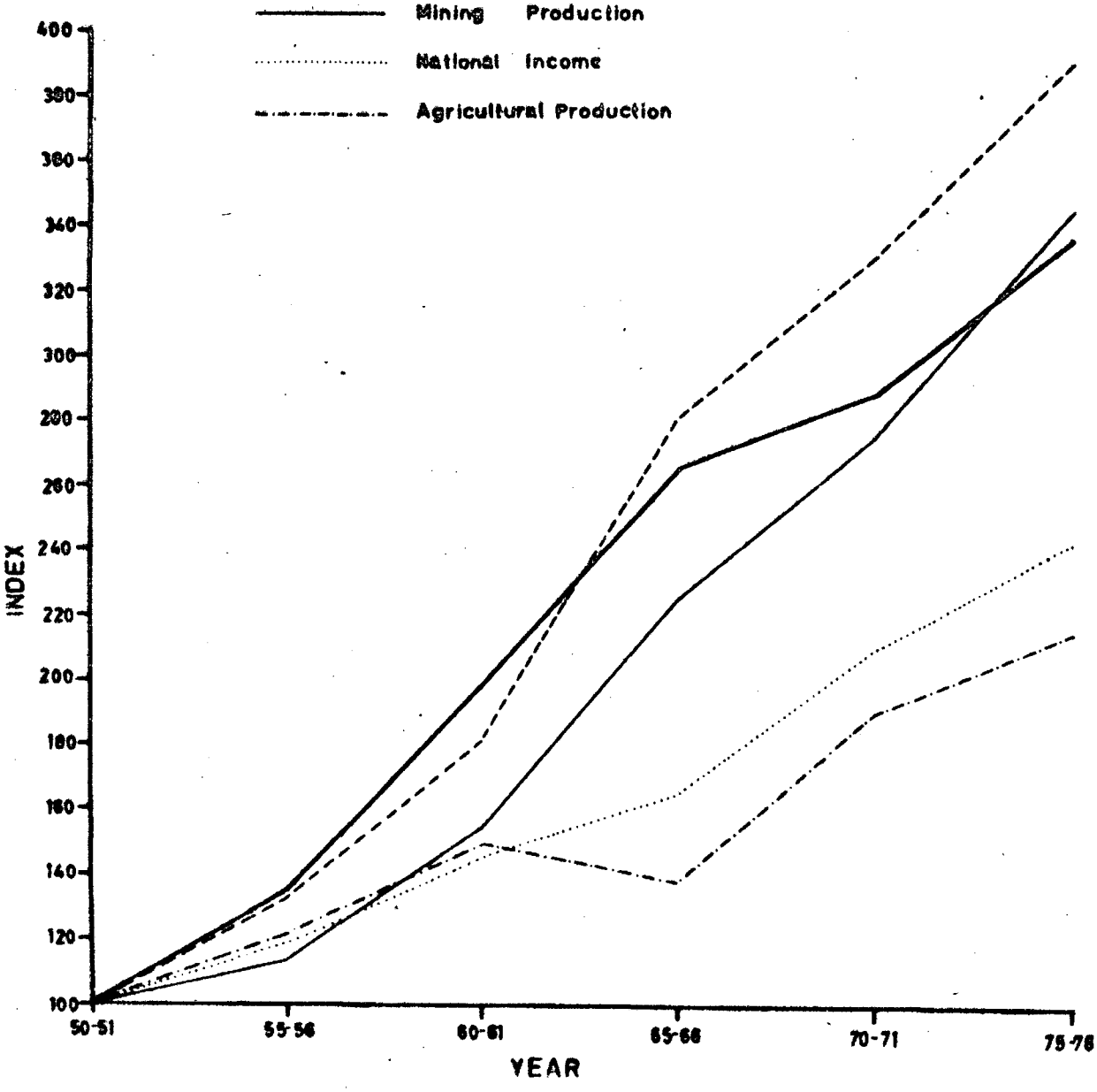


Fig. II 1.1

TABLE II.1.1

RAIL FREIGHT AND ECONOMIC INDICATORS

(Base 1950-51 = 100)

Year	Index of rail freight	Index of ind. prod.	Index of mining output	Index of agri. production	Index of national income
(1)	(2)	(3)	(4)	(5)	(6)
1950-51	100.0	100.0	100.0	100.0	100.0
1955-56	135.0	132.7	113.8	122.5	119.4
1960-61	198.7	182.5	153.8	149.1	145.8
1965-66	265.1	280.7	235.8	139.0	165.8
1970-71	288.7	329.6	273.8	190.7	209.2
1971-72	302.1	339.6	273.8	190.2	212.0
1972-73	309.5	363.9	280.0	175.0	208.7
1973-74	277.3	363.3	281.5	192.2	220.0
1974-75	304.4	374.6	314.4	186.1	221.6
1975-76	336.0	389.4	345.5	214.6	240.9
1976-77	355.3	430.7	369.8	200.3	244.2

Corr. Coeff. of railway freight with

			Corr. Coeff.
i.	industrial production	=	0.98
ii.	mining production	=	0.98
iii.	agricultural production	=	0.92
iv.	national income	=	0.90

TABLE II.1.2

REGRESSION COEFFICIENTS AND ELASTICITIES OF RAIL FREIGHT WITH ECONOMIC INDICATORS

S. No.	Description	Regression Coefficient	Freight Elasticity
(1)	(2)	(3)	(4)
1.	Industrial production	.72731	.826
2.	Mining production	.89126	.889
3.	Agricultural production	2.09794	1.103
4.	National income	1.49829	1.315

II.3.4 The above regression coefficients show that the railway freight is more sensitive to changes in agricultural and national income than mining and industrial production. A change of one unit in mining and industrial production will lead to .89 and .73 units of change in the railway freight. In the case of agricultural production and national income, a change of one unit brings a corresponding change of 2.10 and 1.50 units in railway freight. The impact of these economic indicators on rail freight will depend upon two factors:

i) the impact that these indicators have on the direct freight demand due to changes in the level of production; and

(ii) the indirect impact on the freight, that is due to forward and backward linkages of a particular commodity reflected in the economic indicator on the economy and hence on the freight demand - thus an increase in agricultural production will lead not only to increased demand in freight of agricultural produce, but also for the freight of industrial products which increased due to the buoyant economy caused by increased agricultural production.

II.3.5 Agricultural activity is not concentrated in a few points of the country, but is spread all over a large part of the country. Movement of food products taken place in response not so much to the supply position as to demand in various physically deficit regions and of periodic crop failures in some others. These deficits need not be met only through domestic production but may and indeed often have been met by imports. That is why a year with low agricultural production may see a large movement of imported foodgrains; and a year of good crops may see large inter-regional movements of the same items.

II.3.6 The above analysis, has therefore shown that as development proceeds, the level of economic activity increases and so does the railway freight.

II.4 Growth of Railway Freight in India

II.4.1 The volume of traffic handled by the Indian railways has been increasing at a considerable rate during the last 25 years. It has increased from 93 million tonnes in 1950-51 to 239 million tonnes in 1976-77. The commodity composition of the total freight has also changed considerably during this period, reflecting the trends of economic development in the country.

II.4.2 Information on total freight net tonne kms and average load is presented in Table II.2.1. The table shows that:

i) Increased scale of operations has led to high efficiency in utilisation of railway assets since revenue earning traffic has increased at a higher rate as compared to non-revenue earning traffic. The share of revenue earning traffic has increased from 78% in 1950-51 to 89% in 1976-77.

ii) The increased use of railways for long hauls is suggested by the increase in the average load over the years. This also perhaps suggests that instead of the emergence of technologically laiseed integrated industrial complexes, we are witnessing the development of a few isolated nodes or small evaluses. (Refer fig.

TABLE II.2.1

GOODS TRAFFIC SUMMARY: 1950-51 TO 1976-77

Year	Total orig. tonnes (mln)	Rev. earning (mln. tonnes)	Net tonne kms (millions) Total	Net tonne kms (millions) Rev. earning	Average lead Total	Average lead Rev. earning	Average rate per tonne km
1950-51	93.0	73.2	44,117	37,565	474	513	3.71
1955-56	115.9	92.2	59,576	50,435	514	547	3.52
1960-61	156.2	119.8	87,680	72,533	561	604	3.88
1961-62	160.5	125.6	91,218	75,353	568	600	3.90
1962-63	178.8	139.4	100,693	83,140	563	596	4.12
1963-64	191.1	147.6	106,841	88,624	559	600	4.36
1964-65	193.8	148.8	106,570	88,752	550	596	4.49
1965-66	203.0	162.0	116,936	98,978	576	611	4.57
1966-67	201.6	164.0	116,607	99,284	578	605	4.71
1967-68	196.6	162.4	118,860	101,122	605	623	4.84
1968-69	204.0	170.8	125,140	108,129	613	633	5.08
1969-70	207.9	173.8	128,248	111,826	617	643	5.17
1970-71	196.5	167.9	127,358	110,696	648	659	5.43
1971-72	197.8	170.1	133,265	116,894	674	687	5.61
1972-73	201.5	175.3	136,531	121,164	678	691	5.74
1973-74	184.9	162.1	122,534	109,391	662	675	5.09
1974-75	196.7	173.6	134,304	121,374	683	699	7.16
1975-76	223.3	196.8	148,219	134,874	664	685	8.12
1976-77	239.1	212.6	159,756	144,030	656	677	8.86

II.2.1). The average lead has, however, started falling after 1974-75). This may be partly explained by the large share of commodities like ores and fuels in the total freight. Bulk of these commodities move over shorter distances.[5]

II.4.3 Growth rates of total freight and net tonne kms have been worked out separately for different sets of base and terminal years. Table II.2.2 below shows the growth patterns of freight for various years.

TABLE II.2.2

GROWTH OF GOODS TRAFFIC: 1950-51 to 1976-77
(Compound annual growth rates)

Years	Total freight (mn. tonnes)	Rev. earning (mn. tonnes)	Net tonnes kms (Mn) Total	Rev. earning
1950-51 to 1960-61	5.3	5.0	6.8	6.8
1960-61 to 1970-71	2.3	3.4	3.8	4.4
1970-71 to 1976-77	3.3	4.0	3.6	2.7
1950-51 to 1976-77	3.7	4.2	5.0	5.5

5. Govt. of India, Ministry of Railways, Annual Report and Accounts 1976-77, 1978.

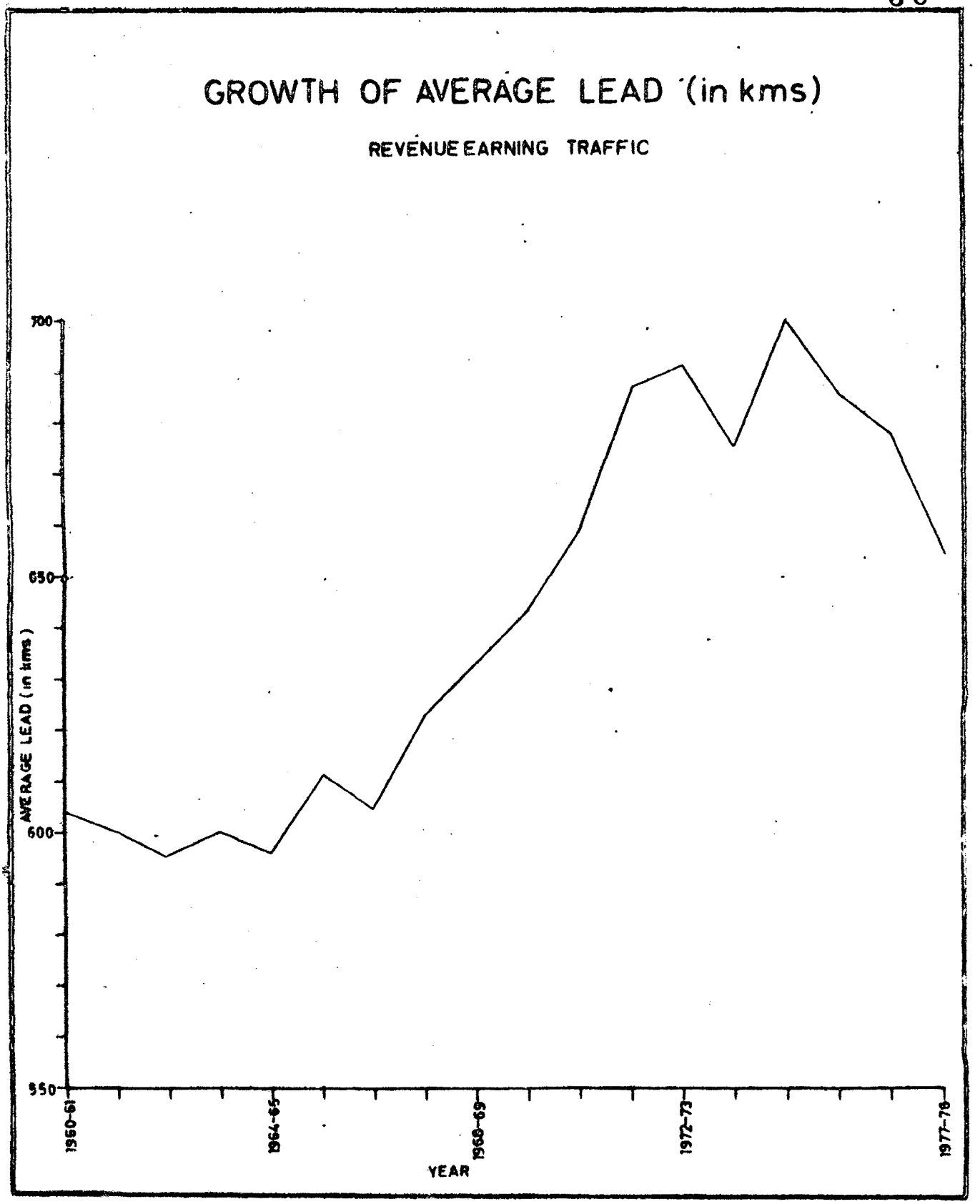

GROWTH OF AVERAGE LEAD (in kms)
REVENUE EARNING TRAFFIC
700
650
600
550
AVERAGE LEAD (in kms)
1960-61
1964-65
1968-69
1972-73
1977-78
YEAR

Fig. II·2·1

II.4.4 Table II.2.2 shows the following:

(i) There are wide variations in the growth of goods traffic during the fifties, sixties and seventies. An overall growth rate of 3.7% per annum has been achieved during 1950-51 to 1976-77, thus showing that the use of railway as freight carrier has been increasing over time. Increase in the railway freight not only leads to increase in interdependence of various regions but also to greater integration of the space economy.

(ii) The maximum growth rate both for revenue earning and total volume of traffic has been achieved during the fifties and there has been a steep fall in the growth rates of freight during the sixties. New industries such as iron and steel, machinery, petroleum and chemicals grew at a very fast rate during the fifties because of the emphasis on heavy industries in governmental policies. The Government invested heavily in these industries to build the industrial base of the country. However, the tempo of economic growth could not be maintained during the sixties, and there were serious shortcomings in industrial production after 1965. Some exogenous factors such as the devaluation of the Indian rupee and the severe drought during 1965-67 also resulted in the sluggish growth of the economy. All these factors contributed to a sharp decline

in the growth of originating traffic during the sixties. With the overall improvement in the economic situation, freight picked up again during the period 1970-71 to 1976-77.

II.5 Bulk and Non-bulk Composition of the Railway Freight

II.5.1 In order to have a better understanding of the role of railways in the national economic development process, it is necessary to investigate the nature of commodities carried by the railways. Indian railways classify the commodities into two major groups:

i) Bulk commodities, which include coal, ores, foodgrains, cement, mineral oils, iron and steel, fertilisers and lime stone.

ii) Other than bulk commodities, which include salt, sugar, tea, jute, oilseeds, sugarcane and textiles.

II.5.2 An important feature of the railway freight is that the composition of the total freight has also changed considerably during the period under review. The details of traffic composition and average lead for bulk and other than bulk commodities for various years are presented in table II.3.1.

II.5.3 Bulk commodities alone are accounting for most of the increase in the volume of freight since the total volume of other than bulk freight has not increased

TABLE II.3.1

BULK AND NON-BULK COMPOSITION OF THE RAILWAY FREIGHT

Year	Volume of traffic (Mn) tonnes		% share of bulk commodities total	Net tonne kms		Average lead	
	Bulk commodities	Other than bulk commodities		Bulk commodities	Other than bulk commodities	Bulk commodities	Other than bulk commodities
1950-51	54.1	38.9	58.20	NA	NA	NA	NA
1960-61	113.7	42.5	72.79	47790	39890	420	938
1965-66	156.3	46.7	77.00	66167	40769	423	885
1970-71	156.8	39.7	79.80	81627	45731	520	1152
1975-76	184.9	30.6	82.80	101021	47198	546	1222
1976-77	169.9	39.2	83.61	109290	47466	547	1211

NA = Not available

much. The share of bulk commodities in the total traffic has moved up from 58.2 per cent in 1950-51 to 83.6 per cent in 1976-77. The latest annual report and accounts of the Indian railways for 1977-78,[6] show that the share of bulk commodities in the total originating tonnage has further gone upto 84.5 per cent during 1977-78.

II.5.4 For bulk commodities the average lead is much less than the average lead for other than bulk commodities. This shows that the commodities constituting other than bulk commodities move over longer distances than the bulk commodities.

II.5.5 Bulk commodities mainly constitute raw materials, industrial inputs and fuels and are developed over shorter distances as compared to other than bulk commodities, which are mainly manufactured products, like textiles, tea, sugar, chemicals, cloth and paper. This indicates the relative concentration of manufacturing activities near the sources of raw materials rather than the markets.

II.6 Commodity Composition of Railway Freight and Economic Development

II.6.1. It is no doubt true that bulk commodities

---

6. Govt. of India, Ministry of Railways, Annual Report and Accounts, 1977-78.

continue to influence the overall pattern of railway freight. It will, therefore, be more revealing to analyse the commodity-wise distribution pattern of the freight.

II.6.2 Table II.4.1 shows the distribution of principal commodities carried by the Indian railways from 1950-51 to 1975-76. The percentage share of each commodity in the total flow is also shown in the table.

II.6.3 An examination of the distribution pattern of total freight reveals that coal alone accounts for about one third of the total originating freight. The share of coal, during the period 1950-51 to 1975-76, has remained almost at the same level, though there has been substantial increase in the volume of traffic of coal.

II.6.4 There has been a slight fall in the share of foodgrains, raw jute, oil seeds and sugarcane, in the total volume of freight. This shows that agricultural sector has grown at a lower rate than the industrial sector. Growth rate of agriculture during 1961-62 and 1976-77 was 2.10 per cent per annum as compared to 4.30 per cent per annum for the secondary sector.[7]

---

7. Economic Surveys, op. cit.

TABLE II.4.1

PRINCIPAL COMMODITIES CARRIED BY RAILWAYS: 1950-51 to 1975-76

(000 Tonnes)

Commodity	1950-51		1960-61		1965-66		1973-74		1974-75		1975-76	
(1)	Vol. (2)	%Distr. (3)	Vol. (4)	%Distr (5)	Vol. (6)	%Distr (7)	Vol. (8)	%Distr. (9)	Vol. (10)	%Distr. (11)	Vol. (12)	%Distr. (13)
Coal	30911	33.26	50,396	32.26	66,741	32.88	62,045	33.56	70,979	36.08	80,518	36.06
Cement	2471	2.66	6,548	4.19	8,649	4.26	10,021	5.42	9,187	4.67	11,597	5.19
Iron & Steel	2750	2.96	7,588	4.86	10,077	4.96	9,282	5.05	9,819	4.99	10,758	4.82
Metallic Ores	3055	3.78	11,140	7.13	18,623	9.17	21,107	11.42	22,627	11.50	26,933	12.06
Manganese ore	881	0.95	1,230	0.79	1,497	0.74	1,080	0.58	1,355	0.69	1,331	0.60
Foodgrains	7805	8.39	12,659	8.10	14,514	7.15	14,648	7.92	13,666	6.95	16,184	7.25
Raw jute	470	0.51	644	0.41	763	0.38	591	0.32	485	0.25	632	0.28
Tea	265	0.28	250	0.16	203	0.10	199	0.11	198	0.10	116	0.05
Paper & paper products	193	0.21	442	0.28	670	0.33	199	0.11	875	0.44	899	0.40
Jute manf.	271	0.29	263	0.17	275	0.14	842	0.46	346	0.18	548	0.25
Raw cotton	525	0.56	536	0.34	485	0.24	447	0.24	340	0.17	382	0.17
Cotton textiles	477	0.51	380	0.24	308	0.15	148	0.08	141	0.07	123	0.06
Oilseeds	1595	1.72	1,517	0.97	1,470	0.72	1,021	0.55	1,055	0.55	1,168	0.52
Sugarcane	2819	3.03	3,237	2.07	2,717	1.34	1,818	0.99	1,688	0.86	1,491	0.67
Sugar	933	1.00	1,488	0.95	1,543	0.76	1,382	0.75	1,566	0.80	2,038	0.91
Salt	1576	1.69	1,981	1.27	2,569	1.27	2,339	1.27	2,964	1.51	2,904	1.30
Chemical manure	589	0.63	1,393	0.89	2,452	1.21	5,315	2.87	5,976	3.04	7,169	3.21
Mineral oils	2692	2.89	4,700	3.01	7,495	3.69	9,994	5.41	10,751	5.47	11,663	5.22
Others	32722	35.18	49,807	31.89	61,949	30.52	42,422	22.94	42,682	21.70	47,116	21.10
Total	93000	100.00	156,200	100.00	203,000	100.00	184.900	100.00	196,700	100.00	223,300	100.00

The share of some commodities like cement, iron and steel, metallic ores, mineral oils and chemical fertilisers in the total freight has been increasing at a rate higher than that of the average growth in freight. The share of these commodities in the total freight has increased from 12.4% in 1950-51 to 30.5% in 1975-76. The total volume of these commodities during this period has grown at the compound rate of about 7% per annum as compared to 3.7 per cent for the total freight.

II.6.6 During the period 1950-65, the highest growth rate of 12.6% in the freight has been recorded by the metallic ores. During 1965-75, however, the highest growth in the freight has been recorded by chemical manures followed by mineral oils and metallic ores.

II.6.7 Since the development of heavy and basic metal industries took place during the fifties and the early sixties, the maximum growth has been recorded in the freight of commodities like metallic ores. However, when the focus of planned development shifted to agriculture during the second half of sixties, the highest growth has been recorded in the freight of chemical fertilisers followed by metallic ores. It may be mentioned here that as a consequence of the green revolution, use of fertilisers became widespread and there were high

imports of fertilisers and the consequent high growth of its freight. The average lead for fertilisers has also increased considerably during this period, from 752 kms in 1965-66 to 988 kms in 1977-78.[8] Thus the use of fertilizers is spreading to more and more remote areas, whereas the production points have not diversified at the same rate.

II.6.8 Commodities like iron and steel, cement, chemical fertilisers, metallic ores and mineral oils are used as intermediate inputs in many productive sectors of the economy. This fact is clearly brought out by an examination of the inter-industry or input-output table. The last available input-output table for India pertains to the year 1968-69,[9] and the same has been used here to analyse the sectoral output disposal pattern of some of the important commodities.

II.6.9 With the help of input-output table, it is possible to find out the share of the output of each sector output that is being used in intermediate consumption. The ratio of total intermediate consumption to its gross output is a measure of the forward linkage of any sector in the transactions matrix of the input-output table.[10]

---

8. Compiled from Railway Board Publications.

9. Govt. of India, Central Statistical Organisation, National Income Statistics 1977-78, 1979.

10. Chenery, H.B., Inter-Industry Economics.

Mathematically,

$$Ui = Xi./Xi$$

Where Ui is a measure of forward linkage

Xi. is the total intermediate demand for the output of i^{th} sector and

Xi is the gross value of output of the i^{th} sector.

The value of forward linkage for some important sectors of the input-output table are presented in Table II.5.1.

TABLE II.5.1

FORWARD LINKAGES FOR SOME SELECTED COMMODITIES

S. No.	Sector Description	Ui
1.	Coal and lignite	.94
2.	Iron ore	.52
3.	Petroleum products	.84
4.	Cement	.94
5.	Iron and steel	.86
6.	Fertilizers	2.34*
7.	Food crops	.16
8.	Sugar	.18
9.	Cotton textiles	.30
10.	Machinery except electrical	.27
11.	Woolen textiles	.17
12.	Leather and leather products	.15

* Because of high imports of fertilizers, intermediate consumption of fertilizers is much more than the production within the country.

II.6.10 Two groups of commodities can be identified from the above table: those with high values and those with low values of forward linkage. Commodities, with high forward linkages, are mainly used as intermediate inputs in other sectors of the economic system and their use in final demand is small. These sectors also have low value added per unit of output. The value of forward linkage for each of these commodities is greater than .50. While the value of forward linkages for the other set of commodity is low (less than .50), it has high value added per unit of output.

II.6.11 It is interesting to note that 40 out of a total of 60 sectors in the inter-industry transactions matrix use coal as one of the basic inputs (fuels) in their production processes. Iron ore is a basic input for iron and steel industry. Petroleum products are also used in almost all the sectors of the economy in one way or the other. Iron and steel is mainly used by construction, metal production and machinery manufacturing sectors. Fertilisers have become one of the basic inputs in agriculture.

II.6.12 Thus, the level of economic activity is determined by the freight of commodities like iron and steel, cement, chemical fertilisers, metallic ores and mineral oils. Consumption of cement alongwith commodities

like iron and steel show the extent of construction activity which is an element of the capital formation in the economy. The growth of the Indian economy during 1950-51 to 1976-77, is thus clearly reflected in the increase in the total volume of traffic; and the sectoral growth of the economy over the period, is reflected in the growth of traffic in commodities like cement, iron and steel, metallic ores, mineral oils and chemical fertilizers.

II.7 Diversification in the Space Economy

II.7.1 Average lead statistics for some important commodities are presented in Table II.6.1. The average lead for commodities like coal, foodgrains, iron and steel, cement, fertilizers, mineral oils etc. has increased over the period suggesting a greater use of these commodities have shown different behaviour in the change of average lead over time.

II.7.2 Cement has recorded very high increase in the average lead - an increase of 48.25% during 1965-66 to 1977-78. This shows that while manufacturing of cement has remain concentrated, the market has expanded in space. Other commodities for which average lead has increased at a high rate are fertilizers (31.38%), foodgrains (46.78%), iron and steel (23.59%).

TABLE II.6.1

GROWTH OF COMMODITY-WISE AVERAGE LEAD FOR REVENUE EARNING TRAFFIC DURING 1965-66 TO 1977-78

Commodity	Average lead	1965-66	66-67	67-68	68-69	69-70	71-72	72-73	73-74	74-75	75-76	76-77	77-78
Coal	571	540	589	575	585	605	537	562	595	586	576	586	
Foodgrains	808	792	853	859	887	1059	1181	1114	1110	957	940	1186	
Iron and Steel	852	913	968	935	967	1028	992	1016	1069	1009	1000	1053	
Cement	456	462	484	527	583	617	641	635	663	741	672	676	
Mineral Oils	598	576	515	576	564	593	614	638	642	607	604	626	
Fertilizers	752	675	775	828	809	832	809	753	801	861	923	988	
Lime stone dolomite	218	215	204	213	232	217	237	241	287	277	274	272	
Other Stones	336	328	317	326	312	351	355	327	338	326	319	333	
Total Freight	611	605	623	633	643	607	691	675	699	685	679	714	

II.7.3 In the case of coal, the increase in average lead has been marginal (2.63%) for two reasons. Firstly, the movement of coal for washeries, which are located very near the extraction point, do not result in any substantial change in average lead. Secondly, the major users of coal like steel plants, fertilizers plants and thermal power houses have not undergone any major locational change, thus resulting in only marginal change in average lead.

II.7.4 The average lead for raw materials has also increased by more than 20%. This is because more remote areas are being exploited to get raw materials for higher levels of production.

The above analysis has thus shown that increased economic activity leads to increase in railway freight and the freight composition reflects the nature of inter-dependence of various activities as well as of various regions. Changes in average lead have suggested that only a few nodes have been able to develop and the formation of large and self sufficient geographical industrial complexes has not taken place so far in the Indian space economy.

CHAPTER III

COMMODITY FLOWS AND THE CONCENTRATION OF ECONOMIC ACTIVITIES IN SPACE

III.1 Nature of Regional Inequalities in the Space Economy

III.1.1 The spatial pattern of interregional trade in developed countries would be similar to or different from that of the underdeveloped countries depending upon the nature of the commodity as well as the organisation of the economy in space. Since, both in developed and under-developed countries, the production activities are more concentrated in space than the consumption activities, the relative concentration of originating freight is expected to be more than that of the terminating freight. There would, however, be exceptions as in the case of commodities like metallic ores, which are collected from a larger hinterland and are processed at one point; and, consequently, receipts tend to be more concentrated as compared to shipments. The degree of concentration for many commodities will be much more in under-developed countries than in the developed countries because of high concentration in the former of economic activities at only a few places. This chapter is devoted to the analysis of spatial patterns of freight distribution and to measure the concentration of the spatial inequalities in shipments and receipts of various commodities.

III.1.2 Constrained by the resource endowments and the relationship between the exchange costs and distance, various areas of the economic system specialise in different activities and exchange their specialities among themselves depending upon the demand in each for the specialized commodities of the others. Commodities would, therefore, originate from the areas of production and terminate in the areas which are either points of intermediate consumption, final demand or are the points of transhipment. Viewed thus, it is not necessary that all the regions of a system participate in the exchange process to the same extent or in the same manner. While there are certain areas with rich mineral resources wherein almost all the requirements of minerals are met locally, there are other areas in the economic system which are either at the receiving end or do not participate in exchange at all. Thus different areas, depending upon their economic base, will have different participation rates for each commodity. The extent of participation can be measured by the share of a particular area in the total originating/terminating freight.

III.1.3 There will be wide regional variations in originating and terminating freight depending upon the natural, social and economic conditions of each region and upon the political economy of inter-regional

relationships. While some area will be playing an active role with high participation rate, others may be passive. Out of the total 355 districts in India (list of districts appears in appendix II), only 317 participate in the rail freight exchange process. The remaining districts usually do not have any railway station. Most of these are hilly and backward districts. The districts which do not interact through railway are listed in appendix III. Not all of the remaining districts participate in the exchange of all commodities. While, some districts send/receive goods of one group only, others like Bombay, Calcutta and Delhi send/ receive many groups of commodities and have a diversified freight pattern.

III.2 Inequalities in Inter-regional Trade of the Developing Economies

III.2.1 The spatial distribution of originating and terminating freight will bring out the relative concentration of activities in different areas. In order to measure the degree of inequalities in the originating and terminating freight, lorenz curve analysis, Gini coefficient and coefficient of variation may be used. Regional variations in the originating and terminating freight will also differ from one commodity to another. It is expected that while there would be concentration

of originating and terminating freight in the case of some commodities. There would be diversification in movement pattern in the case of others. Since balanced regional development has been one of the national objectives in India, it would be interesting to find out as to how far we have moved in this direction. Large concentration in the receipt pattern would clearly show that the economic activities are still concentrated only at a few nodes in space.

III.2.2. It is expected to find the following features in a developing economy:

(i) First order processing of bulk commodities like raw materials will show high concentration ratio both for originating and terminating freight.

(ii) Since the manufacturing points are more concentrated in space than the consumption points, fuels, industrial products, construction material and inputs into agriculture will have high concentration ratio for originating freight as compared to the terminating freight. The difference in the concentration ratio of originating and terminating freight of these commodities should be very large in a diversified market economy.

(iii) The movement of food products depends upon the agricultural situation during a particular year. As agricultural development proceeds different areas tend to

specialize in the production of various crops. In such a situation the relative concentration of originating and terminating freight will be high.

III.3 Commodity Composition of Total Freight

III.3.1 As has been noted earlier, the classification of commodities into groups has been done in such a manner that each group is, by and large, homogeneous internally in terms of the input requirements of the production processes.

III.3.2 Figure III.1.1 shows the commodity wise distribution of the total originating freight in India during 1973-74. Fuels group accounts for 41.17 per cent of total originating freight in India, followed by raw materials from primary sources, which accounts for 23.05 per cent. These two groups taken together account for 64.22 per cent of the total originating freight. The commodities falling in these two groups are either fuels or basic inputs into various manufacturing processes and only a very small proportion of these commodities goes to the final demand sector of the economy.

III.3.3 The share of food products in the total originating freight is only 11.17 per cent. Food products generally move from surplus areas to deficit areas; and there are wide annual fluctuations depending upon the agricultural situation in the country.

COMPOSITION OF ORIGINATING FREIGHT: 1973-74

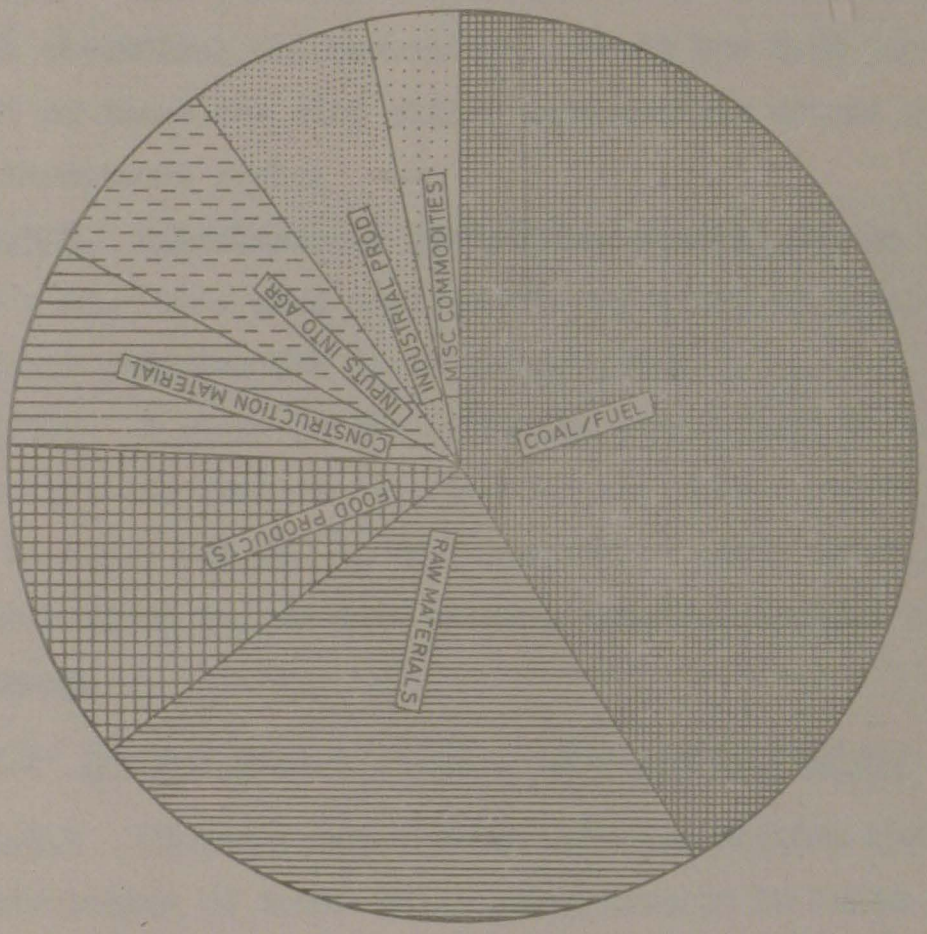


Fig. III·1·1

III.3.4 Fertilizers and manures, which constitute the main inputs in the agriculture group, are again meant for intermediate use only. Construction materials account for 7.41% of the total originating freight and include cement, bricks and tiles, which go in for investment purposes.

III.3.5 Industrial products including metals, machinery both electrical and mechanical account for 6.68 per cent. Most of these are also either intermediate demand goods or investment goods.

III.3.6 Miscellaneous commodities account for as 3.45 per cent. This also includes the movement of goods for defence purposes its share being 0.74%.

III.3.7 A study of the commodity composition of the total freight has thus clearly brought out that a major part of exchange relates to the movement of goods which go as intermediate inputs into other productive sectors of the economy.

III.4 Spatial Distribution of Originating Freight

III.4.1 Figure III.2.1 shows the districtwise spatial distribution of total originating freight in India during 1973-74. Thirty-seven districts have been identified wherein shipments exceeds 1 million tonnes each. The dominance of mining and industrially advanced areas is clearly reflected in the originating freight.

III.4.2 Three type of areas can be identified within this group and these are:

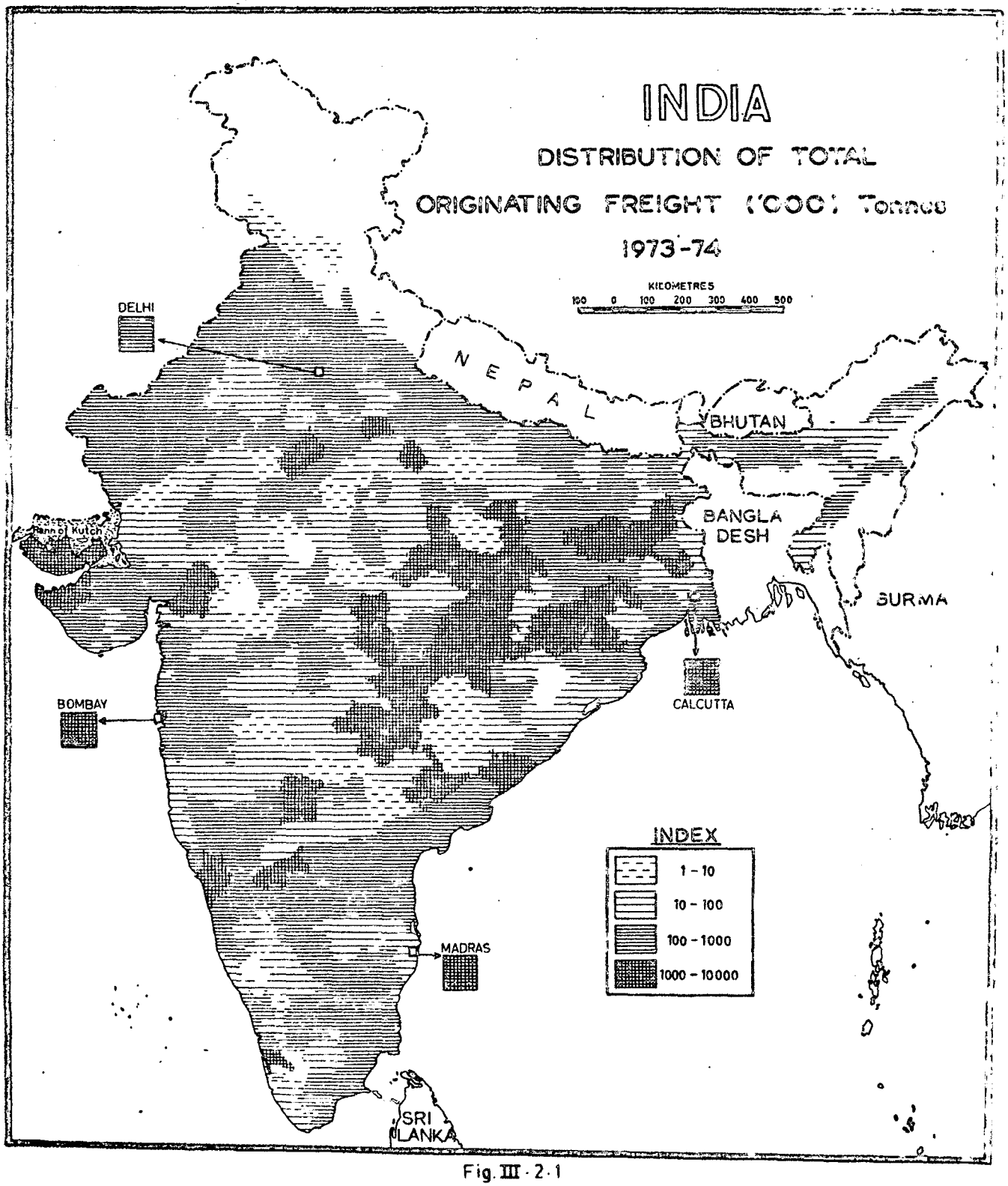

INDIA
DISTRIBUTION OF TOTAL
ORIGINATING FREIGHT ('000 Tonnes
1973-74
KILOMETRES
100 0 100 200 300 400 500
DELHI
NEPAL
BHUTAN
BANGLA DESH
BURMA
Rann of Kutch
BOMBAY
CALCUTTA
MADRAS
SRI LANKA
INDEX
1 - 10
10 - 100
100 - 1000
1000 - 10000

Fig. III · 2·1

(i) Areas like Dhanbad, Burdwan, Hazaribagh, Singhbhum and Bhilai specialising in mineral and basic and heavy industries.

(ii) Important ports like Calcutta, Bombay, Madras, Kandla and Vishakhapatnam.

(iii). Industrially advanced nodes like Kanpur, Baroda, Ahmedabad, Poona and Jamnagar.

III.4.3 These 37 districts with very high shipments taken together account for 74.89 per cent of the total originating freight. Nearly 30 per cent freight originates from Dhanbad, Burdwan, Hazaribagh, Durg (Bhilai), and Singhbhum. These districts are mainly high potential mining areas and form a belt of basic and heavy industrial activity. Thus the dominance of mining and industrial manufacturing belts is clearly reflected in the total originating freight.

III.4.4 There are 145 districts which have total shipment ranging from 0.1 million tonnes to 1 million tonnes per year. The share of shipments from these districts to the total originating freight is only 22.47 per cent.

III.4.5 Most of the areas with high shipments are the areas which either specialise in the production of agricultural commodities or are industrial areas with large and medium type of industrial activity. The

agricultural commodities which mainly originate from these areas are wheat, rice, cotton, oilseeds, etc. Industrial products like cement, fertilizers, sugar, cloth, petroleum and petroleum products also originate from these areas. The areas which fall in this category are the coastal districts of Southern India, Western Rajasthan, Punjab, Haryana and some areas of Western Uttar Pradesh.

III.4.6 Underdeveloped areas of Jamra & Kashmir, Himachal Pradesh, parts of Madhya Pradesh and Uttar Pradesh have very low shipments. Areas with shipments lying below 10 thousand tonnes constitute the third and fourth category. The shipments from these areas account for only 2.64 per cent of the total originating freight.

III.5 Spatial Distribution of Terminating Freight

III.5.1 Figure III.2.2 shows the distribution of terminating freight. Figure III.2.2 presents an entirely different picture as compared to figure III.2.1. The terminating freight is more evenly distributed as compared to the originating freight. The areas with very high receipt are more evenly distributed over the country in the case of terminating freight as compared to the areas of high originating freight. Thus, the patterns of receipts is more diversified than that of the shipments.

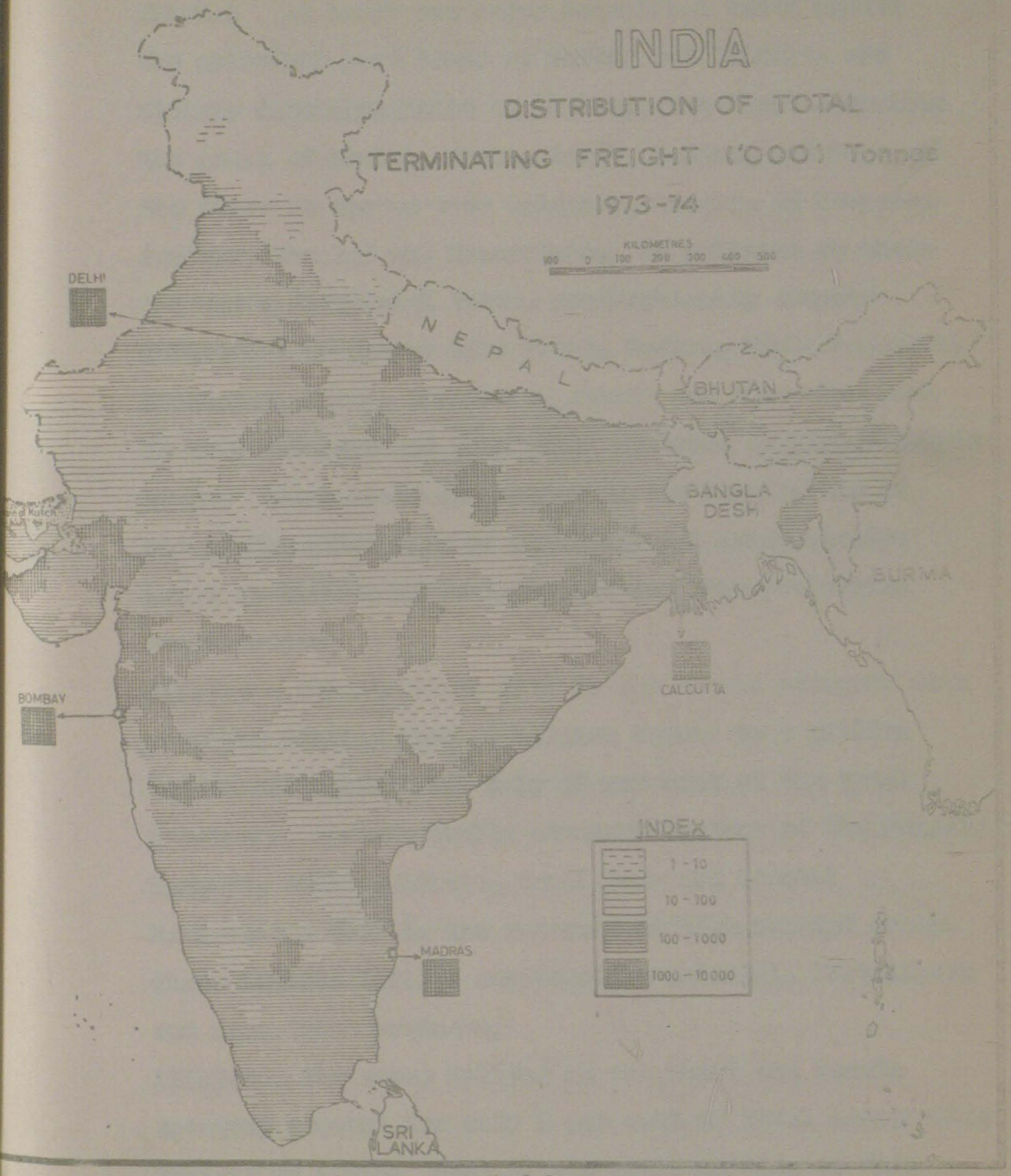

INDIA
DISTRIBUTION OF TOTAL
TERMINATING FREIGHT ('000) Tonnes
1973-74
KILOMETRES
100 0 100 200 300 400 500
DELHI
NEPAL
BHUTAN
BANGLA DESH
BURMA
CALCUTTA
BOMBAY
MADRAS
SRI LANKA
INDEX
1 - 10
10 - 100
100 - 1000
1000 - 10000

Fig. III 2.2

III.5.2 At least two major industrial belts around the principal port towns of Bombay and Calcutta are clearly distinguishable on the map: the first comprises the areas of Bombay, Thane, Nasik, Jalgaon and Pune and the other is spread over Calcutta, Hoogly, 24 Pargana, Burdwan, Dhanbad and Hazaribagh. In addition to these two major industrial belts, geographically compact industrial complexes like Delhi, Madras, Vishakhapatnam, Ahmedabad, Khera, Bangalore, Ambala and Durg also fall in this category and form small clusters of high receipts areas. These areas specialise in the manufacture of one or the other type of commodity and hence receive (68 1.) large quantities of basic inputs for their production requirements.

III.5.3 181 districts fall in the second category with receipts ranging from .1 million tonnes to 1 million tonnes and account for only 30 per cent of the total receipts. Agriculturally advanced regions of the Punjab, Haryana, Andhra, Kerala, Tamil Nadu and coastal Maharashtra fall in the category of high receipt areas. Their imports include construction material, fertilizers and industrial products.

III.5.4 The areas falling in the third and fourth category account for only 2 per cent of total originating freight in India. Most of the areas falling in this category are underdeveloped.

III.6 Spatial Distribution of Originating and Terminating Freight

III.6.1 The spatial pattern of originating and terminating freight as discussed in the above paragraphs suggest overlapping of the originating and terminating freight patterns. It is quite possible that an area, which is rich in mineral and other natural resources but does not have any industrial base, may be shipping large volumes of ores but its receipts may be quite small. Alternatively, there may be certain areas which have very high receipts but their shipments are very small. The economic base of such regions will be quite different from one another. Shipments and receipts taken together reflect the economic base of the region. The correlation coefficient between originating and terminating freight has been found to be statistically significant. This indicates that there is a definite relationship between the shipment and receipts of the region. It is, therefore, necessary to examine the spatial pattern of both originating and terminating freight taken together.

III.6.2 Four types of areas have been identified in terms of originating and terminating freight of various districts. Areas having total originating freight more than the national average, have been classified as high shipment areas and the areas with the originating freight less than the national average have been classified as low shipment areas. Similarly, in the case of terminating

freight areas with terminating freight more than the national average have been defined as high receipt and those with terminating freight less than the national average as the low receipt areas. It may be mentioned here that the national average of originating and terminating freight will be same.

III.6.3 When originating and terminating freight are cross tabulated we get a (2x2) table, with their respective cells as:

i) high shipment and high receipt,

ii) high shipment and low receipt,

iii) high receipt and low shipment,

iv) low shipment and low receipt areas.

On the basis of this classification a map (fig. III.2.3) has been prepared and the areas falling under each class have been shown therein

III.6.4 There are 57 districts wherein the total shipment is more than the national average, and 67 districts wherein the receipts exceed the national average. The shipments and receipts in the remaining districts are below the national average. Table III.1.1 below presents the distribution of districts in the various freight categories as defined above.

Table III.1.1

DISTRIBUTION OF DISTRICTS ACCORDING TO FREIGHT CHARACTERISTICS

Originating \ Terminating	High	Low	Total
High	32 ✓	25	57
Low	35	225 ✓	260
Total	67	250	317

III.6.5 The areal distribution of originating and terminating freight for each district as shown in fig. III.2.3 clearly brings out the fact that a large number of districts have low shipments and low receipts. There are only a few districts which fall in high shipment and high receipt category. These districts like Dhanbad, Burdwan, Hazaribagh, Durg (Bhilai) and Baroda have a concentration of mining and heavy basic industrial activities. These districts fall in the category because the basic inputs (ores) for heavy basic industries like iron and steel cannot be carried over very long distance and hence the manufacturing plants have to be located close to the ore and fuel extraction points. Their dominant receipts are basically ores and fuels. The output of these industries are, however, meant to serve the national market. The fact that average

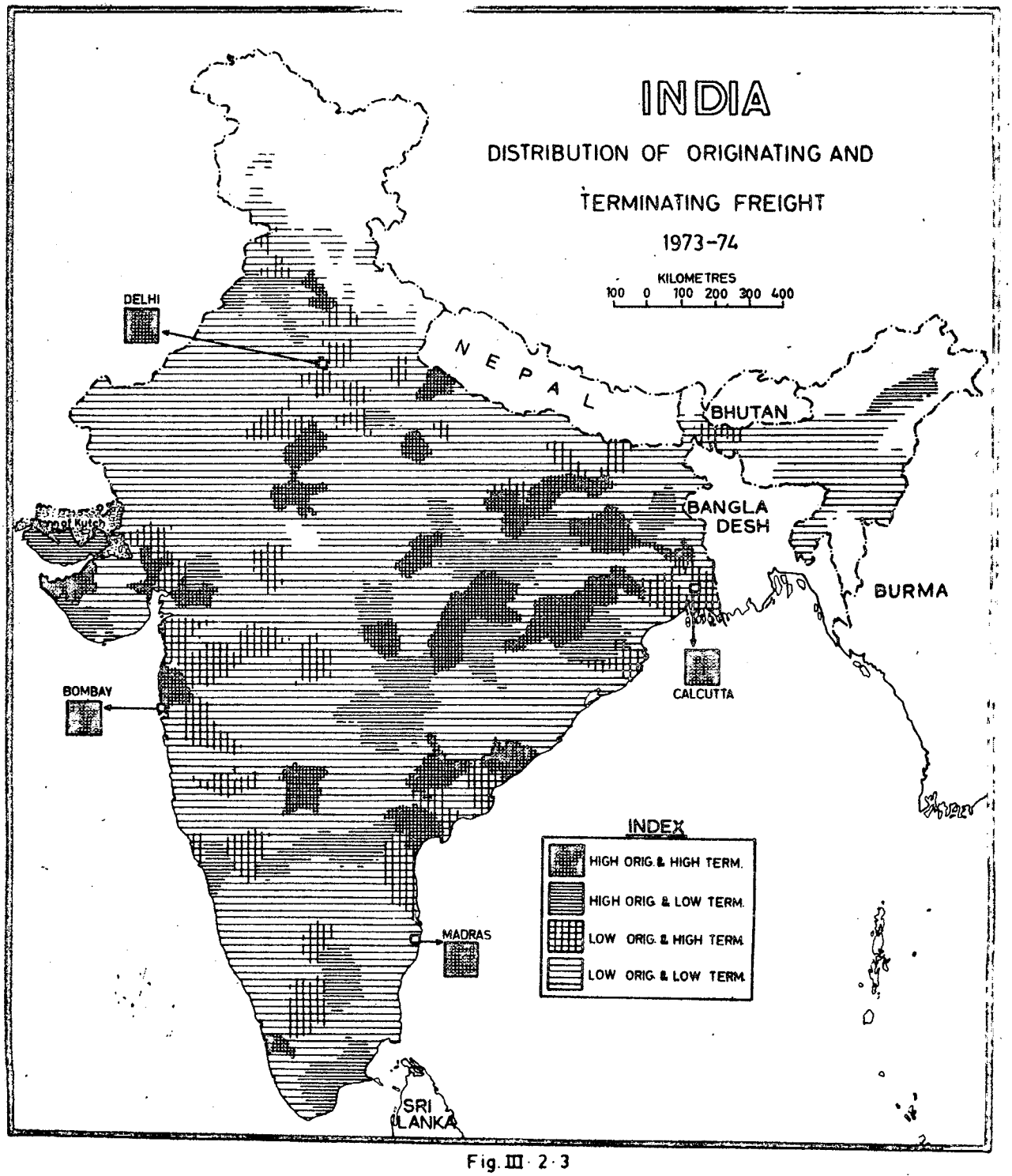

INDIA
DISTRIBUTION OF ORIGINATING AND
TERMINATING FREIGHT
1973-74
KILOMETRES
100 0 100 200 300 400
DELHI
NEPAL
BHUTAN
BANGLA DESH
BURMA
CALCUTTA
BOMBAY
MADRAS
SRI LANKA
INDEX
HIGH ORIG. & HIGH TERM.
HIGH ORIG. & LOW TERM.
LOW ORIG. & HIGH TERM.
LOW ORIG. & LOW TERM.

Fig. III · 2 · 3

lead for inputs is much less than the output shows that resource base industries are located in these areas. Whereas the average lead for receipts of iron ore and coal for steel plants during 1973-74 was 329 kms and 357 kms respectively, the average lead for the shipment of iron and steel was 1016 kms.[1]

III.6.6 Other areas, which fall in the high shipment and high receipt category are those which have a developed commercial and manufacturing sector. These areas are generally engaged in the manufacture of machinery and household or other durable goods. Some of the large centres like Madras, Calcutta, Bombay, Delhi, Kanpur, Patna and Nagpur also fall in this category. Quite a few of these districts happen to be the important port districts which were developed during mainly act as transhipment points and/the colonial period in India for imports to and exports from India.

III.6.7 The second group comprises areas with high shipment and low receipts. Out of 57 districts with high shipments, 25 fall in this category. The districts which fall in this category are those which are located at

---

1. Data taken from Railway Board publications.

some distance from any of the heavy basic industrial plants and supply them either fuel or ore. Raipur and Surguja are two districts in the neighbourhood of Bhilai falling in this category. Some other districts which have high shipments and low receipts are Chindwara, Keonjhar, Adilabad, Shahdol, Karimnagar, and Santal Pargana. This also includes some of the backward districts where large scale industries like fertilisers and cement have been established. Some of the agriculturally advanced districts have similar attributes because these areas import inputs into agriculture, construction materials and industrial products on a substantial scale. This phenomenon is illustrated by districts like Ferozepur, Ludhiana, Sangrur, Dhenkanal and Tirunelveli. The exports of food products from these areas are quite massive; and, hence, they have high shipments and low receipts.

III.6.8 There are 35 districts with high receipts and low shipments. Many of the districts falling in this category receive a large volume of commodities like food products along with raw materials from primary sources, coal and other fuels. While the food products are mainly meant for final consumption, high volumes of coal are received in many of these districts for thermal power houses. The output from thermal power stations does not

directly generate transport demand and hence the volume of shipments is quite low as compared to its receipts.

III.6.9 Thus all the areas with high receipts and low shipments happen to be areas which are highly deficit in food products and which are sites for industries like cement and fertilizer or thermal power houses. Districts like Darbhanga, Saharsa, Surat, Khera, Mehsana, Jalpaiguri and 24 Parganas fall in this category. The high receipts and low shipments may also be explained in some cases by the fact that they are some of these areas are rail terminals and transhipment points for other modes of transport. This may be illustrated by the case of Gurdaspur district in the Punjab, which has very high receipts because it acts as a transhipment point for goods meant for Jamm and Kashmir.

III.7 Measuring Inequalities in Interregional Trade: A Quantitative Approach

III.7.1 Figure III.2.1, III.2.2 and II.2.3 show that there are relatively few areas with high shipments and high receipts, while many districts fall in the category of low shipments and low receipts. The foregoing discussion has clearly brought out the dominance of mining, manufacturing and agriculturally advanced areas in the originating and terminating freight. The fact that the spatial pattern of interregional trade is dominated by relatively few areas suggests that the distribution of commodities is skewed in

favour of a few regions of the economic system. High shipment and high receipt areas account for 53.46% of the shipments and 52.50% of the total receipts. The dominance of commodities with high weight and low value is also clear from the fact that all the areas emerging as high shipment and high receipt centres are generally specialising in mining and heavy and basic industrial activities. Raw materials and fuels dominate the flow pattern in such areas. In order to have a more clear picture about these inequalities, it was considered desirable to work with individual commodities rather than with the total freight. Commodity wise analysis may also help to distinguish the commodities for which the skewness in the distribution of freight may be a desirable feature from those where the highly skewed distribution may be the result of interregional disparities.

III.7.2 The following two techniques have been applied to measure the inequalities in the originating and terminating freight:

(i) Coefficient of variation[2]

(ii) Lorenz curve and Ginni Coefficient

---

2. Coefficient of variation is defined as

$$C.V. = \frac{\sigma}{\bar{x}}$$ where σ = Standard deviation, $\bar{x}$ = Mean

Though both the measures essentially serve the same purpose of measuring relative variation, Coefficient of variation is less sensitive to the extreme values than a corresponding Gini Coefficient.

III.7.3 Table III.2.1 gives the average weight, standard deviation and coefficient of variation for originating as well as terminating freight. While the average weight will be the same both for originating and terminating freight, there will be wide variations in the standard deviation and the coefficient of variation depending upon the spatial links formed by the originating and terminating freight. While the distribution of average weight per district will follow a pattern similar to that of the share of each commodity in the total freight, the values for standard deviation and coefficient of variation would give a clear idea about the concentration or dispersion of various economic activities over space.

Table III.2.1

COMMODITY WISE AVERAGE WEIGHT, STANDARD DEVIATION AND COEFFICIENT OF VARIATION

S. No.	Commodity Group	Average wt. (000 Qtn.) Orig./Term.		Standard Deviation Orig./Term.		Coefficient of variation Orig./Term.		Index of spatial dist.
1.	FP	647		1047	687	1.62	1.66	0.976
2.	MNFP	1335		5185	5199	3.88	3.89	0.997
3.	FUEL	2384		14427	6937	6.05	2.90	2.086
4.	IA	410		9006	2945	4.33	2.18	1.986
5.	CM	429		1269	743	2.96	1.73	1.711
6.	IP	387		1879	1173	4.86	3.03	1.604
7.	MISC	200		598	502	2.99	2.51	1.191

III.7.4 Coefficient of variation of shipments and receipts will indicate the forward spatial links generated by each commodity. Index of forward spatial distribution has been worked out by using the two coefficients of variation for each commodity.[3] The spatial distribution of a commodity with high value of the index will be more dispersed as compared with commodities with a low value. This is illustrated by inputs into agriculture and coal as well as fuel have high indices of spatial distribution as these commodities originate from a relatively small number of areas and are received at a much larger number of centres.

III.7.5 Index of spatial distribution in the case of food products and raw materials from primary sources show that these commodities originate from a large number of places and are received at a smaller number of places. In the case of food products it is quite possible that these are further distributed through the road network. Since all the steel plants receive ore from a large hinterland, the index happens to be less than 1 for raw materials.

---

3. Index of forward spatial distribution =

$$\frac{C.V.\ (O)}{C.V.\ (R)}$$

C.V. (O) = C.V. for Shipments
C.V. (R) = C.V. for Receipts

III.7.6 High values of coefficient of variations suggest that marked regional variations exist in shipments and receipts of various commodities. Since C.V. does not give any idea about the shape of the distribution curve, it was decided to use the techniques of lorenz curve analysis,[4] so that the relative dominance of top ranking areas could be identified. Ginni coefficients have also been worked out for shipments and receipts of various commodities. A comparison of Ginni coefficient for shipment and receipts gives an idea about the extent of concentration or diversification of each in relation to each other.

III.7.7 In order to draw the Lorenz curves, all the observations were arranged in descending order and the relative contribution of each district was found in the total freight of that commodity. Lorenz curve was drawn by taking % freight (cumulative) on X axis and the corresponding value of % districts (cumulative) on Y axis. Lorenz curves for both shipments and receipts for each commodity have been drawn on the same graph so that their relative

---

4. Lorenz curve distribution is a very useful analytical technique to measure the concentration of a particular variable. A line at 45 degrees from the origin is called the line of equal distribution. A curve passing near the diagnol line shows less skewed distribution than the one far away from the diagnol line. The value of Ginni coefficient which is used as a measure of inequality is found by taking the ratio of area under the curve to the total area in the traingle in which the curve falls. The value of Ginni Co-efficient will very from 0 to 1 depending upon the nature of distribution. The extent of inequality increases as the ratio moves from 0 to 1.

TABLE NO. III.3.1

COMMODITY-WISE DISTRIBUTION OF ORIGINATING FREIGHT

Cumulative percent of Districts	Cumulative percent of Freight							
	FP	RM	COAL	IA	CM	IP	MISC	TOTAL FREIGHT
1	2	3	4	5	6	7	8	9
2	22.05	55.01	70.74	61.74	36.42	67.66	35.30	33.86
5	40.29	71.09	88.48	75.79	62.00	79.98	49.09	53.50
10	57.23	80.81	98.41	85.33	85.44	87.65	63.96	71.41
15	67.43	86.13	99.25	89.33	93.47	92.06	73.18	78.98
20	75.17	89.62	99.58	92.22	96.84	94.96	79.96	85.13
25	80.84	92.41	99.75	94.27	98.23	96.71	85.07	88.19
30	85.14	94.25	99.85	95.58	98.93	97.64	89.00	90.99
35	88.52	95.59	99.91	96.58	99.32	98.23	91.99	92.96
40	91.40	96.73	99.95	97.47	99.58	98.74	94.39	93.68
45	93.76	97.60	99.97	98.25	99.74	99.10	96.08	95.22
51	95.86	98.42	99.98	98.87	99.86	99.41	97.42	96.71
60	98.06	99.27	99.99	99.45	99.95	99.72	98.69	98.24
70	99.41	99.78	100.00	99.82	99.99	99.90	99.51	99.31
75	99.73	99.89	100.00	99.92	100.00	99.95	99.73	99.62
80	99.92	99.97	100.00	99.97	100.00	99.98	99.88	99.85
90	100.00	100.00	100.00	100.00	100.00	100.00	99.99	99.99
100	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

FP = Food products
COAL = Coal and other fuels
CM = Construction materials
MISC = Miscellaneous

RM = Raw materials for primary sources
IA = Inputs into agriculture
IP = Industrial products

TABLE NO. III.3.2

COMMODITY-WISE DISTRIBUTION OF TERMINATING FREIGHT

Cumulative percent of Districts	Cumulative percent of Freight							
	FP	RM	COAL	IA	CM	IP	MISC	TOTAL FREIGHT
1	2	3	4	5	6	7	8	9
2	25.91	54.52	34.75	50.19	21.17	36.48	31.63	28.49
5	50.84	74.93	57.59	58.31	34.56	54.70	47.87	50.88
10	51.82	83.17	73.21	37.00	48.34	69.76	64.70	64.60
15	61.17	87.80	80.39	73.11	57.03	78.46	73.24	73.82
20	69.12	91.02	85.35	78.48	64.67	83.97	80.12	78.11
25	75.42	93.12	89.47	82.90	70.89	87.58	85.16	82.58
30	80.38	94.69	92.52	86.55	76.24	90.30	88.72	85.94
35	64.22	95.88	94.47	89.36	80.62	92.37	91.32	88.62
40	87.62	96.91	96.07	91.83	84.55	94.17	93.53	91.06
45	90.47	97.75	97.26	93.81	87.86	95.66	95.26	93.07
51	93.11	98.53	98.35	95.66	91.16	96.96	96.73	95.03
60	96.04	99.30	99.35	97.68	94.95	98.29	98.23	97.24
70	98.26	99.77	99.85	99.14	97.85	99.28	99.30	98.93
75	99.05	99.89	99.93	99.56	98.77	99.60	99.60	99.43
80	99.66	99.96	99.98	99.82	99.47	99.84	99.84	99.75
90	100.00	100.00	100.00	100.00	99.99	99.99	99.99	99.91
100	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

FP = Food products
RM = Raw materials for primary sources
COAL = Coal and other fuels
IA = Inputs into agriculture
CM = Construction materials
IP = Industrial products
MISC = Miscellaneous

positions may be compared.

III.7.8 Table III.3.1 and III.3.2 show the commodity wise distribution of per cent freight (cumulative) and the corresponding share of districts (cumulative) both for shipments and receipts respectively. Lorenz curves for shipments and receipts of each commodity and for the total freight are shown in figure III.3.1 and III.3.2.

III.7.9 The nature of Lorenz curve for each commodity group is quite different from that for the other commodities. Even within the same commodity group, there are wide variations in the distribution of shipments and receipts. The value of Gini co-efficient for each commodity group both for shipments and receipts have been presented in Table III.3.3 below.

Table III.3.3

GINNI CO-EFFICIENTS FOR ORIGINATING AND TERMINATING FREIGHT

S. No.	Commodity Group	Ginni Coefficient	
		Originating	Terminating
1.	Food Products	.72	.68
2.	Raw Materials from Primary Source	.86	.87
3.	Coal and Fuels	.95	.82
4.	Inputs into Agriculture	.89	.82
5.	Construction Material	.90	.63
6.	Industrial Products	.91	.81
7.	Miscellaneous	.82	.81
8.	All Commodities (Total Freight)	.80	.76

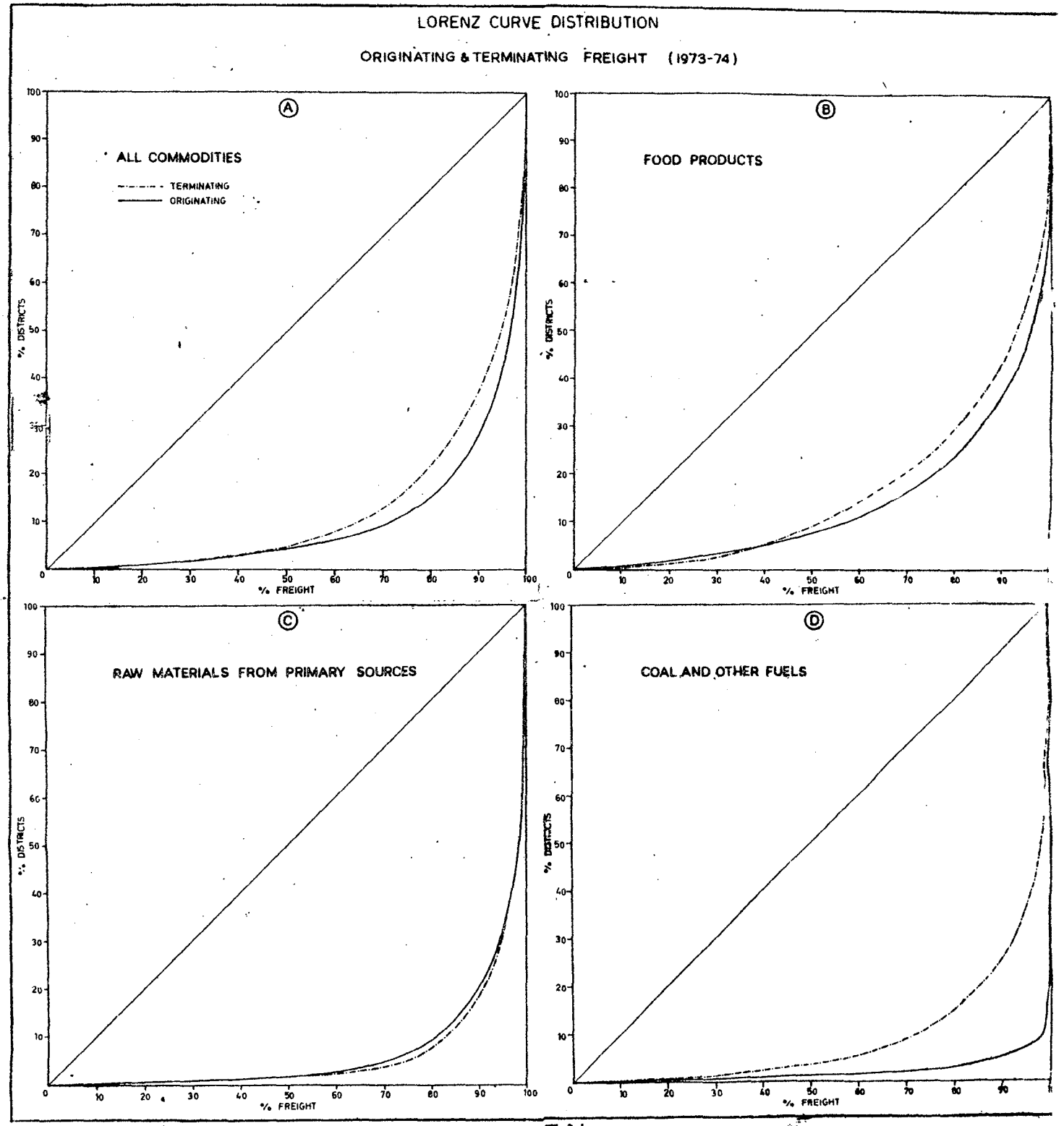

LORENZ CURVE DISTRIBUTION
ORIGINATING & TERMINATING FREIGHT (1973-74)
A
ALL COMMODITIES
TERMINATING
ORIGINATING
B
FOOD PRODUCTS
C
RAW MATERIALS FROM PRIMARY SOURCES
D
COAL AND OTHER FUELS
% DISTRICTS
% FREIGHT

Fig III 3·1

LORENZ CURVE DISTRIBUTION

ORIGINATING & TERMINATING FREIGHT (1973-74)

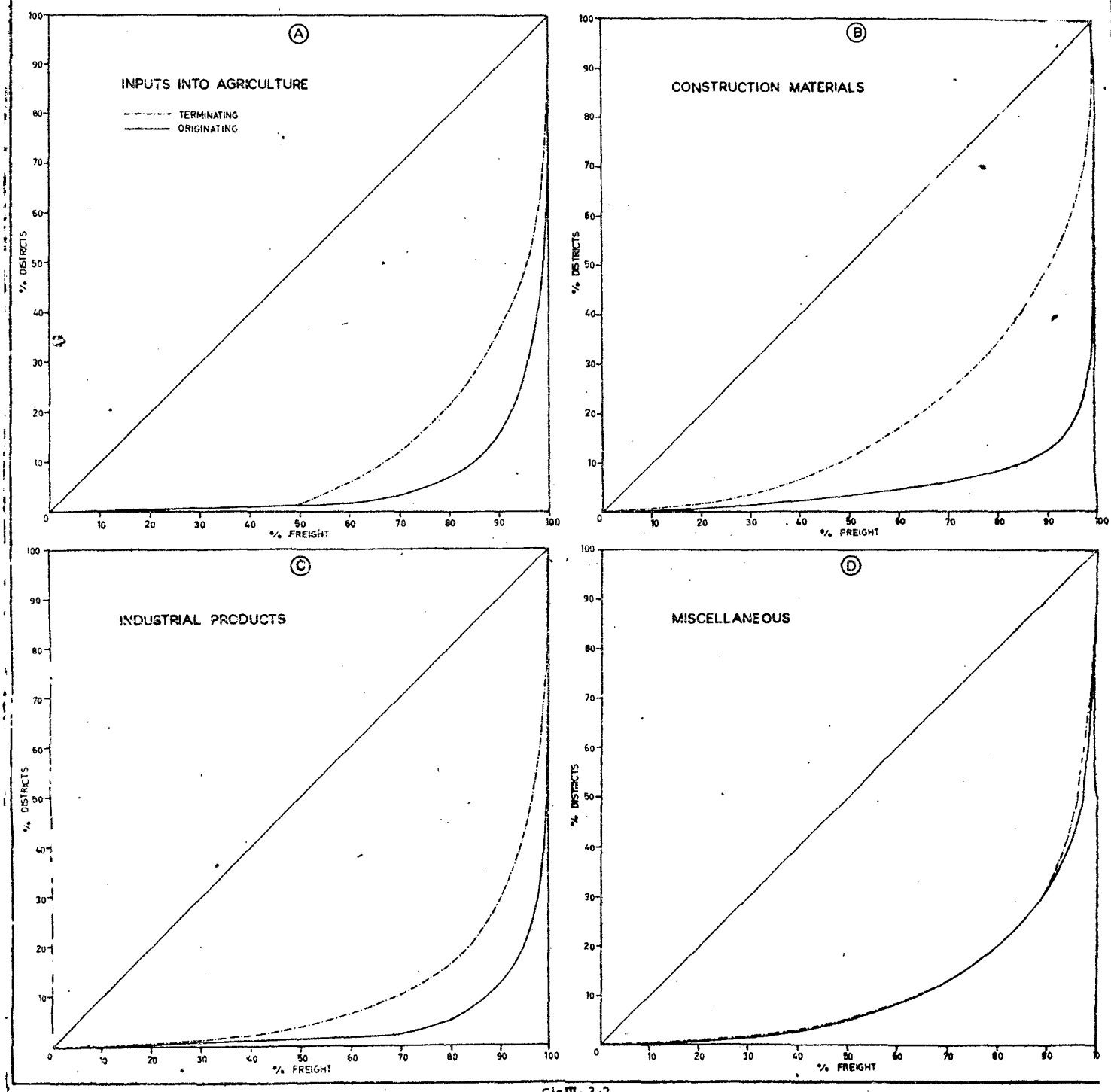


Fig III · 3·2

III.7.10 The distribution pattern of total freight is highly skewed (Ref. Fig. III.3.1 (A)). Very high value of Ginni Coefficients show the dominance of a relatively few areas in shipments and receipts. Stop ranking districts account for 35 per cent of shipment and 31 per cent of receipts of the total freight. At the end are 100 districts, which originate only 0.50 per cent and receive only 0.70 per cent of the total freight. The spatial distribution of total shipment and receipts has already been discussed in III.4 and III.5. Since the commodity composition of the total freight show high dominance of raw materials and fuels, it was decided to shift the focus to individual commodities.

III.7.11 In all the commodities except raw materials from primary sources, the distribution of shipments is more skewed than the distribution of receipts. In the case of raw materials from primary sources it is the other way round i.e., the concentration is high in terminating freight because receipts are more skewed than the distribution of shipments. The inequalities are more in the receipts because there are only a few places, where basic metal manufacturing plants are located and their basic inputs like ores, which fall in the category of raw materials from primary resources, come from their immediate hinterlands, and these hinterlands are of fairly large size.

This leads to a slightly higher concentration in the case of receiving as compared to originating freight from raw materials from primary resources. The Ginni coefficient for the originating freight is .86 as compared to .87 for terminating freight. Thus, as expected, the processing of bulky raw materials can be done efficiently near their extraction points. This type of inequality is not undesirable.

III.7.12 The Lorenz curve distribution for food products is shown in Fig. III.3.1 (B). Initially, the distribution of receipts is more skewed than the shipments but later the distribution of shipments becomes more skewed. There are 7 districts which receive more than 25 per cent of the total food products. This clearly shows that there exist some areas, which are highly deficit in food and their requirements are much more than what the highest 7 export districts can spare. The high demand for food products is mainly generated by the metropole districts of Calcutta, Bombay, Delhi, Madras, Bangalore and Hyderabad.

III.7.13 The lowest 135 districts are shipping only 2% and receiving as 4% of the total movement in food products. The values of Ginni co-efficients are .72 and .68 for shipments and receipts respectively.

III.7.14 In the case of coal and fuel, the distortions in the shipments are of an extreme order. There are four

districts namely Dhanbad, Burdwan, Hazaribagh and Surguja, which taken together account for nearly 60% of the total originating freight in coal and other fuels. This shows the extent of the dependence of the remaining areas on these for their fuel requirements. However, one would expect generally even distribution of fuels in terms of receipts, since almost every region requires coal and diesel. But the demand for coal and other fuels is also highly skewed. The major users of coal and other fuel are steel plants, thermal power houses and Indian railways. These taken together account for nearly 60 per cent of the total demand for coal. The value of Ginni co-efficient for originating freight is 0.95 and for terminating freight it is 0.82. The lowest 135 districts taken together receive only .65 per cent of the total originating freight. III.7.15 In the case of inputs into agriculture, the value of Ginni co-efficient for originating freight is .89, which shows a very high level of inequality. High level of imports and the transhipment activities of the port towns has led to a high concentration in the originating freight. It may noted, for example, that nearly 46 per cent of total fertilizer requirement was met by imports in 1973-74. The distribution of terminating freight for inputs into agriculture is less skewed as compared to the originating freight. But still the lowest 135 districts are

accounting for only 2.5 per cent of the total freight. This clearly shows that the use of fertilizers is restricted to a small area only. The areas which mainly use fertilizers and other agricultural inputs are the green revolution areas of Punjab, Haryana and Andhra Pradesh. However, the development of agricultural sector and adoption of modern farming practices may result in reducing the concentration ratio of the receipts of inputs into agriculture.

III.7.16 The Ginni coefficient for terminating traffic is lowest in the case of construction materials, which mainly includes cement. This shows that the consumption of cement is more equitably distributed than any other commodity. As far as originating freight is concerned the value of Ginni coefficient is .90, which shows that the location of manufacturing plants is highly concentrated in space whereas the distribution pattern is diversified.

III.7.17 Industrial products also show high inequality in the distribution of originating and terminating freight and the corresponding values of Ginni coefficients are .91 and .81 respectively. Thus there is not much difference in the concentration of shipments and receipts. It has also been found that high shipment areas are also high receipt areas. This shows that the activities related to

the industrial sector are concentrated only at a few centres. The first six top ranking districts are accounting for 34% of the total terminating freight in industrial products. The high receipt districts are Calcutta, Bombay, Delhi, Madras, Ahmedabad and Durgapur.

III.7.18 There is practically no difference in the distribution pattern of originating and terminating for miscellaneous commodities. However, the top ranking districts in originating as well as terminating freight are all industrial districts. This suggests that the behaviour of the miscellaneous commodities is very similar to that of industrial products. This fact has also been corroborated by the analysis that follows in the succeeding chapter.

III.8.1 The above analysis has thus shown that the spatial pattern of inter-regional trade is highly skewed in all the major commodity groups. Production centres are relatively more concentrated in space as compared to the consumption centres. This is evident from the fact that the distribution of the originating freight is more skewed as compared to the distribution of the receipts. The skewed spatial distribution of certain commodities in the production and distribution process can be a healthy sign of modernisation and industrial development especially when the location of natural resources,

economies of scale and technological constraints of the production process warrant the location of the industries at some specific points in space. Ores, mineral oils, and other basic metal ores are expected to have very highly skewed distribution both in originating and terminating freight in view of their locational considerations. However, the highly skewed distribution of commodities like iron and steel, cement, fertilizers and other industrial products show the disparities that exist between the few top consumers and the remaining areas of the economic system. High values of Ginni coefficients for shipments and receipts of these products are an indication of the unbalanced regional development and the extent of regional disparities. Wide regional disparities have been observed in the production and consumption processes inspite of the fact that the balanced regional development has been one of the major objectives of Indian planning.

CHAPTER IV

COMMODITY FLOW INTERRELATIONSHIPS: AREAL SPECIALIZATION AND LEVELS OF ECONOMIC DEVELOPMENT

IV.1 Economic Development and Commodity Flow Inter-relationships

IV.1.1 The inter-regional movement of various commodities is a highly interrelated phenomenon, which is mainly determined by the location of economic activities in space. An attempt has been made in this chapter to capture the inter-relationships between the movement of various commodities in space and its relationship with the level of economic development of various regions. Within an economic system, the movement of one commodity is related to the movement of others. For example, raw materials and fuel are complementary to each other and terminate at similar places. Areas specializing in industrial activity are usually deficit in food products and receive food products along with raw materials and fuels. Thus the receipt pattern of these commodities will be similar to each other. The dissimilarities in the originating freight are the consequence of varying production specialization of different types of areas. It is expected that industrial products will move out from the areas which receive raw materials and fuels, thus showing an inverse type of relationship between their movement.

IV.1.2 Locational pattern of industries in space is the major factor influencing the inter-relationships between the movement of various commodities forming inputs into and output of various industries. In the agricultural sector also, inter-relationship exists. The movement of agricultural and industrial commodities is also related to each other. Areas specialising in food production should receive inputs into agricultural and industrial products. Thus the movement of various commodities is an interrelated phenomenon since the movement of one commodity leads to a chain of movement of other commodities, some in the same and the others in the opposite direction.

IV.1.3 The type of inter-relationships as envisaged above will be disturbed to some extent by the international trade of the country, where the movement in one direction cannot be related to the movement in the other. In the case of international trade, port transplay a significant role as transhipment points for export from and imports into the country. The amount of disturbance will vary from commodity to commodity. The overall impact will be negligible as long as the volume of international trade is insignificant as compared to inter-regional trade. In the opposite case, there would be a high order disturbance in the inter-relationships between the movement of various commodities.

IV.1.4 In order to capture the inter-relationships between the movement of various commodities, the techniques of correlation coefficient and factor analysis have been used, wherein weights are determined so that the sum of squares of correlation coefficients are minimized for a given set of variables. Areas forming belts, clusters and nodes of various type of economic activities have been identified and their relationship with the levels of economic development studied.

IV.2 Commodity Flow Inter-relationships: A Quantitive Analysis

IV.2.1 In order to identify similarities and dissimilarities in the originating and terminating freight of various commodities a correlation matrix was obtained for 14 variables. Each commodity group has been treated as a separate variable. Thus there are 7 variables for originating freight and another 7 variables for terminating freight. There are thus 14 variables pertaining to originating and terminating freight taken together. The (14x14) correlation matrix is presented in Table IV.1.1.

IV.2.2 Originating flows of food products have negative correlation with the originating flows of raw materials from primary sources as well as of coal and other fuel, construction materials and industrial products. This clearly brings out the nature of the general relationship between agricultural and industrial flow patterns of originating freight.

TABLE NO. IV.1.1

CORRELATION MATRIX OF ORIGINATING AND TERMINATING FREIGHT FOR EACH COMMODITY GROUP

		ORIGINATING							TERMINATING						
		FP	RM	COAL	IA	CM	IP	MISC	FP	RM	COAL	IA	CM	IP	MISC
OR	FP	1.000													
IG	RM	- .005	1.000												
IN	COAL	- .023	.018	1.000											
AT	IA	.043	.006	.038	1.000										
IN	CM	- .013	.205	.087	.046	1.000									
G	IP	- .038	.575	.421	.076	.188	1.000								
	MISC	.074	.074	.217	.167	.335	.372	1.000							
TE	FP	.111	.061	.169	.002	.045	.117	.237	1.000						
RM	RM	.060	.465	.354	.093	.198	.817	.296	.145	1.000					
IN	COAL	.007	.295	.469	.041	.152	.623	.266	.262	.540	1.000				
AT	IA	.057	.057	.006	.022	.024	.037	.108	-.001	.060	-.007	1.000			
IN	CM	.137	.081	.230	.160	.165	.469	.656	.284	.459	.465	.081	1.000		
G	IP	.065	.097	.218	.160	.205	.541	.705	.193	.484	.445	.089	.919	1.000	
	MISC	.080	.207	.193	.167	.311	.611	.765	.210	.564	.458	.098	.859	.875	1.000

FP = Food products
RM = Raw materials from primary sources
COAL = Coal and other fuels
IA = Inputs into agriculture
CM = Construction materials
IP = Industrial products
MISC = Miscellaneous

IV.2.3 A week positive correlation also exists between the originating freight of food products on the one hand and of inputs into agriculture on the other. This may be partly explained by the fact that all the imported foodgrains and fertilisers originate from the same port districts. It may be noted that nearly 46% of the total requirements of fertilisers were met by the imports during 1973-74;[1] and that the import of foodgrains totalled to 3.6 million tonnes during the same period.[2] This can also be explained to some extent by the fact that some of the fertilisers plants are located in the areas with high agricultural output potential.[3]

IV.2.4 The following analysis shows that because of high transport costs the industries for the first round processing of ores and other primary materials into metal and cement etc., are efficiently located in space. Originating freight of raw materials from primary sources has significantly high correlation with the originating freight of industrial products and construction materials, thereby showing their common origin. Thus industrial

---

1. Fertiliser Association of India, Fertiliser Statistics of India 1973-74, New Delhi.

2. Govt. of India, Central Statistical Organisation, Economic surveys for various years.

3. Large fertiliser plants are located in Punjab, Gujarat, Andhra Pradesh, and Western U.P.

products and construction materials mainly originate from the areas which are resource rich in terms of ores and limestone.

IV.2.5 For the originating freight, industrial products also have high correlation with coal and other fuels. This shows that industrial products (which mainly includes Iron and Steel) are being manufactured mainly in the areas where raw materials (ores) and coal and other fuels are easily available. The fact that the correlation between coal and fuels and construction material is small, shows that the construction material are mainly manufactured away from the coal and fuel producing centres and the plants are situated in the areas where raw materials from primary sources are readily available.

IV.2.6 Thus the correlation matrix has clearly brought out the relationship between location of the plants for manufacturing industrial products and construction material vis-a-vis their sources of basic inputs. A thorough investigation in this area may lead to more meaningful results about the efficiency in the location of manufacturing industries in space.

IV.2.7 The flow patterns of miscellaneous commodities are quite similar to those of industrial products. The originating freight of miscellaneous commodities has a

significantly high correlation with industrial products and construction material. This shows that these commodities mainly originate from areas from where industrial products and construction material originate. All the movements covered under the defence of India rules and meant for defence purposes, have been classified under the miscellaneous category, and commodities like cement, iron and steel, machinery and industrial products meant for defence use originate from these areas.

IV.2.8 In the case of terminating freight for miscellaneous commodities, the highest correlation has been observed with the terminating freight of industrial products and construction materials. This clearly shows that the flow patterns of miscellaneous commodities are quite similar to that of industrial products and construction materials; and this also reflects the nature of commodities constituting the miscellaneous commodities group. Movements of raw materials and fuels over short distances leads to intra-district flows of bulk commodities and is shown by a significantly high correlation between the originating and terminating freight of the raw materials from primary sources and fuels. Dominance of a few regions in inter-regional trade of industrial products is clearly brought out by a significantly high correlation between the originating and terminating freight of industrial products.

IV.2.9 Input-output type of relationship between raw materials and fuels as inputs and industrial products as output is established by the high correlation between the receipts of raw materials and fuels on the one hand and of the shipments of industrial products on the other. It has also been noted that areas which receive industrial products also receive construction material, fuels and raw materials and is evident from the inter-correlations between the movement of these commodities. Areas specializing in the production of fuels are generally backward in agriculture and depend upon other regions for their food requirements. This is indicated by the significantly high correlation between receipts of food products and shipment of fuels and raw materials. The freight characterization of the various commodities and inter-relationships in their movement pattern have been brought out in the above analysis. It has also shown that dominant primary and resource-based manufacturing activities are efficiently located in space.

IV.3.1 Yet another meaningful dimension of the commodity flow patterns pertains to the spatial distribution of areas with similar characteristics. For this purpose the broad developmental indices were computed and correlated with indices of transport flows.

IV.3.2 In order to identify spatial clusters showing identical behaviour in terms of originating and terminating freight, a number of factor analysis programmes were run. The results of the factor analysis were quite encouraging and it was discovered that the similarities in the terminating freight patterns are more pronounced than in the case of originating freight. The results are discussed below:

IV. 4 Commodity Flow Characteristics and Areal Specialisation (Shipments)

IV.4.1 Originating freight for all the seven commodity groups was analysed by factor analysis in order to study the relationships between various combinations of these variables. Three Eigen values were obtained. All the three Eigen values taken together were able to account for 60 per cent of the total variation in the data. Corresponding to these three Eigen values, three factor loadings were obtained. The Eigen values, and the corresponding factor loading are presented in Table IV.2.1. More than 29 per cent of the variation has been explained by the first factor only. The examination of the corresponding value of factor loading for each variable shows that, except for food products and inputs into agriculture, all other commodity groups have high factor loading i.e. greater than .50. The first factor may therefore be considered

TABLE IV.2.1

FACTOR LOADINGS-SHIPMENTS

(All Commodities)

Eigen values	2.04566	1.13417	1.02079
Cumilative percentage of Eigen values	0.29224	0.45426	0.60009

FACTOR LOADINGS:

S.No.	Variable	Ist Factor	IInd Factor	III Factor
1.	Food products	.00296	.50507	-.42360
2.	Raw materials from primary sources	.57044	-.50069	-.48403
3.	Coal and fuels	.55151	.02343	.68788
4.	Inputs into agriculture	.20951	.59612	.02662
5.	Construction materials	.52336	.14109	-.35312
6.	Industrial products	.83534	-.25124	.08819
7.	Miscellaneous commodities	.64973	.43526	.02664

to represent industrial activity. Thus all the high factor scores corresponding to the first factor will represent the dominance of industrial freight. The second factor, which is able to explain about 16% of the total variation, has high positive loadings for food products and inputs into agriculture. Thus the second factor represents the dominance of agricultural activity. The third factor explains about 15% of the total variations and the high positive loading corresponds to coal and other fuel group. Thus the third factor shows the dominance of fuel producing areas in the originating freight.

IV.4.2 In the light of the above, three significant groups of shippers may be identified on the basis of originating freight. These are:

i) areas specialising in the shipments of industrial products (1st Factor);

ii) areas specialising in the shipments of agricultural products (2nd Factor); and

iii) areas specialising in the shipments of coal and other fuels (3rd Factor).

Factor scores have been obtained for each group by using the factor loadings given in Table IV.2.1. The values of factor scores for each group are shown in appendix IV. The ranking of factor scores for a particular factor loading matrix shows the relative dominance of each district in that group. Factor scores for all the three groups have

been ranked and a frequency distribution curve was obtained to identify the cut-off points. For each dominant group the scores corresponding to each category have been plotted on different maps.

IV.5 Areal Specialisation of Industrial Activity (Shipments)

IV.5.1 Factor scores of the first factor (Industrial group) have been plotted on a map (Refer fig. IV.1.1).[4] The relative dominance of metropolitan towns like Bombay, Calcutta, Madras and Delhi has been clearly brought out. The level of industrial activity in terms of originating freight varies from one metropole to other. Bombay has the highest score (15.09) followed by industrial districts like Burdwan, Durg, Singhbhum and Dhanbad which specialise in first round processing of bulk commodities like coal and ores. These areas from a group having a very high level of activity.

IV.5.2 In terms of shipments of industrial products, Calcutta is in the high level of activity group. There are

---

4. Cut-off points were obtained by the frequency distribution curve and the following classification was obtained.

Factor Scores	Level of Activity
0	Very low
0 - 1.99	Low
2.00 - 3.99	Medium
4.00 - 7.99	High
8.00 and above	Very high

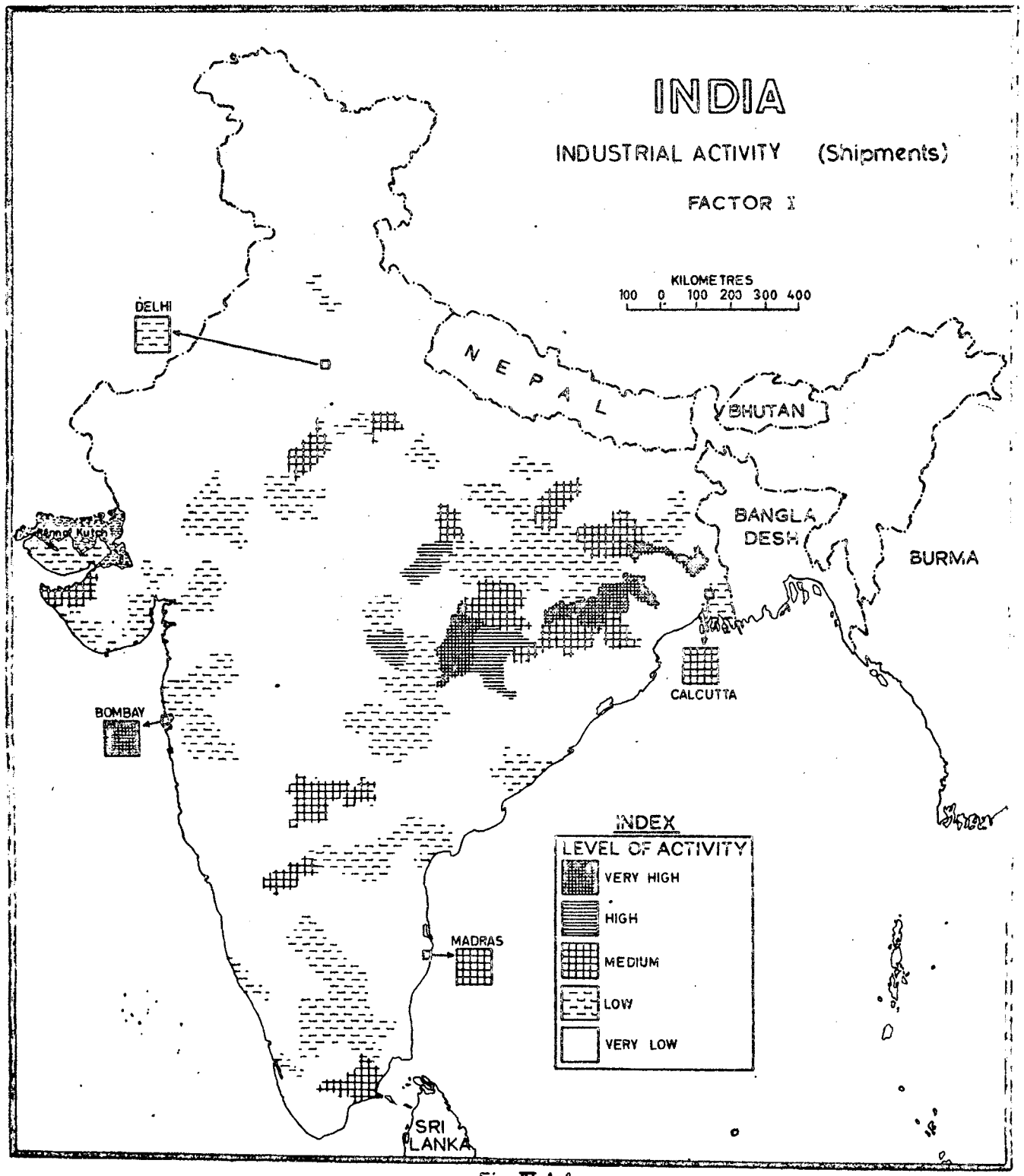

INDIA
INDUSTRIAL ACTIVITY (Shipments)
FACTOR I
KILOMETRES
100 0 100 200 300 400
DELHI
NEPAL
BHUTAN
BANGLA DESH
BURMA
CALCUTTA
BOMBAY
MADRAS
SRI LANKA
INDEX
LEVEL OF ACTIVITY
VERY HIGH
HIGH
MEDIUM
LOW
VERY LOW

Fig. IV·1·1

14 districts having medium level of activity. These are Hyderabad (A.P.), Shahabad (Bihar), Jamnagar (Gujarat), Bilaspur (M.P.), Hazaribagh (Bihar), Sambalpur (Orissa) and Madras (T.N.). All these areas specialise in one or the other type of industrial activity. Mainly cement and industrial products are shipped from these areas. Delhi falls far below as compared to Bombay, Calcutta and Madras. Its rank is very low in the originating traffic of industrial activity. Areas with low level of activity are fairly scattered all over India.

IV.5.3 Well defined spatial clusters corresponding to different types of industrial activities have been clearly brought out in fig. IV.1.1. It is interesting to note that all clusters specialise in different type of industrial activities. It is possible to classify these clusters into three different categories; namely

i) spatial clusters of industrial activity around mining areas;

ii) spatial clusters of industrial activity around principal port towns; and

iii) other nodes of industrial activity.

From the above analysis, the following points emerge:

i) The most dominant cluster being the mining, heavy and basic industrial areas of West Bengal, Orissa, Madhya Pradesh and Bihar;

ii) Bombay, Pune, Thana and Nasik industrial belt is also well marked and is clustered around the port town of Bombay;

iii) Ahmedabad, Baroda and Bhavnagar constitute one cluster specialising in cotton textiles, industrial products and petrochemicals;

iv) Bangalore, Tumkur, Salem, Coimbatore, Trichurelli and Ramanathpuram constitute another industrial belt specialising in the manufacture of construction material and industrial products; and

v) in addition to the above, some nodes like Delhi, Agra and Kanpur also emerge as important centres of industrial activities.

IV.5.4 Thus the dominance of Bengal, Bihar industrial belt has been clearly brought out. A number of other spatial clusters and nodes with varying level of industrial activity have also been identified on the basis of shipments.

IV.6 Areal Specialisation of Agriculture Oriented Activity (Shipments)

IV.6.1 Agricultural activities include food products and inputs into agriculture like fertilisers. The dominance of agriculture oriented activities in the originating freight has been clearly brought by the factor loadings

corresponding to the second factor, which is able to explain about 16% of the total variation (refer Table IV.2.1). Since the factor loadings for both food products and inputs into agriculture exceed .50, the dominance of various districts in these activities will be clearly brought out by their respective factor scores. (For factor scores, refer Col. 4 of appendix IV). Two type of regions dominate in agricultural oriented activities and these are:

i) port towns from where high import of foodgrains and fertilizer has taken place; and

ii) agriculturally advanced areas specializing in the production of one or more crops.

IV.6.2 Factor scores of the second factor representing agricultural activities for each district have been plotted on a map (refer fig. IV. 1.2).[5] The port districts of Bombay, Vishakhapatnam and Kandla, have very high positive scores (greater than 3.00) and thus show their dominance in the originating freight for agriculture oriented

---

5. Cut off points were identified from the frequency distribution and the following classification was obtained:

Factor Scores	Level of Activity
< 0	Very low
0 - .99	Low
1.00 - 1.99	Medium
2.00 - 2.99	High
3.00 & above	Very high

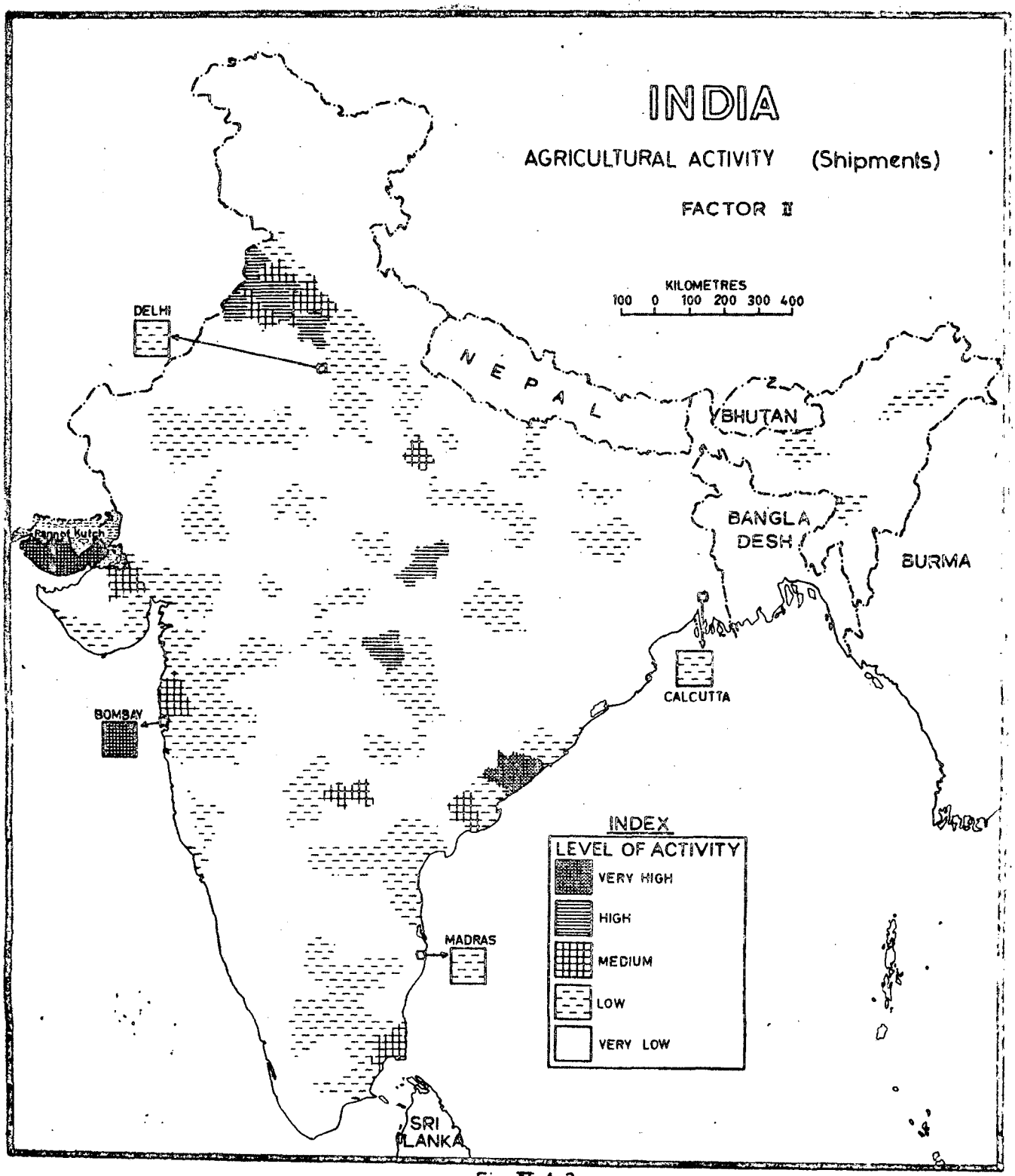

INDIA
AGRICULTURAL ACTIVITY (Shipments)
FACTOR II
KILOMETRES
100 0 100 200 300 400
DELHI
NEPAL
BHUTAN
BANGLA DESH
BURMA
CALCUTTA
BOMBAY
MADRAS
SRI LANKA
INDEX
LEVEL OF ACTIVITY
VERY HIGH
HIGH
MEDIUM
LOW
VERY LOW

Fig. IV·1·2

commodities. Though these areas are not major producers of agricultural products, yet these happen to occupy dominant position because of high imports of fertilisers and foodgrains. All the imported foodgrains and fertilisers are originating from these points for inland movement to their destinations; and, hence, these centres get high scores.

IV.6.3 Ludhiana, Ferozepur, Amritsar, Sangrur and Karnal districts of agriculturally advanced states of Punjab and Haryana, have very high level of agricultural activity. These are all high surplus areas in foodgrains especially in wheat. Many other districts of Punjab and Haryana have medium level of agricultural activity. These are Ambala, Jullunder, Bhatinda and Patiala. The deficit areas of Bengal and Bihar mainly depend upon these areas for their food requirement.

IV.6.4 While wheat is the most important crop in Punjab and Haryana, cotton, bajra and groundnut are the major crops in Bombay, Puna and Ahmedabad. Whereas rice is the dominant crop in Tamil Nadu and the coastal districts of Andhra Pradesh. In Jodhpur, and Sawai Madhopur districts bajra happens to occupy that position. Thus different cluster as identified in fig. IV.1.2 show the dominance of various crops in various regions.

IV.7 Areal Specialisation of Coal and Fuel (Shipments)

IV.7.1 The third factor loading vector corresponds to the dominance of shipments in coal and other fuels (Factor loading = 0.69). The corresponding value of factor scores for each district is shown in col. 5 of appendix IV. The dominant areas in the shipments of coal and other fuels (including petrol and diesel) are Burdwan, Dhanbad, Hazaribagh, Panchmahals, Baroda, Shahdol, Chindwara and Sarguja. All these districts have factor scores which exceed +1. These are mainly either coal producing areas or sites of petro-chemical complexes and account for more than 72% of the total originating freight in coal and fuel group. Districts falling in this group have been shown in fig. IV.1.3.

IV.8 Commodity Flow Characterisation and Areal Specialisation (Receipts)

IV.8.1 Terminating freight for all the seven commodities was analysed by factor analysis in a way similar to the one discussed earlier in this chapter (refer section IV.3). In the first exercise, two Eigen values were obtained; and total explanatory power of the Eigen values was 66 per cent. Corresponding to the two Eigen values, a matrix of two factor loadings was obtained (for details refer Table IV.2.2). The factor loadings for all other commodities except food

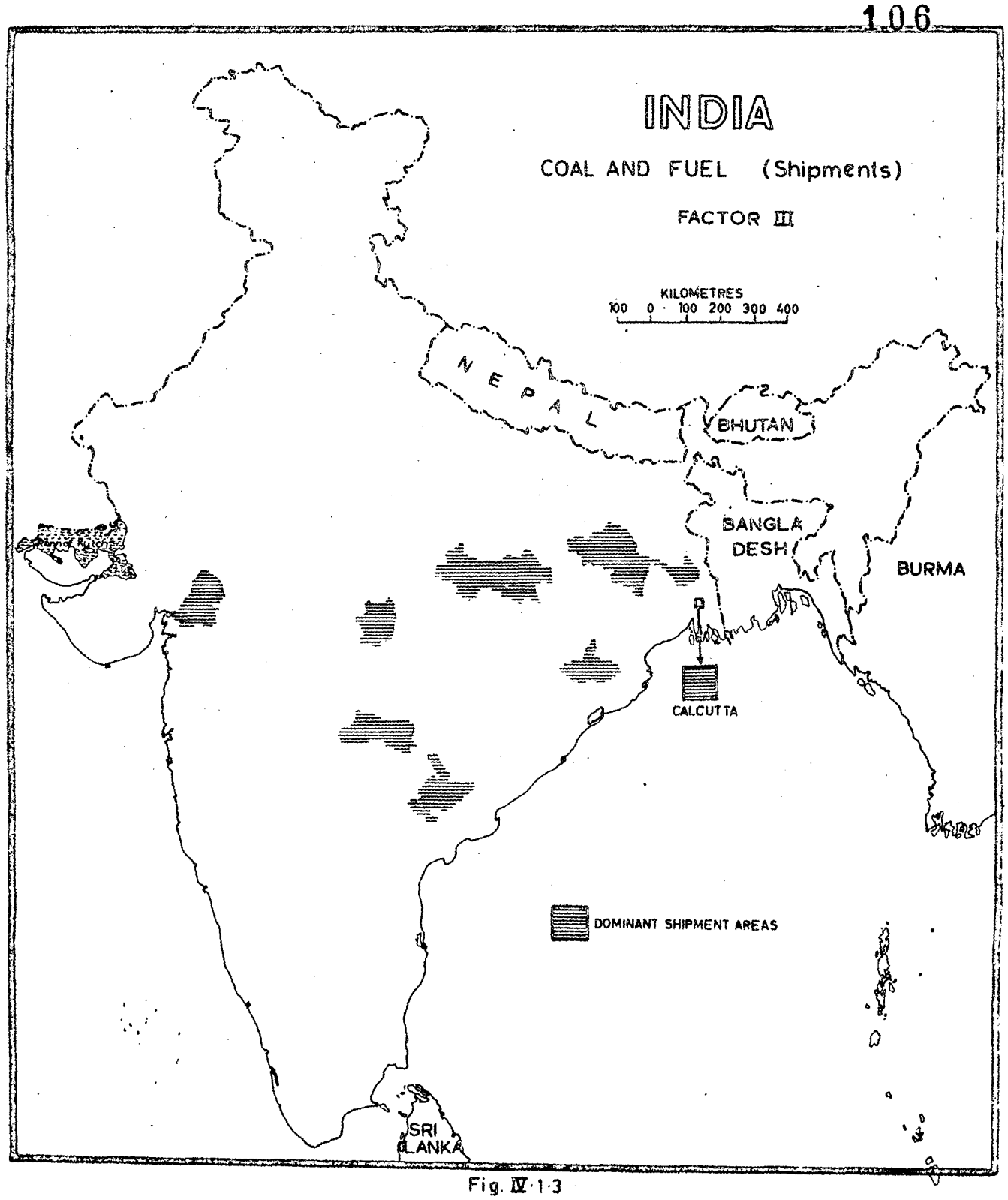

INDIA
COAL AND FUEL (Shipments)
FACTOR III
KILOMETRES
100 0 100 200 300 400
NEPAL
BHUTAN
BANGLA DESH
BURMA
CALCUTTA
DOMINANT SHIPMENT AREAS
SRI LANKA

Fig. IV·1·3

TABLE IV.2.2

FACTOR LOADINGS:- RECEIPTS

(All Commodities)

Eigen values	3.58259	1.02471
Cumulative percentage of Eigen values	.51180	.65819

FACTOR LOADINGS

S.No.	Variable	Ist Factor	IInd Factor
1.	Food products	.35009	-.44990
2.	Raw materials from primary sources	.69632	-.05709
3.	Coal and fuels	.66819	-.25092
4.	Inputs into agriculture	.11381	.85196
5.	Construction materials	.91616	.06490
6.	Industrial products	.91347	.12031
7.	Miscellaneous commodities	.91758	.10745

products and inputs into agriculture were found to be greater than 0.50 for the first factor matrix. It may also be noted that the first factor has no negative loadings. Non-negative values of loadings show that the terminating freight is an increasing function of all indicators. The first factor is able to explain about 51 per cent of the total variation, while the second factor explains only 15 per cent of variations. The factor loadings for the second factor show that inputs into agriculture have a very high weight as compared to other commodities, while food products have negative loading or weight.

IV.8.2 Since the areas which receive food also receive very large volume of raw materials, fuels, construction materials and industrial products, separate group of districts could not be identified for food products. In order to improve the results further, it was decided to drop food products and inputs into agriculture altogether and the exercise was repeated with the remaining five variables only. With 5 variables comprising industrial activities, one Eigen value and hence only one set of factor loadings was obtained.

IV.8.3 The explanatory power of the first factor has now increased from 51 per cent to 70 per cent. Since, we have now got only one factor, the corresponding factor scores for each districts will act as a composite index

for receipt pattern and hence more importance can be attached to these weights.

IV.9 Areal Specialisation of Industrial Activities (Receipts)

IV.9.1 Factor loadings for terminating freight are given in Table IV.2.3. The corresponding factor score are given in appendix V. All the districts were arranged in descending order on the basis of their respective factor scores.[6] Factor scores have been plotted on a map (refer fig. IV.2.1). Three types of areas have been identified from fig. IV.2.1. These are:

i. port towns which act as traditional outlets of imports and exports;

ii. industrially advanced areas receiving mainly raw materials (basic inputs and fuels); and

iii. areas specialising in the production of agriculture but receiving large volumes of non-agricultural products.

IV.9.2 Areas with very high level of activity are mainly the port areas of Calcutta, Bombay, Madras and Vishakhapatnam. Since the port of Vishakhapatnam is being

---

6. Cut off points were identified from the frequency distribution curve and the following classification was obtained.

Factor Score	Level of Activity
< 0	Very low
0 - 1.99	Low
2.00 - 5.99	Medium
6.00 - 11.99	High
12.00 & above	Very high

TABLE IV.2.3

FACTOR LOADINGS- RECEIPTS

(For industrial activity only)

Eigen value	3.48117
Cumulative percentage of Eigen values	.69623

FACTOR LOADINGS

Sr.No.	Variable	Ist factor loadings
1.	Raw materials from primary source	.70393
2.	Coal and fuels	.66273
3.	Construction materials	.91624
4.	Industrial products	.92268
5.	Miscellaneous commodities	.92499

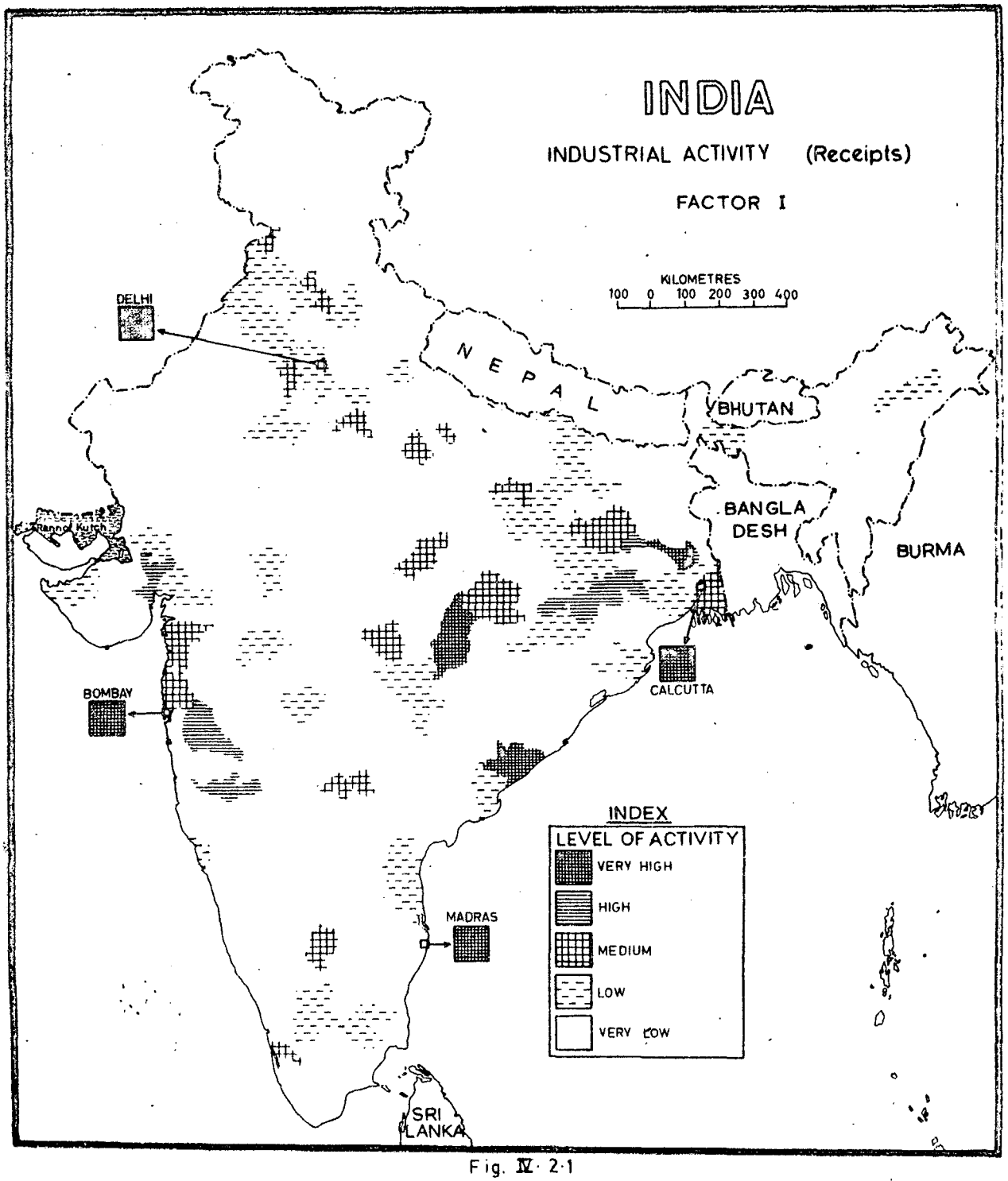

INDIA
INDUSTRIAL ACTIVITY (Receipts)
FACTOR I
KILOMETRES
100 0 100 200 300 400
DELHI
NEPAL
BHUTAN
BANGLA DESH
BURMA
BOMBAY
CALCUTTA
MADRAS
SRI LANKA
INDEX
LEVEL OF ACTIVITY
VERY HIGH
HIGH
MEDIUM
LOW
VERY LOW

Fig. IV· 2·1

mainly used for export of iron and other ores, it has very high receipts. The other areas having very high scores are Delhi, Burdwan and Durg. Burdwan and Durg receive large quantities of raw materials and fuels, because big iron and steel plants are located in these districts. Delhi has a large volume of industrial activity largely induced by the demand centres around it.

IV.9.3 Industrially advanced areas in manufacturing processes (as identified on the basis of originating freight factor) also happen to be the areas with high receipts. The clusters of high receipt areas, which emerge are the heavy basic industrial belt of Hazaribagh, Singhbhum, Dhanbad, Burdwan and Calcutta. These areas receive mainly fuels and raw materials. These districts taken together account for about 23% of the receipts of raw materials and 20% of fuels.

IV.9.4 Bombay-Thane industrial belt specialising in medium and large scale industries emerges as one of the dominant receipt centre. It ranks next to the areas specialising in basic metals and allied manufacturing activities.

IV.9.5 Many districts of Punjab, Haryana and Western U.P. are also high receipt areas. These districts mainly specialize in the production of agricultural commodities (as identified in the case of originating freight - refer figure IV.1.2). Since these areas are not highly specialised in industrial activities, fuels, inputs into agriculture

construction materials and modern industrial products (including heavy machinery) are imported therein. Thus, these areas emerge as big consumers of products manufactured elsewhere.

IV. 10 Areal Specialisation and Multiple Activities

IV.10.1 It is possible that any region may specialize in more than one type of activity. Three types of activities were identified for originating freight namely, industrial, agricultural and mining. Areas specializing in more than one activity are very few and practically no area specialises in all the three industrial, agricultural, and mining activities. No area has been identified which specialises both in mining and agricultural activities. Some regions with both industrial and agricultural or with both industrial and mining activities have been identified. Bombay, Hyderabad and Jabalpur fall in the former while Burdwan, Dhanbad and Hazaribagh fall in the latter category. In the case of receipts, only one type of activity could be identified. Trends in industrial and agricultural activity for the districts with positive factor scores have been plotted and are shown in fig. IV.2.2. It has been observed that the places like Dhanbad, Burdwan, Durg, Hazaribagh have very high level of industrial activity and very low lever of agricultural activity. Areas with high levels of agricultural activity are the states of Punjab and Haryana and have very low level of industrial activity as compared to

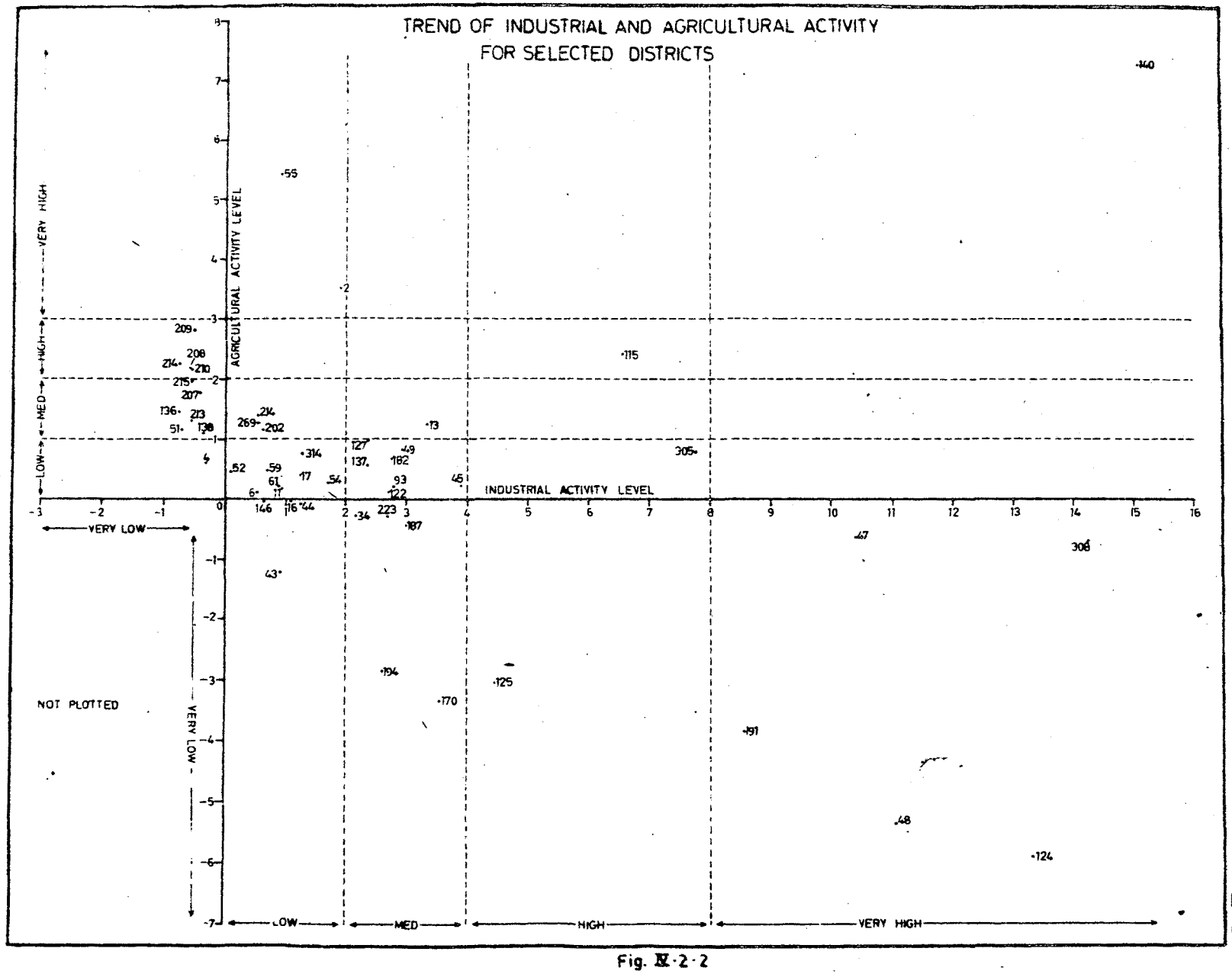

TREND OF INDUSTRIAL AND AGRICULTURAL ACTIVITY
FOR SELECTED DISTRICTS
AGRICULTURAL ACTIVITY LEVEL
INDUSTRIAL ACTIVITY LEVEL
VERY HIGH
HIGH
MED
LOW
VERY LOW
NOT PLOTTED
LOW
MED
HIGH
VERY HIGH

Fig. IX·2·2

industrial districts. Thus the development of agriculture and industry in space appear to be mutually exclusive.

IV.10.2 Areas with high level of originating freight are not expected to necessarily have high level of receipts and vice versa. In order to identify similarities in shipment and receipt activities, the two maps relating to shipment and receipt were super-imposed to see them in relation to each other. The distinct role of metropole towns is noteworthy. Bombay has been found to have very high level both for receipt and shipments, whereas Calcutta has very high level of receipt and only high level of shipment. Madras has very high level of receipt and medium level of shipment. The commodity flow activities at these principal port towns are highly related to the international trade of the country. The newly developing port of Vishakhapatnam has a very high level both in shipments and receipts. This port is being mainly used for the export of ores and imports of industrial and agricultural inputs. Because of the weak industrial base, Delhi has very low level of activity in shipments and very high level of activity in receipts. Durgapur is also emerging as very high level of industrial activity area. Other areas with high level of industrial activity are Dhanbad, Sundergarh, Hazaribagh, Hyderabad and Thane.

IV.11 Commodity Flows and Levels of Development

IV.11.1 The process of national economic development leads to greater interregional interdependence and hence to increase in interregional exchange. Since there is no balancing mechanism in the interregional exchange, it sometimes leads to differential development of various regions consequently resulting in interregional disparities of a high order. With the help of interregional exchange of commodities data, we have been able to develop some indices of development. It may be mentioned here that these indices are not influenced by the pricing mechanism which usually plays a crucial role in metropole hinterland trade to the latter's disadvantage.

IV.11.2 Two types of activities can be associated with the development of a particular region. These are production and consumption activities. In terms of commodity flows production activities can be associated with shipments and consumption with receipts. As has been shown in earlier chapters, production activities are highly concentrated in space as compared to consumption activities. It may also be noted that consumption is a better indicator of development than production. It is, therefore, expected that there should be high correspondence between levels of

development and receipts rather than shipments. Correspondence between levels of development and commodity flow indices, as developed by us, have also been studied in some depth.

IV.11.3 Very little work has been done and only a limited number of studies are available about levels of development of various regions in India. One of the significant studies in this category is that of M.N. Pal.[7] Unlike other studies, Pal's work identified relatively less or more developed districts of India in relation to an average national level of development.

IV.11.4 The method of first principal component of a group of related variables identifying specific characteristics was used in the study. 17 variables were selected for the study from the four specific groups of agricultural, secondary, tertiary and urbanization activities. Using these variables 6 indices of development were developed and these are:

(i) Composite index of development

(ii) Index of agricultural development

(iii) Index of non-agricultural development

(iv) Index of development in secondary activity

---

7. Pal, M.N., "Regional Disparities in the level of Development in India" Indian Journal of Regional Science, vol. 7, no. 1, 1975.

(v) Index of development in tertiary activity

(vi) Index of urbanisation

IV.11.5 The data on each composite index were then classified into six classes in order of their value. The quantitative definitions are given in Table IV.3.1 and the classes were defined as:

(i) Extremely high (EH)

(ii) Very high (VH)

(iii) High (H)

(iv) Medium (M)

(v) Low (L) and

(vi) Very low (VL)

IV.11.6 The composite index of development is a useful tool for interregional comparisons. The values for each composite index were tabulated for all the districts. These absolute values of levels of development have been used in the subsequent analysis. While interpreting the results note should be taken of the fact that the levels of development referred to above pertain to the year 1961. It would, however, be not wrong to assume that the overall ranking of districts has not changed much since 1961 and hence the results are not going to be substantially effected.

IV.11.7 In order to determine whether the level of economic development of a region is more related to production or consumption activities within a region,

TABLE IV.3.1

CLASSIFICATION OF INDICES

Class Symbols	Class Intervals of Indices					
	Z	X	Y	Ys	Yt	Yu
(1)	(2)	(3)	(4)	(5)	(6)	(7)
VL	below 0.50	below 0.85	below 0.70	below 0.63	below 0.76	below 0.66
L	0.60 - 0.88	0.85 - 0.95	0.70 - 0.90	0.63 - 0.87	0.76 - 0.92	0.66 - 0.89
M	0.88 - 1.16	0.95 - 1.05	0.90 - 1.10	0.87 - 1.10	0.92 - 1.07	0.89 - 1.12
H	1.16 - 1.44	1.05 - 1.15	1.10 - 1.30	1.10 - 1.34	1.07 - 1.22	1.12 - 1.35
VH	1.44 - 2.00	1.15 - 1.35	1.30 - 1.70	1.34 - 1.82	1.22 - 1.53	1.35 - 1.81
EH	above 2.00	-	above 1.70	above 1.82	above 1.53	above 1.81

VL = very low, L = low, M = medium, H = high, VH = very high, and EH = extremely high

Z = composite index of development
X = index of agricultural development
Y = index of non-agricultural development
Ys = index of development in secondary activities
Yt = index of development in tertiary activities
Yu = index of urbanism

districtwise total shipments and receipts were related to the corresponding levels of development of the district. The correlation matrix is presented below:

TABLE IV.4.1

CORRELATION MATRIX FOR SHIPMENTS, RECEIPTS AND LEVELS OF DEVELOPMENT

S. No.	Level of Development	Corr. Coeffi. with Shipments	Corr. Coeffi. with Receipts
1.	Composite	.150	.399
2.	Agricultural	-.044	-.225
3.	Non-agricultural	.183	.387
4.	Industrial	.229	.400
5.	Tertiary	.101	.275
6.	Urbanisation	.191	.427

IV.11.9 From the above table, it is clear that all indices of the levels of development are more related to to the indices pertaining to receipts rather than those related to shipments. Therefore, it is not the production, but the consumption which reflects the levels of development of various regions in India. The negative correlation between agricultural development and terminating freight indicates that even with the agricultural development, the terminating freight remains low, thus showing the

relative self sufficiency of agriculturally advanced areas. Urban bias in the development process is quite clear from the fact that a significantly high correlation exists between urban development and terminating freight. Thus the dominance of the metropolos in the economy is indicated.

IV.11.10 Since the commodity composition of receipts and shipments is different for each district, it was therefore, decided to take commodity wise shipments and receipts and then relate it to levels of development. The correlation matrix is given in Table IV.4.2.

IV.11.11 That even commodity-wise receipts are more correlated with the levels of development than shipments is clearly reflected in the correlation matrix. The correlation values are high for receipts for every commodity as compared to the corresponding values for their shipments. This phenomenon is true for all the six indices of the levels of development. Thus, it has been established that irrespective of the nature of commodities, the receipt patterns rather than shipments are more associated with the levels of development.

IV.11.12 Since the receipts of various commodities will have different influence on the development of a region, the commodity-wise relationships with the levels of

TABLE IV.4.2

CORRELATIONS MATRIX FOR COMMODITY SHIPMENTS, RECEIPTS AND LEVELS OF DEVELOPMENT

Index of Levels of Development	SHIPMENTS							RECEIPTS						
	FP	RM	FUEL	IA	CM	IP	MISC	FP	RM	FUEL	IA	CM	IP	MISC
Composite	.320	.179	.213	.327	.235	.457	.360	.393	.384	.380	.371	.433	.538	.464
Agriculture	-.001	.014	-.118	-.134	-.120	-.128	-.158	-.044	-.026	-.001	.066	.033	-.023	-.052
Non-agriculture	.507	.349	.248	.505	.285	.569	.486	.597	.558	.573	.588	.643	.704	.634
Secondary	.431	.319	.285	.485	.305	.588	.459	.552	.532	.545	.550	.583	.668	.595
Tertiary	.459	.257	.153	.374	.196	.440	.374	.506	.436	.473	.490	.560	.588	.526
Urbanisation	.546	.397	.241	.558	.281	.572	.530	.621	.600	.605	.627	.672	.722	.661

Note: FP = Food Products
RM = Raw Materials
FUEL = Coal and Fuel
IA = Inputs into Agriculture
CM = Construction Material
IP = Industrial Products
MISC = Miscellaneous Commodities

development are expected to unravel the nature of development. From the correlation Table IV.4.2, we find that high correlation has been obtained between the receipts of all types of commodities and urban development. Thus, the urban centres are wholesale consumers of foodproducts, raw materials, fuels and industrial products. It may be mentioned here that there is a very high correspondence between urban development index and composite index of development as developed by M.N. Pal. Therefore, urban centres continue to dominate the economy and these are also the places which have high values of composite level of development. Trend in the level of urban development and the level of industrial activity (based on commodity flow characteristics) have been plotted and are shown in fig. IV.3.1. The positive correspondence between urban development and industrial development is evident from fig. IV.3.1. The above analysis has therefore clearly shown that the urban centres forming the core of the so called developed regions are continuing to appropriate the economic surplus. This establishes the fact that the regional structure of under-development, established by the imperial power to meet the requirements of its exploitative mechanism during the colonial period, still persists in many of

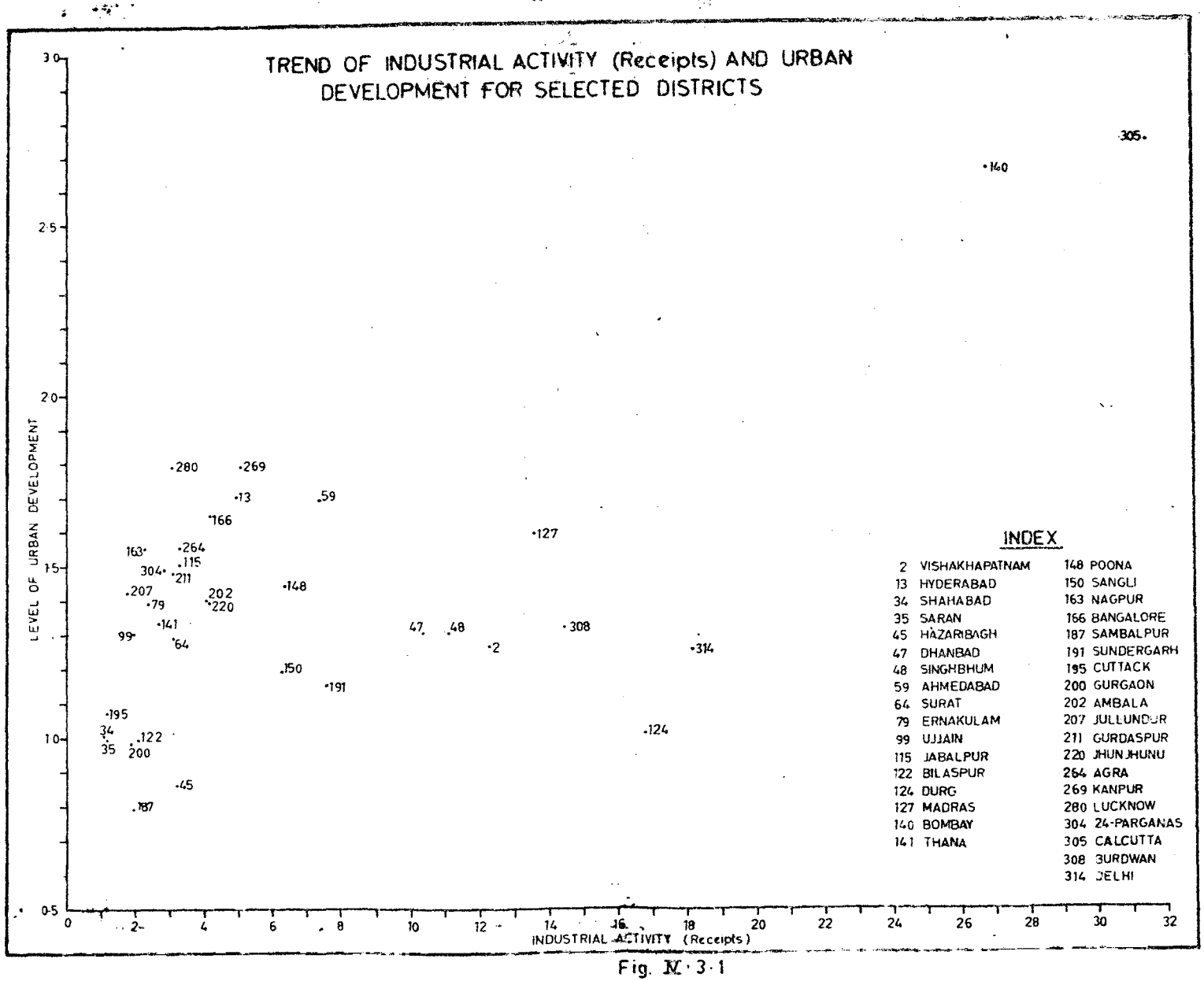

TREND OF INDUSTRIAL ACTIVITY (Receipts) AND URBAN DEVELOPMENT FOR SELECTED DISTRICTS
LEVEL OF URBAN DEVELOPMENT
INDUSTRIAL ACTIVITY (Receipts)
INDEX
2 VISHAKHAPATNAM
13 HYDERABAD
34 SHAHABAD
35 SARAN
45 HAZARIBAGH
47 DHANBAD
48 SINGHBHUM
59 AHMEDABAD
64 SURAT
79 ERNAKULAM
99 UJJAIN
115 JABALPUR
122 BILASPUR
124 DURG
127 MADRAS
140 BOMBAY
141 THANA
148 POONA
150 SANGLI
163 NAGPUR
166 BANGALORE
187 SAMBALPUR
191 SUNDERGARH
195 CUTTACK
200 GURGAON
202 AMBALA
207 JULLUNDUR
211 GURDASPUR
220 JHUNJHUNU
264 AGRA
269 KANPUR
280 LUCKNOW
304 24-PARGANAS
305 CALCUTTA
308 BURDWAN
314 DELHI

Fig. IV·3·1

its essential characteristics.[8]

IV.12 Level of Activity and Level of Development

IV.12.1 It was considered worthwhile to examine the relationship between the level of activity as determined by the commodity flows and the level of development of a region. One does expect that areas with high level of activity would be more developed than those with low level of activity areas. Since it has been shown earlier that the levels of development are more related to receipt pattern than the shipment pattern, a correlation matrix was obtained between levels of development and indices of levles of industrial activity for receipts only. The correlations matrix is presented in Table IV.5.1.

IV.12.2 Significantly high correlation between the receipt index and composite index of development show that there is a correspondence between the level of development and its receipts level. In other words, the areas with high level of receipts are more developed than the areas with low level of receipts. Trend of industrial activity for receipts and industrial development has been plotted and are shown in fig. IV.5.2. The negative correlation between the level of agricultural development and the level of industrial receipts show that advanced areas in agriculture

---

8. See Raza, Moonis and Chattopadhyay, Boudhayan, "Regional Development: Analytical Framework and Indicators", Indian Journal of Regional Science, Vol. 17, No. 1, 1975.

TABLE IV.5.1

CORRELATION COEFFICIENT BETWEEN LEVEL OF INDUSTRIAL RECEIPTS AND LEVELS OF DEVELOPMENT

S.No.	Index of Levels of Development	Level of industrial receipts
1.	Composite	.604
2.	Agriculture	-.364
3.	Non-agriculture	.532
4.	Secondary activities	.539
5.	Tertiary activities	.422
6.	Urbanization	.550

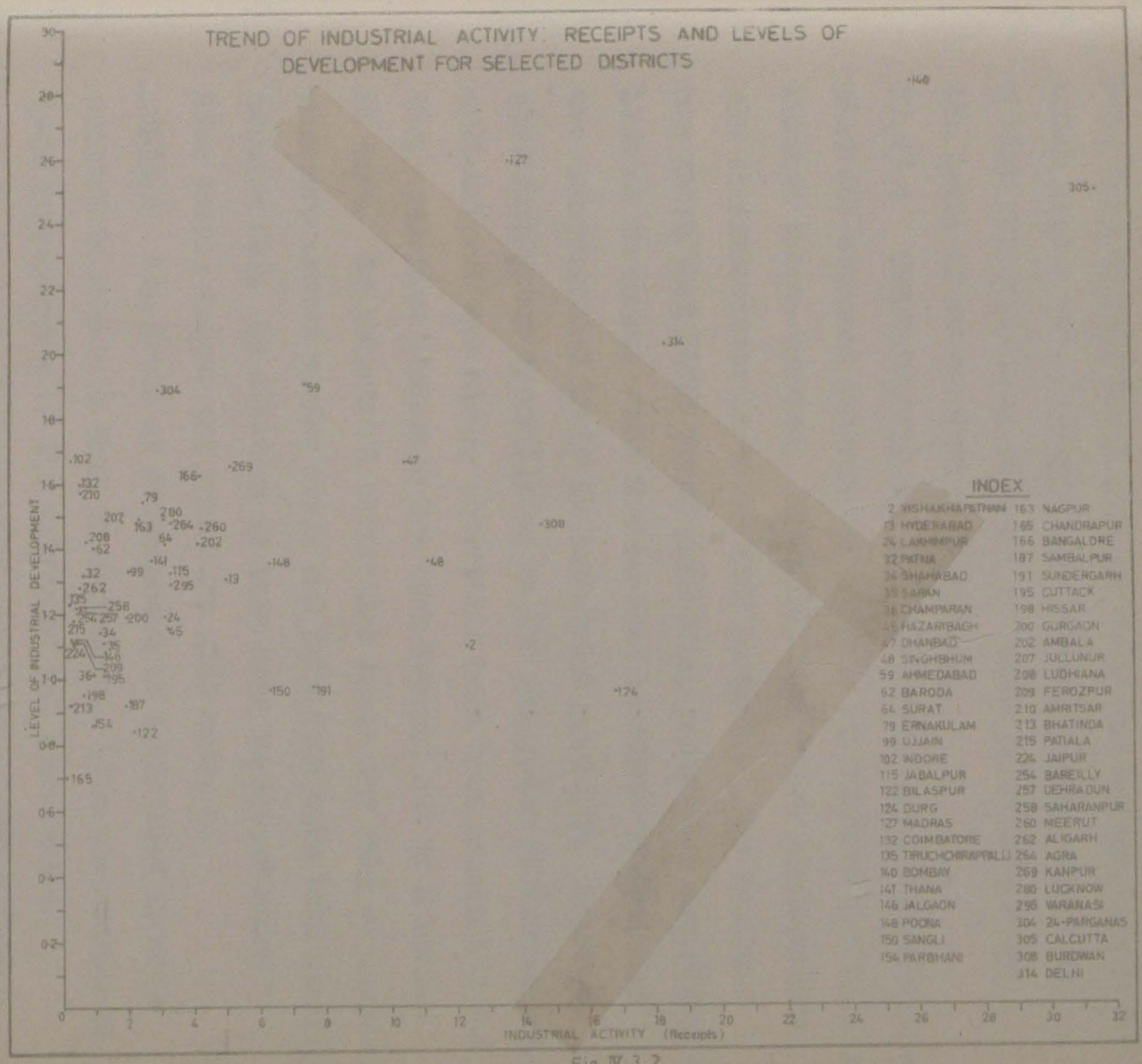

TREND OF INDUSTRIAL ACTIVITY: RECEIPTS AND LEVELS OF DEVELOPMENT FOR SELECTED DISTRICTS
LEVEL OF INDUSTRIAL DEVELOPMENT
INDUSTRIAL ACTIVITY (Receipts)
INDEX
2 VISHAKHAPATNAM
13 HYDERABAD
24 LAKHIMPUR
32 PATNA
34 SHAHABAD
35 SARAN
36 CHAMPARAN
45 HAZARIBAGH
47 DHANBAD
48 SINGHBHUM
59 AHMEDABAD
62 BARODA
64 SURAT
79 ERNAKULAM
99 UJJAIN
102 INDORE
115 JABALPUR
122 BILASPUR
124 DURG
127 MADRAS
132 COIMBATORE
135 TIRUCHIRAPPALLI
140 BOMBAY
147 THANA
148 JALGAON
148 POONA
150 SANGLI
154 PARBHANI
163 NAGPUR
165 CHANDRAPUR
166 BANGALORE
187 SAMBALPUR
191 SUNDERGARH
195 CUTTACK
198 HISSAR
200 GURGAON
202 AMBALA
207 JULLUNUR
208 LUDHIANA
209 FEROZPUR
210 AMRITSAR
213 BHATINDA
215 PATIALA
224 JAIPUR
254 BAREILLY
257 DEHRADUN
258 SAHARANPUR
260 MEERUT
262 ALIGARH
264 AGRA
269 KANPUR
280 LUCKNOW
295 VARANASI
304 24-PARGANAS
305 CALCUTTA
308 BURDWAN
314 DELHI

Fig. IV 3 2

have less of industrial activity than the deficit areas which happen to be industrially active. Thus, there is a high correspondence between the level of receipts and the level of development of a region.

IV.13.1 The foregoing analysis has thus clearly established that the movement patterns of various commodities are highly related to one another. There are some broad similarities and dissimilarities in their flow patterns. The analysis has shown that first round processing industries are efficiently located in space. Only few regions continue to dominate the interregional trade in industrial products. Separate spatial cluster specialising in the shipments of industrial, agricultural and mining activities have been identified and their relative dominance has been brought out by a series of maps. In industrial activities again the role of spatial clusters around mining areas and port town have been clearly brought out. In addition to this some important nodes like Delhi, Kanpur and Agra have also emerged.

IV.13.2 The level of development of a district is more related to receipts than to shipments. This phenomenon is true irrespective of the nature of the commodities. Industrial products have high correlation with the level of development of a region than any other commodity group. There is a high correspondence between urban development and the level of development of a region. Therefore,

urban centres still continue to dominate the Indian space economy. This also brings out the existence of colonial type of regional structure. Lastly, it has been established that there is a high correspondence between the level of development of a region and its industrial activity level.

CHAPTER V

DISTANCE DECAY AND LOCATION OF ECONOMIC ACTIVITIES

V.1 Characteristics of Distance Decay

V.1.1 Movement of any kind within an economic system is a highly complex phenomenon, which is influenced by a whole range of interrelated variables. However, intervening distance and volume are two major attributes of interregional exchange. The greater the distance a consignment is sent the greater will be cost of shipment. Economies of scale, however, operate when the volume of shipment is beyond a critical level and the distance over which it is being sent is also large. Commodity flow patterns based on the volume of exchange have already been examined in the previous chapters. Any study on interregional commodity flows will be incomplete without examining the impact of distance on the movement pattern of various commodities. This chapter is, therefore, devoted to the study of the role of distance in the interregional exchange of commodities.

V.1.2 The existence of numerous points of consumption as well as competing sources of supply for many goods suggests the operation of distance effect. It is generally agreed that the intensity of movement and interaction falls as distance increases. Thus one expects a definite

relationship between the volume of goods shipped and the distance it travels. The movement pattern will be different for each commodity depending upon its nature and utility. Some commodities will be moving over shorter distances only, while others may be moving over shorter as well as longer distances. Therefore, the distance-weight curve for each commodity will be of different shape, which will depend upon the degree with which flows decline with distance.

V.1.3 Unfortunately, not much empirical evidence is available on distance - weight relationships. In the theory of location, the use of transport cost as a measure of distance has been quite popular following the Weberian tradition.[1] The same criterion has also been applied to commodity flow studies. Nevertheless, the superiority of measuring distance in cost rather than in shear kms has not been established. Nor has it been demonstrated that the distance decay exponent is unity when distance is measured in terms of costs. In view of the above, it is difficult to establish the superiority of one concept over the other. It may, however, be noted that in view of the freight equalisation policy in India, it is difficult to study cost-weight relationships for many of the commodities carried by the railways. This

---

1. Weber, A., The Theory of Location of Industries, translated by Carl J. Friedrich, Chicago, University of Chicago Press, 1929.

policy is at present operative in the case of commodities like pig iron, steel, cement, fertilizers and foodgrains. The objective underlying this policy appears to be that the consumers receive these commodities at uniform prices throughout the country irrespective of their location.[2] It, therefore, becomes all the more important to study distance - weight relationships, particularly with a view to evaluate the tariff policy of the Indian Railways.

V.1.4 In their studies of flows of commodities by rail from major parts of Australia and Ghana, Smith and Gould found that intervening distance had almost no effect upon observed variation in the volume of goods shipped to towns in the surrounding hinterlands.[3] Smith noted that for towns in southern New South Wales, variation in distance was weakly correlated with variation in the tonnage of commodities received from Sydney and Melbourne. He found that variation in the population of these towns was sufficient to account for approximately 68 per cent of the variation in tonnage received from Sydney or Melbourne and for approximately 77 per cent of the

---

2. Draft Five Year Plan, 1978-83, op. cit.

3. Smith Robert H.T., Commodity Movement in Southern New South Wales, Sydney: Department of Geography, Australian National University, 1962; Gould, Peter R., The Development of the Transportation Pattern of Ghana, Evaston: Northwestern University Studies in Geography No. 5, 1960.

variation of tonnages which they received from Sydney and Melbourne combined.[4] In the case of commodity flows to hinterland towns from port of Tekoradi in Ghana, Gould observed that the distances involved were too short to have any effect upon the volume of flow. He found that variation in the population of receiving towns alone accounted for approximately 49 per cent of the variation in the volume of goods which they received from Tekoradi.[5]

V.1.5 Although Smith and Gould observed no significant distance effect upon variation in the commodity flows under study, their experience does not rule out the possible importance of distance as a variable influencing the flow of goods inversely. The absence of a distance effect suggests that particular spatial arrangements of activities and costs of operating specific modes of transport may minimize the difficulties of overcoming distance effects for certain commodity flows. One would expect intervening distance to have little or no effect upon the volume of flows to a set of destinations if there is but one major originating source — as in the case of a port with a

---

4. Smith, op. cit., pp. 104-122.

5. Gould, op. cit., pp. 98.

relatively closed hinterland. If all the destinations are located relatively close to that source the operating costs for the mode of transport used would be mainly starting, stopping and terminal costs; if all the destinations are at relatively equal, distances from the source, the distance effect would not operate even if the intervening distances are large. Even if the intervening distances are large and unequal, the distance effect may be offset by some form of transport subsidy. Alternatively for a set of destinations enjoying many competing sources of supply and located at substantially varying distances from each source, one would expect that variation in distance would have considerable effect upon the volume of goods which a set of destinations will receive from anyone source. For example, within the large Canadian economy, Ray found that 58 per cent of the variation in the volume of commodity flows by rail from Southern Ontario to points throughout the rest of Canada could be accounted for simply by variation in the distance to receiving points.[6] The distance decay exponent was 1.55 when distance was measured in terms of cost per ton and 1.45 when measured in miles. These results show clearly that

---

6. Ray, op. cit., p. 65.

distance measured in cost did not perform significantly better than the distance measured in terms of miles. Reed in his study on commodity flows of the Bengal-Bihar Industrial area, has made an attempt to study the relationships between inflows, outflows and distance.[7] In explaining variations in flow by distance, the range of explanation was quite small — from 2 to 7 per cent. One of the reason for such a weak explanation may have been the size of study area itself.

V.1.6 In almost all the empirical studies referred to above, the distance-weight analysis was mainly restricted to the volume of total freight and no attempt, whatsoever, has been so far made to study the distance-weight patterns for individual commodities. In fact, sometimes the composition of the total freight may be such that the distance decay does not seem to operate, while for some of the commodities it may have more significant relationship than the others. In this study, therefore, distance decay has been examined separately for total volume of freight and for all the 7 commodity groups separately.

V.2 Distance Decay and Commodity Flows in India

V.2.1 Since the necessary information required for examining the distance decay effects in the volume of movement of each commodity corresponding to different distance classes, a table containing data on the volume of originating

---

7. Reed, U., op. cit.

TABLE V.1.1

COMMODITY-WISE DISTANCE - WEIGHT CLASSIFICATION OF RAILWAY FREIGHT IN INDIA (1973-74)

S. No.	Distance (kms)	Freight (000 tonnes)							
		FP	RM	COAL	IA	CM	IP	MISC	TOTAL FREIGHT
1.	54	1299	13216	15550	939	1499	980	590	34073
2.	162	1383	5661	7944	2729	1827	617	783	20940
3.	270	1667	8716	5762	1529	2211	478	645	21008
4.	378	1713	5243	11696	1386	1963	908	597	23506
5.	486	1180	2109	3643	1107	1493	601	461	10594
6.	594	1015	879	3220	810	1057	608	411	8000
7.	702	952	522	2746	499	552	786	378	6435
8.	810	919	603	2854	356	301	627	262	5922
9.	918	1319	390	2608	521	385	902	292	6417
10.	1026	1232	329	2336	366	227	824	238	6578
11.	1134	1150	372	2479	339	212	898	195	5645
12.	1242	1150	364	822	475	238	838	274	4157
13.	1350	1053	282	538	287	165	675	195	3195
14.	1458	833	124	373	142	154	322	115	2063
15.	1566	748	181	402	148	140	466	137	2222
16.	1674	387	306	2926	103	300	322	113	4457
17.	1782	337	71	145	62	162	464	45	1286
18.	1890	365	96	3527	32	45	220	28	4113
19.	1998	247	36	23	25	48	213	20	612

FP = Food products
RM = Raw materials from primary sources
COAL = Coal and fuel
IA = Inputs into agriculture
CM = Construction material
IP = Industrial products
MISC = Miscellaneous commodities

freight corresponding to different distance slabs was obtained using point to point movement data for each commodity. The volume of freight corresponding to each distance slab is given in Table V.1.1. Curves showing the volume of shipments for each distance class have been plotted and are shown in figures V.1.1 and V.1.2. The shape of distance-weight curves reveals that generally the volume of freight falls as the distance increases. The intensity of fall depends upon the slope of the curve. The slope of the each curve is different for different commodities. It has been observed from figures V.1.1 and V.1.2, that the volume of freight carried falls as the distance increases. Mathematically, the extent of relationship between distance and weight can be significantly measured by finding the correlation coefficient and coefficient of determination. Values of correlation coefficients are presented in Table V.1.2.

TABLE V.1.2

CORRELATION COEFFICIENTS BETWEEN DISTANCE AND FREIGHT

S. No.	Commodity Group	Corr. Coeff.	Coeff. of Determination
1.	Food products	-.857*	.74
2.	Raw materials	-.726*	.52
3.	Coal and fuels	-.730*	.53
4.	Inputs into agriculture	-.808*	.65
5.	Construction material	-.857*	.73
6.	Industrial products	-.645*	.41
7.	Miscellaneous commodities	-.954*	.53
8.	All commodities	-.824*	.68

* Significant at 99% level of confidence.

DISTANCE-WEIGHT RELATIONSHIPS

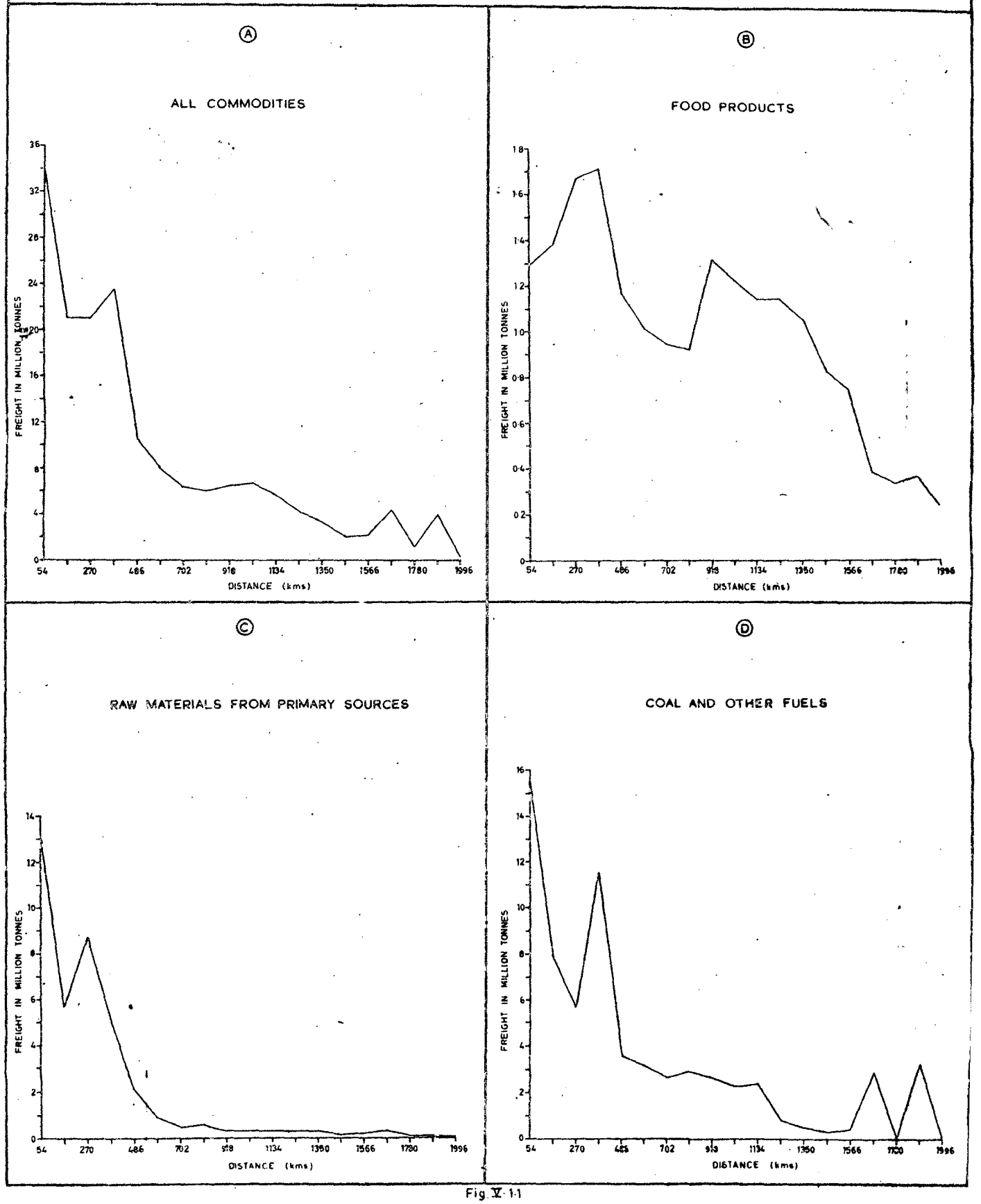
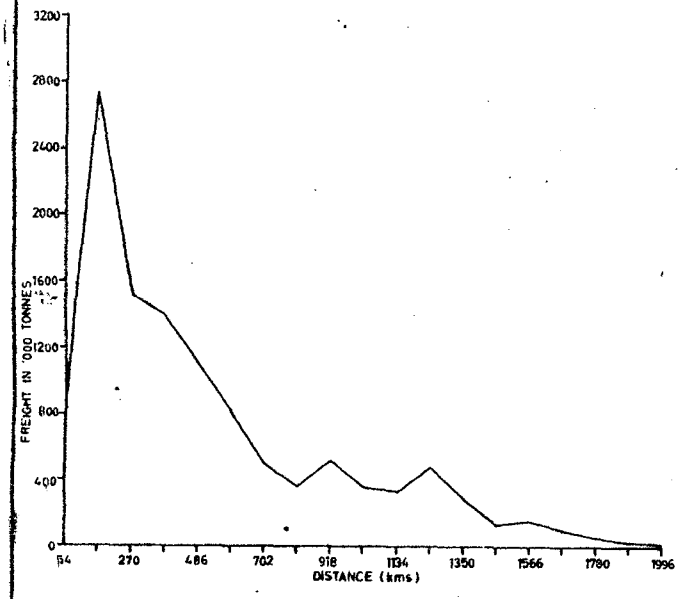


Fig. V·1·1

DISTANCE-WEIGHT RELATIONSHIPS

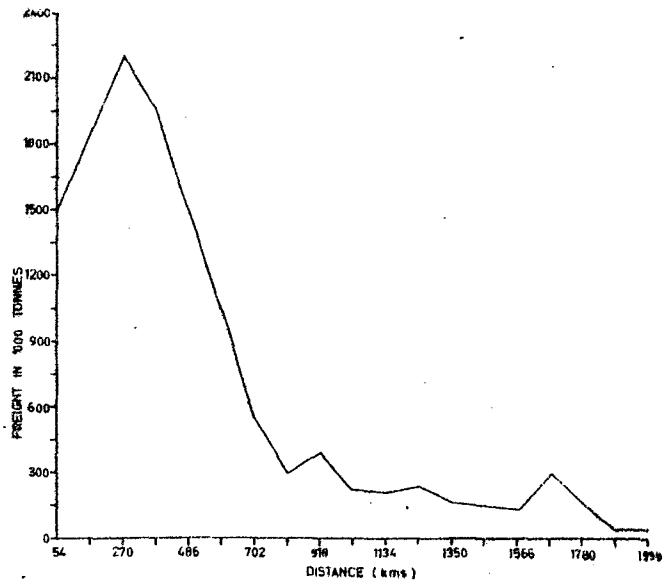
Ⓐ

INPUTS INTO AGRICULTURE



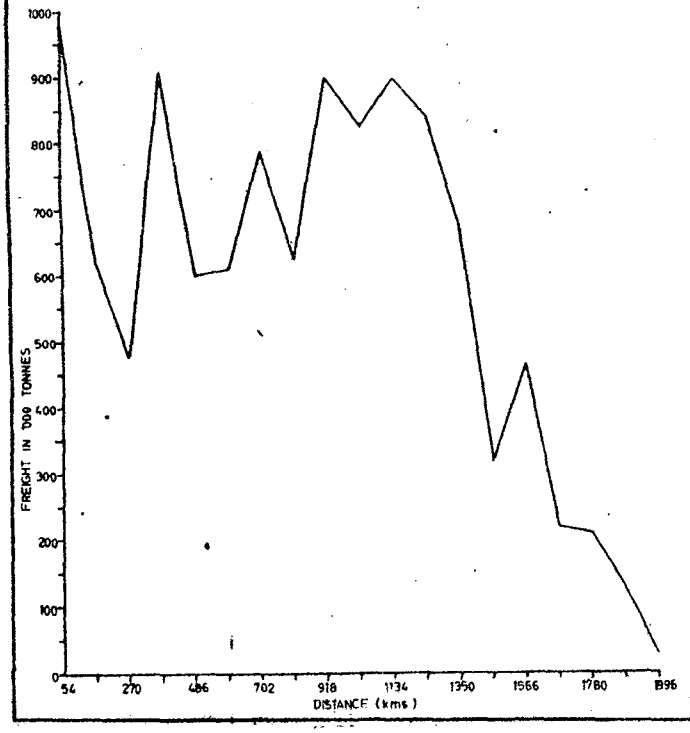
Ⓑ

CONSTRUCTION MATERIALS



Ⓒ

INDUSTRIAL PRODUCTS



Ⓓ

MISCELLANEOUS

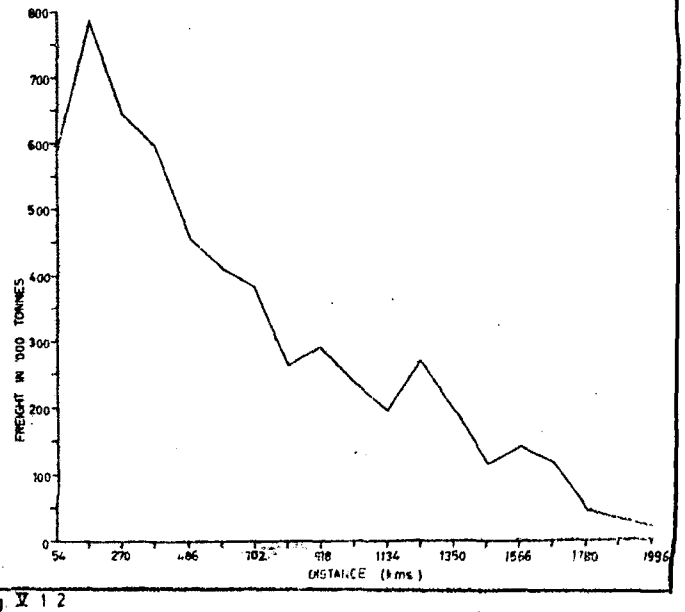


Fig. V 1 2

V.2.2 Statistically significant relationship between distance and weight is obvious from the high values of correlation coefficient and coefficient of determination. The following conclusions emerge from the above analysis:

(i) since the values of correlation coefficient between distance and weight are negative and highly significant, there is an inverse relationship between distance and freight for each commodity group. The value of correlation coefficient for all commodities taken together is as high as -.824;

(ii) high values of coefficient of determination show that much of the variations in distance-weight relationship can be explained for each commodity group. The coefficient of determination is greater than 0.50 for all commodities except industrial products. For the total freight the coefficient of determination is 0.68; and

(iii) that the railway freight movement pattern of each commodity follows the principle of distance decay, has been established by combining the results of (i) & (ii) above.

V.2.3 As noted earlier, Reed[8] in his study on commodity flow of Bengal-Bihar Industrial Areas, has examined the distance-weight relationships for the shipment and receipts of the study area. No other study is available in which distance-weight relationships have been examined in the

---

8. Reed, W., op. cit., pp. 148.

Indian context. It has been observed that our results are in sharp contrast with the findings of Reed. For the total originating and terminating freight in the study area, Reed could explain only 4% to 7% of the total variation with distance-weight relationship. However, as discussed above, our results have been able to explain 68% of the total variation for total freight and more than 70% of variations for some commodities like food products and construction material. As shown later, the performance of the distance-weight relationship will improve considerably, if the variables are log transformed to take care of the variations due to the bulk movement of commodities like raw materials, coal and fuels. The following factors seem to be responsible for the poor fit obtained by W. Reed:

(i) one of the major reasons for the poor performance of the distance-weight relationship was the study area's proximity to the industrial demand centre of Calcutta and most of the freight movement took place only to a particular point only, thus considerably reducing the distance effect;

(ii) Governmental controls over the allocation and pricing of the area's two largest flows, coal and steel may have reduced the influence of distance upon variations in these flows. Moreover, the study area did not form a closed economic system, which further reduced the scope of distance decay hypothesis.

V.2.4 Since the correlation coefficients are highly significant and the coefficients of determination are also very high, it was, therefore, considered desirable to examine the distance-weight relationship in depth. Techniques of multivariate regression analysis have been applied to study the nature of distance-weight relationships. For each commodity group, two types of distance decay models have been tested and these are:

(i) Simple Linear Relationship

VT = F (Distance). This relationship taken the form $Y = \alpha + \beta X$

(ii) Log Linear Relationship

VT = F (Distance). In order to reduce the fluctuations in the data logrithmic transformations have been applied to the variables. The function takes the form

$$\ln Y = \alpha + \beta \ln X$$

V.2.5 The regression results of both the models for each commodity group are presented in Tables V.2.1 and V.2.2. From these results, the following conclusions about the nature of distance decay emerge:

(i) the best fit of the model is determined by the nature of the commodity. Log linear model gives best fit for coal and other fuels and raw materials from primary sources, while simple linear function has been found to be most suitable for other commodity groups. Since very high quantities of coal and raw materials move over relatively

TABLE V.2.1

PERFORMANCE OF SIMPLE LINEAR REGRESSION MODEL ($Y = \alpha + \beta X$)

Sr.No.	Dependent variable	Corr. coeff.	R^2	Intercept	Regression coefficient	F-value
1.	Food products	-0.857	.74	1613.54	-0.598	47.168**
2.	Raw materials from primary sources	-0.726	.52	6473.04	-4.263	18.970**
3.	Coal and fuels	-0.730	.53	8613.66	-4.898	19.397**
4.	Inputs into agriculture	-0.808	065	1549.51	-0.891	32.035**
5.	Construction materials	-0.851	.73	1730.42	-1.015	44.830**
6.	Industrial products	-0.645	.41	873.73	-0.251	12.096**
7.	Miscellaneous commodities	-0.954	.91	665.34	-0.347	173.50**
8.	Total freight	-0.824	.68	21574.04	-12.262	36.059**

Note: ** significant at 99% level of confidence
Y= freight in thousand tonnes
X= distance in kms.

TABLE V.2.2

PERFORMANCE OF LOG LINEAR REGRESSION MODEL($\ln Y = \alpha + \beta \ln X$)

Sr.No.	Dependent variable	Corr. coeff.	R^2	Intercept	Regression coefficient β	F-value
1.	Food products	-0.64	.41	9.33276	-0.384	11.334**
2.	Raw materials from primary sources	-0.93	.86	17.18642	-1.632	107.841**
3.	Coal and fuels	-0.72	.52	15.47255	-1.216	18.335**
4.	Inputs into agriculture	-0.78	.60	12.90575	-1.064	26.085**
5.	Construction materials	-0.84	.70	12.79450	-1.065	40.790**
6.	Industrial products	-0.52	.27	8.02796	-0.255	6.165*
7.	Miscellaneous commodities	-0.77	.59	10.93439	-0.838	23.939**
8.	Total freight	-0.87	.75	14.922	-0.946	53.585**

Note: ** significant at 99% level of confidence
* significant at 95% level of confidence
£ regression coefficients give the distance decay rates
Y= freight in thousand tonnes
X= distance in kms.

shorter distance and there is a sharp decline in the quantity carried over relatively larger distances, the log linear function gives the best fit. In other commodities the simple linear relationship holds good;
(ii) these regression models have been able to explain a very high proportion of variations in data except in the case of industrial products. While the coefficient of determination is less than .50 for industrial products, it is more than .50 for all other commodities. The not so good fit in the case of industrial products can be attributed to the influence of some other variables, like relative location and concentration of production and consumption centres. About 31 per cent of the total receipts of industrial products terminates at Bombay, Calcutta, Delhi, Madras and Ahmedabad and all these centres happen to be at a large distance from the producing areas. This results in the high value of average lead for industrial products.[9] It may be noted in this connection that iron & steel constitutes about 75% of the flow in industrial products. The other major reason can be the impact of freight equalization policy which is operative in the case of iron and steel; and

---

9. In 1973-74, the average lead for iron and steel was 1016 kms. as compared to 662 kms. for the total freight.

(iii) the fact that the weight tends to decrease for all commodity groups as the distance increases is clearly brought out by the similarities in the regression coefficients, all of which are negative with varying degrees.

V.2.6 The best fit regression equation for each commodity is given below in Table V.2.3.

TABLE V.2.3

DISTANCE - WEIGHT REGRESSION MODEL FOR EACH COMMODITY GROUP

Model 1: Simple Linear regression model ($Y = \alpha + \beta x$)

Commodity Group	Regression line
Food products	Y = 1613.54 - 0.598X
Inputs into agriculture	Y = 1549.51 - 0.891X
Construction materials	Y = 1730.42 - 1.015X
Industrial products	Y = 673.74 - 0.251X
Miscellaneous commodities	Y = 665.34 - 0.347X

Model 2: Log Linear regression model ($\ln Y = \alpha + \beta \ln X$)

Raw material from primary sources	lnY = 17.18642 - 1.632 lnX
Coal and other fuels	lnY = 15.47225 - 1.216 lnX
Total freight	lnY = 14.922 - 0.946 lnX

V.2.7 The sensitiveness of the weight corresponding to change in distance is given by the corresponding value of β in the regression equation. The intercept can be used as a measure of bulk movement of the commodity. Bulk movement pattern and the rates of distance decay as emerge from the above analysis are:

(i) the bulk movement of construction materials is over shorter distances. The distance decay rate is also very high for construction materials. There is a sharp bend in the distance freight graph at 594 kms (Refer fig. V.2.1);

(ii) the highly specialised nature of industrial products and relative concentration of its production activities and dispersion of major consuming centres in space has resulted in low value of intercept and a small distance decay rate; and

(iii) the extent of bulk movement of fuels and raw materials from primary sources over relatively short distance has been clearly brought out in log linear regression model. The raw materials from primary sources move in bulk and over relatively short distances as compared to coal and other fuel. This is clear from the fact that both intercept and regression coefficients are higher for raw materials from primary sources as compared to coal and fuel. The average lead for coal was 574 kms as compared to 354 kms for iron ore. The dominance of raw materials and fuels in the total freight is also clear from the fact that log linear function is a good fit for total freight.

V.3 Market Accessibility

V.3.1 The distance-weight relationship and the distance decay rates have already been examined in the

previous section with the help of regression analysis. It has been shown that in the linear distance-weight relationship of the form $W_T = f$ (Distance) or $Y = \alpha + \beta X$, the value of intercept α is a measure of the bulk movement of a particular commodity and β is a measure of change in Y corresponding to changes in X. Since, it has been observed that the values of β are negative for all commodity groups, it is possible to find a value of X, such that $Y = 0$. Corresponding to $Y = 0$, the value of X will give the distance at which the volume of commodity moved becomes zero. Corresponding to $Y = 0$, the value of P is given by

$$P = \alpha / |\beta|$$

V.3.2 Since the value of P depends upon the bulk movement and β, the effect of distance decay can be taken as a measure of market accessibility of the given commodity. It is expected that market accessibility will be directly related to the average load. A commodity with high market accessibility will have high average load. The market potential for various commodity groups is given in the following table.

TABLE V.3.1

MARKET ACCESSIBILITY OF VARIOUS COMMODITIES

S. No.	Commodity Group	Market accessibility (kms)
1.	Food products	2698
2.	Raw materials from primary sources	1518
3.	Coal and fuel	1758
4.	Inputs into agriculture	1739
5.	Construction material	1704
6.	Industrial products	3341
7.	Miscellaneous commodities	1917
8.	All commodities	1759

V.3.3 Highest market accessibility has been observed in the case of industrial products. Raw materials have the lowest range of market accessibility again supporting the hypothesis that the raw material based industries tend to be located near the raw materials rather than the market.

V.4.1 The distance-freight relationship shows how the demand and supply constraints cause the movement of various goods in the space-economy. The above analysis has established that the phenomenon of distance decay operates very strongly for commodity flows in India. The rates of distance decay are sharp for raw materials

and small for commodities like industrial products. Linear relationship between weight and distance holds good for commodities like Food products, Inputs into agriculture, Cement and Industrial products. Because of bulk movement of raw materials and fuels, log linear relationship has been found to be most suitable. Raw materials have the lowest while Industrial products have the highest market accessibility. Thus, industries tend to locate near their sources of raw material rather than the market.

CHAPTER VI

CONCLUSIONS

VI.1.1 Within an economic system, the process of production and consumption leads to inter-regional and inter-sectoral exchange of goods. While the development process has been mostly studied in terms of inter-sectoral relations with special emphasis on the growth of the economy and its sectors, the inter-regional aspect have been by and large neglected. In the foregoing analysis, the inter-regional exchange patterns and the relationship between the commodity flows on the one hand and spatial and sectoral development on the other, have been examined in some depth for the Indian economy. Any study on inter-regional commodity flows would be incomplete without examining the impact of distance on the movement pattern of various commodities. The existance of numerous points of consumption as well as competing sources of supply for many goods suggest the existance of distance decay effect. Therefore, the present study also examines the role of distance in the inter-regional exchange of commodities. In order to study the inter-regional flow of commodities within the system of spatially separated production and consumption centres in India, commodity exchanges through the railway network have been analysed. The main findings of the study are given below:

VI.2.1 Bulk commodities continue to dominate the railway freight in India. Their share in the total freight has moved from 52.8% in 1950-51 to 84.5% in 1977-78. These commodities are basic raw materials, coal and fuels, cement, iron and steel and fertilisers. All these commodities are mainly used as intermediate inputs in many productive sectors of the economy, and thus have very high forward linkages also. The analysis has shown that the Indian railways are playing a significant role in carrying the goods most needed in the production processes.

VI.2.2 The role of the Indian railways in the national development process has been studied by considering the relationship between the indices of railway freight and other economic indicators. A very high correspondence between the index of rail freight on the one hand and indices of national income and of industrial, mining and agricultural production on the other, strengthens the hypothesis that increase in the level of economic activity leads to increase in the inter-dependence among regions and hence to increase in the railway freight. The commodity composition of the freight reflects and has changed along with the sectoral growth in the economy.

VI.2.3 The analysis of the average lead presents an interesting picture. While it increased during the period 1950-51 to 1974-75, a declining trend has been observed since 1974-75. Rising average lead generally suggests that geographically compact production complexes, with strong input-output links within, have not been formed and that the manufacturing activities continue to be located in a haphazard fashion in space. The declining trend in the average lead, however, does suggest a reversal of this phenomenon. The trend of the falling average lead has not, however, been stabilised and it is quite possible that the fall in the average lead during the last two or three years may well turn out be quite ephemeral in character. Average lead of all the important commodities has increased over the years except for coal and fuel. While the increase in the average lead has been only marginal (2%) in the case of coal and fuel. The percent increase has been much more in the case of other commodities like iron ore, cement, iron and steel, foodgrains and fertilizers. Since neither the major demand centres for coal (including the washeries), nor the production centres have undergone major locational changes, the average lead has remained almost constant. While in the case of other commodities there has been a continuous increase in their demand and their market is expanding.

The freight policy of the government may also have influenced the movement pattern of certain commodities.

VI.3.1 Wide regional variations in the volume of originating and terminating freight have been observed. All the regions of the economic system do not necessarily participate in the exchange process to the same extent or in the same manner. Out of a total of 335 districts in India, 18 do not participate in the exchange process at all. The spatial distribution of the total originating and terminating freight brings out the relative concentration of the production and consumption centres. On the basis of the distribution of the total originating and terminating freight, three broad categories of spatial arrangements have been identified. These are:

i) areas like Dhanbad, Burdwan, Hazaribagh, Singhbhum and Bhilai specialising in mineral and basic manufacturing industries;

ii) important ports like Calcutta, Bombay, Madras, Kandla and Vishakhapatnam, which act as transhipment points for imports and exports, and

iii) industrially advanced nodes like Kanpur, Baroda, Ahmedabad, Pune and Jamnagar.

VI.3.2 That the consumption centres are more dispersed in space as compared to the production centres is evident from the fact that the pattern of receipts is more evenly distributed as compared to that of the shipments. On the basis of the total shipments and receipts from/to a particular region, a classification of the districts based on the following criterion was developed and the results have been mapped.

i) high originating and high receipt areas
ii) high originating and low receipt areas
iii) low originating and high receipt areas
iv) low originating and low receipt areas

It is interesting to note that out of a total 317 districts, 225 fall in the category of low shipments and low receipts. 57 districts have total shipments more than the national average and 67 have receipts more than the national average. Only a few districts account for a large share of shipments and receipts. It has been observed that the 8 top ranking districts account for 35% of the total shipments and 31% of the total receipts. While the lowest 100 districts account for only 0.50% of shipments and .70% of the total receipts. It is clear from the above that the pattern of inter-regional trade is dominated by a relatively few areas. The inequalities in the production and consumption processes of various commodities have been measured by

coefficient of variation and lorenz curve analysis. The values of Ginni coefficients have also been calculated for shipments and receipts for each commodity separately. The value of Ginni coefficient varies from 0.72 to 0.95 in the case of originating freight and from 0.66 to 0.87 for terminating freight.

VI.3.3 The distribution of shipments is more skewed as compared to the distribution of receipts. This shows that the production centres are relatively more concentrated in space as compared to the consumption centres. The highly skewed distribution pattern of certain commodities like ores, raw materials, mineral oils and resource based products can be a healthy sign of modernisation and industrial development. Location of natural resources, economies of scale and technological constraints in the production processes would result in the skewed distribution of these commodities. However, the highly skewed distribution of commodities like iron and steel, cement, fertilizers, and other industrial products, show that the disparities exist between the few top consumers and the remaining areas of the economic system. Wide regional disparities have been observed inspite of the fact that balanced regional development has been one of the major policy objectives of Indian planning.

VI.4.1 In any economic system actively engaged in the production and consumption activities, the movement of any particular commodity will be related to the movement of a number of other related commodities either in the same or in the opposite direction. For example, raw material and fuels which are complementary to each other in the production process are expected to be received at similar nodes. While the movement of raw materials and industrial products is expected to be negatively related to each other. Receipts of one would be associated with the shipments of the other. In this study an attempt has been made to capture the inter-relationships between the movement of various commodities. The analysis has shown that the primary and resource based industries are efficiently located in space. Dominance of a few regions in the inter-regional trade of industrial products has been clearly brought out by a significantly high correlation between the originating and terminating freight of the industrial products. It has also been observed that areas which receive industrial products also receive construction material, fuels and raw materials. Areas specialising in the production of fuels are generally backward in agriculture and depend on other regions of the system for their requirements of food products. A high correlation has been observed

between the shipments and receipts of fuels and raw materials showing that these commodities move over shorter distance and their movement is of an intra regional type.

VI.4.2 Another meaningful dimension of the commodity flow analysis pertains to the study of spatial distribution of areas with similar characteristics. The analysis has shown that similarities in the freight pattern are more pronounced in the receipts than in the case of originating freight. Three groups of shippers have been identified on the basis of commodity flows for originating freight.

i) areas specialising in industrial activity;

ii) areas specialising in the agricultural activity;

iii) areas specialising in the shipments of coal and fuels.

Well defined areal clusters have been identified for industrially active regions and these are:

i) spatial clusters specialising in industrial activity around mining areas;

ii) spatial clusters specialising in industrial activity around principal port towns; and

iii) other important nodes of industrial activity.

Similarly, the spatial clusters in terms of the shipment of coal and fuel and agricultural activity have been shown cartographically in a series of maps. It has also been shown that agriculturally advanced areas do not have strong industrial base thus leading to huge imports of cement, fertilizers, iron and steel and other industrial goods in to these areas. Thus the development of industry and agriculture in space appears to be mutually exclusive, since the areas with high level of industrial activity have in general low level of agricultural activity and vice-versa.

VI.4.3 Areas having similar receipt characteristics have also been identified. Since the areas which receive food products also receive large quantities of raw materials, fuels, construction material and industrial products, the impact of industrial characteristics is more pronounced in receipts. Composite index has been developed for the level of industrial activity in each district and three district type of regions have been identified and these are:

i) port towns which act as traditional outlets of imports and exports;

ii) industrially advanced areas receiving mainly raw materials and fuels; and

iii) areas specialising in the production of agriculture but receiving large quantities of non-agricultural products.

VI.4.4 Relationships between the freight characteristics and the levels of development of a district have also been studied in detail. It has been observed that the indices of development are better related to the receipts than to shipments. This leads us to conclude that consumption patterns reflect the level of development of a district more effectively. Index of urban development has the highest correlation with the receipts thus showing that urban centres are the major consumers of food-products, raw materials, construction material and industrial products. Trend in the level of urban development and the level of industrial activity also show positive correspondence. The analysis also shows that most of the manufacturing is being done as at urban centres which continue to dominate the Indian space economy.

VI.5.1 The existance of numerous spatially dispersed nodes of consumption as well as competing sources of supply suggest the existance of distance decay effects. Transport costs have been taken as a measure of distance in commodity flow studies. The superiority of measuring distance in terms of costs rather than sheer kms. has not been established neither for India nor for other countries. Nor has it been demonstrated that the distance decay exponent is unity when the distance is measured in terms

of costs. No empirical evidence is available about the distance decay in commodity flows in India. In the foregoing analysis, we have, therefore, considered intervening distance and volume of exchange to analyse the distance weight relationships.

VI.5.2 The existence of distance weight relationships for the commodity flows in India, is apparent from the distance decay graphs and the extent of relationship between these two has been measured by correlation coefficient and coefficient of determination. The distance decay rates vary from one commodity to another depending upon its nature and utility. Low rated commodities like ores, raw materials and coal have a very sharp rate of decay, while for high rated commodities like iron and steel, the distance effect is smaller though significant.

VI.5.3 Simple linear and log linear regression models were tested to explain the distance decay for various commodities. Log linear regression model has been found to be a good fit for low rated commodities like raw materials, coal and fuels. These commodities move in bulk over short distances and hence the decay is fast and the intercept is large. Simple linear regression model has been found suitable for all the other

commodities. The bulk movement of construction materials is over shorter distances. The distance decay rate is also high for construction material. In the simple linear regression model, the intercept is a measure of the bulk movement of a particular commodity and β is a measure of the change in weight corresponding to change in distance. Based on these two parameters, market accessibility of each commodity has been calculated. Industrial products have the highest value of the market accessibility followed by food products, miscellaneous commodities, coal and fuel, inputs into agriculture, construction material and raw materials, in that order. The highest and the lowest value of market accessibility for industrial products and raw materials reveal that the manufacturing industries tend to be located near the sources of raw materials rather than the market centres. The above analysis also establishes that the intervening distance is a major determinant of the inter-regional trade and the intensity of movement falls as the distance increases.

Appendix I

COMMODITY GROUP LIST

Commodity Group 1	Commodities Included in the Group 2
I. FOOD PRODUCTS	
Food Grains	Rice of all varieties, Gram, Barley, Ragi, Wheat, Jowar, Bajra, Pulses, Maize, Millet
Grain Flour	Wheat flour, Rice flour, Gram flour, Jowar flour, Bajra flour, other flour
Fruits and Vegetables	Mangoes, Plantains, Oranges, other fresh fruits, Vegetables, Coconuts
Products of Dairy, Poultry and Fisheries	Meat, Meat products, Fish (fresh and dry), Eggs, Ghee
Spices and other provisions	Dry Fruits, Pepper, Turmeric, Chillies, Cardomom, Dry Ginger, Dry Coconut, Other spices, Betul Nuts, Seeds, Other than Oilseeds, Groceries, Other provisions
Beverages	Tea, Coffee

1		2
	Sugar	Sugar, Candy, Glucose, Khandsari sugar, Gur, Molasses
	Salt	Salt in various forms
	Edible oils	Vegetable oil, Seed oils (of all kinds) and other Edible oils
II.	RAW MATERIALS FROM PRIMARY SOURCES	
	From Agricultural Sector	Oil seeds of all kinds, and farm, Jute, Cotton, Silk, Hemp, Sugar Cane, Raw wool, Hides, Skins, Bones
	From Plantations	Rubber, Bidi leaves, Tobacco, Opium
	From the Mines	Limestone, Dolomite, Other stones, Metallic Ores, Mica China Clay
	Semi Processed	Metal Scrap
III.	COAL AND FUEL	
	From the Mines	Coal and Coke, Petrol, Diesel, Kerosene, Gas
	From the Forests	Firewood and Other Fuels

1	2
IV. INPUTS INTO AGRICULTURE	
From the Agricultural Sector	Fodder, Manure
From the Industrial Sector	Chemical Fertilizers, Agricultural Implements
V. CONSTRUCTION MATERIALS	
Primary	Lime, Marble, Wood, Sand
Manufactured	Coal Tar, Bitumen, Cement, Bricks, Tiles
VI. INDUSTRIAL PRODUCTS	
Textiles	Cotton, Jute, Wool, Silk
Electrical	Fans, Batteries, Motor
Paper	Paper, Stationary, Card boards, News Print
Chemicals	Acids, Fireworks, Drugs, Paints, Varnishes, Dyes
Basic Metal and Alloys	Iron, Steel, Pigiron (ingots, sheets, pipes)
Non-Ferrous Metallic	Alluminium, Zinc, Brass, Copper, Tin (ingots, sheets, pipes)

	1	2
	Transport Equipments	Motor Cars, Parts, Cycles, Cycle Parts
	Other Consumer Goods	Tubes, Tyres, Chinaware, Glassware, Soap, Matches, Leather Products, Cigarette, Bidies
VII.	MISCELLANEOUS	
	Unclassified Goods	Unspecified, including goods transferred by container services
	Military traffic	

Appendix: II

LIST OF DISTRICTS IN STATES

ANDHRA PRADESH

001	Srikakulam
002	Vishakapatnam
003	East-Godavari
004	West-Godavari
005	Krishna
006	Guntur
007	Nellore
008	Chittoor
009	Cuddapah
010	Anantapur
011	Kurnool
012	Mahbubnagar
013	Hyderabad
014	Medak
015	Nizamabad
016	Adilabad
017	Karimnagar
018	Warangal
019	Khammam
020	Nalgonda

ASSAM

021	Golapara
022	Kamrup
023	Darrang
024	Lakhimpur
025	Nowgong
026	Sibsagar
027	Cachar
028	Garo Hills
029	United Khasi & Jaintia Hills
030	United Mikir & N.C.Hills
031	Mizo Hills

BIHAR

032	Patna
033	Gaya
034	Shahabad
035	Saran
036	Champaran

037	Muzaffarpur	056	Banaskantha
038	Darbhanga	057	Sabarkantha
039	Monghyr	058	Mehesana
040	Bhagalpur	059	Ahmedabad
041	Saharsa	060	Kheda
042	Purnea	061	Panch Mahals
043	Santal Parganas	062	Baroda
044	Palamau	063	Bharuch
045	Hazaribagh	064	Surat
046	Ranchi	065	The Dangs
047	Dhanbad		JAMMU AND KASHMIR
048	Singhbhum	066	Anantnag
	GUJARAT	067	Srinagar
049	Jamnagar	068	Baramula
050	Rajkot	069	Ladakh
051	Surendranagar	070	Doda
052	Bhavnagar	071	Udhampur
053	Amreli	072	Jammu
054	Junagarh	073	Kathua
055	Kutch	074	Poonch-Rajouri

KERALA

075 Cannanore

076 Kozhikode

077 Palghat

078 Trichur

079 Ernakulam

080 Kottayam

081 Alleppey

082 Quilon

083 Trivandrum

MADHYA PRADESH

084 Morena

085 Bhind

086 Gwalior

087 Datia

088 Shivpuri

089 Guna

090 Tikamgarh

091 Chatarpur

092 Panna

093 Satna

094 Rewa

095 Shahdol

096 Sidhi

097 Mandsaur

098 Ratlam

099 Ujjain

100 Jhabua

101 Dhar

102 Indore

103 Dewas

104 West Nimar

105 East Nimar

106 Shajapur

107 Rajgarh

108 Vidhisha

109 Sehore

110 Raisen

111 Hoshangabad

112 Betul

113 Sagar

114 Damoh

115	Jabalpur	136	Thanjavur
116	Narsimhapur	137	Ramo Natha Puram
117	Mandla	138	Tirunevali
118	Chindwara	139	Kanya Kumari
119	Seoni		MAHARASHTRA
120	Balaghat	140	G.Bombay
121	Surguja	141	Thana
122	Bilaspur	142	Kolaba
123	Raigarh	143	Ratnagiri
124	Durg	144	Nasik
125	Raipur	145	Dhulia
126	Bastar	146	Jalgaon
	MADRAS	147	Ahmadnagar
127	Madras	148	Poona
128	Chingleput	149	Satara
129	North Arcot	150	Sangli
130	South Arcot	151	Sholapur
131	Salem	152	Kolhapur
132	Coimbatore	153	Aurangabad
133	The Nilgiris	154	Parbhani
134	Madurai	155	Bhir
135	Tiruchirappali	156	Nanded

157 Osmanabad

158 Buldhana

159 Akola

160 Amravati

161 Yeotmal

162 Wardha

163 Nagpur

164 Bhandara

165 Chandrapur

MYSORE

166 Bangalore

167 Tumkur

168 Chitradurg

169 Kolar

170 Bellary

171 Mysore

172 S.Kanara

173 Coorg

174 Hassan

175 Shimoga

176 Chikmagalur

177 Mandya

178 Belgaum

179 Bijapur

180 N.Kanara

181 Dharwar

182 Gulbarga

183 Bidar

184 Raichur

ORISSA

185 Kalahandi

186 Koraput

187 Sambalpur

188 Bolangir

189 Baudh-Khondamals

190 Ganjam

191 Sundergarh

192 Dhen-Kanal

193 Puri

194 Keonjhar

195 Cuttack

196 Mayurbhanj

197 Balasore

PUNJAB (PRE PARTITION)

198 Hissar

199 Rohtak

200 Gurgaon

201 Karnal

202 Ambala

203 Simla

204 Kangra

205 Lahaul and Spiti

206 Hoshiarpur

207 Jullundur

208 Ludhiana

209 Ferozpur

210 Amritsar

211 Gurdaspur

212 Kapurthala

213 Bhatinda

214 Sangrour

215 Patiala

216 Mahendragarh

RAJASTHAN

217 Ganganagar

218 Bikaner

219 Churu

220 Jhunjhunu

221 Alwar

222 Bharatpur

223 Sawai Madhopur

224 Jaipur

225 Sikar

226 Ajmer

227 Tonk

228 Jaisalmer

229 Jodhpur

230 Nagaur

231 Pali

232 Barmer

233 Jalor

234 Sirohi

235 Bhilwara

236 Udaipur

237 Chitrogarh

238 Dungapur

239	Banaswara	259	Muzaffarnagar
240	Bundi	260	Meerut
241	Kota	261	Bulandshahr
242	Jhalawar	262	Aligarh
	UTTARPRADESH	263	Mathura
243	Uttar Kashi	264	Agra
244	Chamoli	265	Etah
245	Pithoregarh	266	Mainpuri
246	Tehri Garhwal	267	Farrukhabad
247	Garhwal	268	Etawah
248	Almora	269	Kanpur
249	Nainital	270	Fatehpur
250	Bijnor	271	Allahabad
251	Moradabad	272	Jhansi
252	Budaun	273	Jalaun
253	Rampur	274	Hamirpur
254	Bareilly	275	Banda
255	Pilibhit	276	Kheri
256	Shahjanpur	277	Sitapur
257	Dehra Dun	278	Hardoi
258	Saharanpur	279	Unnao

280 Lucknow

281 Rai Bareli

282 Bahraich

283 Gonda

284 Bara Banki

285 Faizabad

286 Sultanpur

287 Pratapgarh

288 Basti

289 Gorakhpur

290 Deoria

291 Azamgarh

292 Jaunpur

293 Ballia

294 Ghazipur

295 Varanasi

296 Mirzapur

WEST BENGAL

297 Darjeeling

298 Jalpaiguri

299 Cooch Behar

300 West Dinajpur

301 Malda

302 Murshidabad

303 Nadia

304 24-Parganas

305 Calcutta

306 Howrah

307 Hooghly

308 Burdwan

309 Birbhum

310 Bankura

311 Midnapur

312 Purulia

313 Andaman and Nicobar

314 Delhi

HIMACHAL PRADESH

315 Chamba

316 Mandi

317 Bilaspur

318	Mahe		NAGALAND
319	Cirmaur	332	Kohima
320	Kinnaur	333	Mokokchung
321	Laccadive Minicoy	334	Tuensang
322	Manipur		SIKKIM
323	Tripura	335	Sikkim
324	Dadra and Nagar Haveli		
	GOA, DAMAN, DIU		
325	Goa		
326	Daman		
327	Diu		
328	Pondicherry		
329	Karaikal		
330	Mahe		
331	Yanam		

Appendix III

LIST OF DISTRICTS NOT PARTICIPATING IN THE COMMODITY EXCHANGE

S.No.	Dist. Code	District Name	State
1.	28	Garo Hills	Assam
2.	31	Mizo Hills	Assam
3.	65	The Dangs	Gujarat
4.	68	Baramula	J & K
5.	69	Ladakh	J & K
6.	70	Doda	J & K
7.	147	Ahmadnagar	Maharashtra
8.	205	Lahul & Spiti	Himachal Pradesh
9.	313	Andaman & Nicobar	
10.	318	Mahasu	Himachal Pradesh
11.	320	Kinnaur	Himachal Pradesh
12.	321	Lakshadeep & Minicoy	
13.	324	Dadra & Nagar Haveli	
14.	326	Daman	
15.	327	Diu	
16.	331	Yanam	
17.	333	Mokokchung	Nagaland
18.	334	Tuensang	Nagaland

FACTOR SCORES

(ORIGINATENG FREIGHT)

DISTT. CODE	NAME	Ist Factor	2nd Factor	3rd Factor
001	Srikakulam	-0.16421	0.32152	-0.03002
002	Vishakhapatnam	1.80854	3.48943	-1.45813
003	East Godavari	-0.44746	0.24901	-0.09967
004	West Godavari	-0.64111	1.02600	-0.78100
005	Krishna	-0.32349	0.59621	-0.65978
006	Guntur	0.53089	0.09945	-1.21980
007	Nellore	-0.58843	0.13653	-0.06424
008	Chittoor	-0.80377	-0.14870	0.10886
009	Cuddapeh	-0.60104	-0.43743	0.14620
010	Aventipur	-0.64971	-0.16951	0.10812
011	Kurnool	0.96245	0.16262	-0.82549
012	Mehbubnagar	-0.80950	-0.35082	0.30513
013	Hyderabad	3.37443	1.32450	0.71340
014	Medak	-0.77236	-0.31230	0,31050
015	Nizamabad	-0.79786	-0.14653	0.14971
016	Adilabad	1.08620	-0.06307	0.65833
017	Karimnagar	1.24418	0.39698	0.19051
018	Warangal	-0.79406	-0.22669	0.21647
019	Khamman	-0.09410	-0.18396	0.96390
020	Nalgonda	-0.83085	-0.35899	0.31490
021	Golapara	-0.60906	-0.31165	0.09232
022	Kamrup	-0.04459	0.15655	0.02358
023	Darrang	-0.68310	-0.22819	0.20767

DISTRICT CODE	NAME	IST FACTOR	2nd Factor	3rd Factor
024	Lakhimpur	-0.28750	0.01355	0.25079
025	Nowgong	-0.75215	-0.13707	0.07168
026	Sibsagar	-0.73643	-0.25259	0.21433
027	Cachar	-0.19512	0.06951	0.14223
029	United Khasi & Jaintia Hills	-0.83556	-0.36380	0.31631
030	United Mikir & N.C. Hills	-0.79921	-0.36987	0.29339
031	Mizo Hills	-0.83557	-0.36530	0.31765
032	Patna	-0.30025	0.01457	0.37950
033	Gaya	-0.57655	-0.39942	0.09358
034	Shahabad	2.15658	-0.30006	-0.54073
035	Saran	-0062105	-0.15688	0.00423
036	Champran	-0.30995	-0.23089	-0.24992
037	Muz affarpur	-0.70283	-0.25669	0.15057
038	Darbhanga	-0.59754	-0.20701	0.01634
039	Monghyr	-0.36147	-0.40647	0.07307
040	Bhagalpur	-0.79986	-0.33000	0.28770
041	Saharasa	-0.73058	-0.34095	0.19835
042	Purnea	-0.49200	-0.18428	-0.06457
043	Santal Parganas	0.91473	-0.26142	-0.97189
044	Palamau	1.24615	-0.08284	-0.73289
045	Hazaribagh	3.91365	0.22251	5.15834
046	Ranchi	0.66307	-0.05348	-0.08290

DISTT.CODE	NAME	Ist Factor	2nd Factor	3rd Factor
047	Dhanbad	10.38770	-0.63504	7.42453
048	Singhbhum	11.04298	-5.37929	-3.64933
049	Jamnagar	2.93841	0.79622	-1.84267
050	Rajkot	-0.45295	-0.04139	-0.14155
051	Surendranagar	-0.68767	1.15819	-0.93803
052	Bhavnagar	0.10917	0.46454	-0.19879
053	Amreli	-0.81647	-0.31695	0.29030
054	Junagarh	1.69742	0.25841	-1.18855
055	Kutch	0.88780	5.38812	-2.68188
056	Banaskantha	-0.79652	-0.24109	0.19041
057	Sabarkantha	-0.79803	-0.33252	0.30933
058	Mehesana	-0.71616	-0.21074	0.16252
059	Ahmedabad	0770884	0.47159	-0.03731
060	Kheda	-0.42894	0.95305	-0.80165
061	Panch Mahals	0.86868	0.17580	1.06479
062	Baroda	1.05572	0.15123	0.99935
063	Bharuch	-0.75602	-0.34205	0.27744
064	Surat	-0.33603	0.58074	-0.10936
066	Anantnag	-0.83557	-0.36539	0.31765
067	Srinagar	-0.83190	-0.36318	0.31782
071	Udhampur	-0.82714	-0.36182	0.31813
072	Jammu	-0.77878	-0.34654	0.30861
073	Kathua	-0.82801	-0.36503	0.31610

DISTT. CODE	NAME	Ist Figure	2nd Figure	3rd Figure
074	Poonch-Rajauri	-0.83557	-0.30532	0.31765
075	Cannanore	-0.72480	-0.35933	0.24895
076	Kozhikode	-0.44860	-0.01933	-0.06057
077	Palghat	-0.78696	-0.35339	0.28399
078	Trichur	-0.47187	-0.25206	0.07142
079	Ernakulam	0.67285	0.59202	0.30613
080	Kottayam	-0.74417	-0.35098	0.26978
081	Alleppey	-0.89175	-0.36459	0.30476
082	Quillon	-0.64120	-0.40300	0.24557
083	Trivandrum	-0.79476	-0.36667	0.31021
084	Morena	-0.49037	-0.17106	-0.06298
085	Bhind	-0.83002	-0.26198	0.22797
086	Gwalior	-0.48767	-0.07435	0.25059
087	Datia	-0.83055	-0.33939	0.22527
088	Shivpuri	-0.52040	-0.33628	0.29745
089	Guna	-0.78598	-0.22236	0.20775
090	Tikamgarh	-0.81873	-0.29573	0.26416
091	Chatarpur	-0.82924	-0.35528	0.30904
093	Satna	2.81229	0.17965	-2.23892
094	Rewa	-0.81787	-0.36146	0.30927
095	Shahdol	0.01767	-0.29549	1.05718
097	Mandsaur	-0.68545	-0.15979	0.19715
098	Ratlam	-0.70091	-0.23969	0.24127
099	Ujjain	-0.27282	-0.20984	0.27909

DISTT.CODE	NAME	1st Factor	2nd Factor	3rd Factor
100	Jhabua	-0.82362	-0.35911	0.31105
101	Dhar	-0.83523	-0.36552	0.31746
102	Indore	-0.58793	0.12272	0.04602
103	Dewas	-0.83347	-0.36487	0.31775
104	West Nimar	-0.83132	-0.36843	0.31504
105	East Nimar	-0.46991	-0.12004	0.15866
106	Shajapur	-0.82750	-0.31836	0.28236
108	Vidhisha	-0.79442	-0.10862	0.12656
109	Sehore	-0.52360	-0.12070	0.12446
110	Raisen	-0.80812	-0.33645	0.30962
111	Hoshangabad	-0.40902	0.08278	0.07273
112	Betul	-0.63086	-0.29119	0.28905
113	Sagar	-0.37907	0.14018	0.15146
114	Damoh	-0.80574	-0.30077	0.27199
115	Jabalpur	6.54310	2.40444	-3.32433
116	Narsimhapur	-0.80286	-0.14059	0.11754
117	Mandla	-0.79860	-0.35745	0.27956
118	Chindwara	0.39475	-0.30486	1.77381
119	Seoni	-0.81632	-0.32625	0.28732
120	Balaghat	-0.55909	-0.42377	0.06092
121	Surguga	0.86772	-0.15888	1.96717
122	Bilaspur	2.70554	0.08971	-0.95705

DISTT. CODE	NAME	Ist Factor	2nd Factor	3rd Factor
123	Raigarh	-0.73600	-0.27554	0.21380
124	Durg	13.28987	-6.10645	-2.57606
125	Raipur	4.43952	-3.05205	-4.50513
126	Bastar	-0.83252	-0.36779	0.31519
127	Madras	2.36139	0.94283	0.33180
128	Chingleput	-0.74858	-0.28406	0.28754
129	North Aroot	-0.69420	0.04330	-0.01637
130	South Aroot	-0.58667	-0.03136	0.14728
131	Salem	1.56269	0.76883	-1.68440
132	Coimbatore	0.06370	0.37041	-0.63598
133	The Nilgiris	-0.81014	-0.35029	0.31516
134	Madurai	-0.75061	-0.24670	0.19846
135	Tiruchirappalli	0.82425	0.43445	-0.98019
136	Thanjavur	-0.74910	1.44404	-1.10183
137	Rama Natha Puram	2.34480	0.57460	-1.80219
138	Tirunevelli	-0.35006	1.09906	-0.98404
1 39	Kanya Kumari	-0.83335	-0.36506	0.31773
140	G. Bombay	15.08648	7.25077	0.05483
141	Thana	0.53849	1.36870	-0.25870
142	Koleba	-0.42670	0.09703	0.13687
144	Nasik	0.24030	0.64385	0.09882
145	Dhulia	-0.74992	-0.12709	0.20212
146	Jalgaon	-0.44260	0.13424	0.20595

DISTT.CODE	NAME	Ist Factor	2nd Factor	3rd Fact
147	Ahmednagar	-0.65525	0.39981	-0.23950
148	Poona	0.27454	0.67337	0.06509
149	Satara	-0.78445	-0.18839	0.19004
150	Sangli	-0.67016	-0.00753	0.11276
151	Sholapur	-0.77561	-0.18042	0.19445
152	Kolhapur	-0.73448	0.16801	-0.09971
153	Aurangabad	-0.82222	-0.34941	0.30508
154	Parbhani	-0.99532	-0.27354	0.24334
155	Bhir	-0.81272	-0.34128	0.31113
156	Nanded	-0.79637	-0.26305	0.23149
157	Osmanabad	-0.82618	-0.24486	0.22915
158	Buldhana	-0.75899	-0.23552	0.26854
159	Akola	-0.71968	-0.14169	0.16738
160	Amravati	-0.59980	0.01055	0.19995
161	Yeotmal	-0.72915	-0.32246	0.22872
162	Wardha	-0.63499	-0.21647	0.28971
163	Nagpur	-0.04977	-0.15210	0.30879
164	Bhandara	0.27219	0.07145	0.04769
165	Chandrapur	0.77860	0.13636	0.08364
166	Bangalore	0.19953	0.33561	0.11152
167	Tumkur	0.36965	-0.02317	-0.48006
168	Chitradurg	-0.53574	-0.32608	0.16349
169	Kolar	-0.81609	-0.27073	0.24172
170	Bellary	3.53452	-3.35805	-3.15076

DISTT.CODE	NAME	1st Factor	2nd Factor	3rd Factor
171	Mysore	-0.75912	-0.27062	0.22804
172	S.Kanara	-0.67150	-0.05887	0.04541
173	Coorg	-0.83529	-0.36544	0.31768
174	Hassan	-0.68851	-0.21948	0.25892
175	Shimoga	0.36916	-0.02995	0.08372
176	Chikmagalur	-0.76586	-0.34275	0.29384
177	Mandya	-0.79097	-0.25076	0.22884
178	Belgaum	-0.38575	-0.13228	0.13664
179	Bijapur	-0.22250	-0.17779	-0.09002
180	N. Kanara	1.00642	-1.59240	-0.93659
181	Dharwar	-0.47483	-0.11440	0.20034
182	Gulburga	2.76353	0.64850	-2.06984
183	Bidar	-0.82928	-0.29240	0.25609
184	Raichur	-0.77929	-0.27591	0.27443
185	Kalahandi	-0.63316	-0.18442	0.05530
186	Koraput	-0.49304	-0.23660	0.26452
187	Sambalpur	2.98103	-0.45907	-1.93793
188	Bolangir	-0.77521	-0.3224	0.26102
189	Baudh-Khondamals	-0.83550	-0.36537	0.31760
190	Ganjam	-0.57543	-0.26686	0.16736
191	Sundergarh	8.56639	-3.86328	-3.32732
192	Dhen-Kanal	-0.43404	-0.28555	0.52637
193	Puri	-0.52505	-0.12498	0.24160
194	Keoujhar	2.59511	-2.83897	-2.28002

DISTT.CODE	NAME	Ist Factor	2nd Factor	3rd Factor
195	Cuttack	-0.41696	-0.35625	0.20734
196	Mayurbhanj	-0.66379	-0.32234	0.28083
197	Balasore	-0.62103	-0.16866	0.16040
198	Hissar	-0.58268	0.74405	-0.62091
199	Rohtak	-0.45471	-0.04068	0.08861
200	Gurgaon	-0.03024	0.28206	-0.24862
201	Karnal	-0.58426	2.17755	-1.08183
202	Ambala	0.67475	1.11886	-0.65168
203	Simla	-0.68868	-0.16048	0.20088
204	Kangra	-0.83082	-0.35771	0.31354
206	Hoshiarpur	-0.30608	0.91017	-0.45811
207	Jullundur	-0.38281	1.73368	-1.24746
208	Ludhiana	-0.61087	2.14791	-1.73579
209	Ferozpur	-0.48971	2.79986	-2.28644
210	Amritsar	-0.54208	2.45086	-1.69016
211	Gurdaspur	-0.57988	0.93531	-0.73441
212	Kapurthala	-0.76947	0.69340	-0.55645
213	Bhatinda	-0.56008	1.30525	-1.03298
214	Sangraur	-0.74673	2.24480	-1.85354
215	Patiala	-0.53587	1.94500	-1.53751
216	Mahendragarh	-0.31115	-0.00474	-0.20863
217	Ganganagar	-0.36994	0.57992	-0.83908
218	Bikaner	-0.01860	-0.22837	-0.00680
219	Churu	-0.78333	-0.19299	0.15021
220	Jhunjhunu	-0.79238	-0.29706	0.24402

DISTT CODE	NAME	Ist Factor	2nd Factor	3rd Factor
221	Alwar	-0.73201	-0.17112	0.16915
222	Bharatpur	-0.60953	-0.18167	00.07669
223	Sawai Madhopur	2.68614	-0.31105	-2.15613
224	Jaipur	-0.37502	0.68846	0.46717
225	Sikar	-0.74127	-0.33550	0.26753
226	Ajmer	-0.55259	-0.16707	0.26803
227	Tonk	-0.82310	-0.35263	0.31463
228	Jaisalmer	-0.59916	-0.44706	0.14737
229	Jodhpur	-0.45564	0.07248	-0.16627
230	Nagaur	-0.38899	0.10039	-0.44165
231	Pali	-0.70723	-0.32852	0.24047
232	Barmer	-0.53774	-0.18410	0.14856
233	Jalor	-0.82530	-0.35009	0.30181
234	Sirohi	-0.76119	-0.32337	0.328813
235	Bhilwara	-0.61522	-0.22560	0.29022
236	Udaipur	0.95815	0.71149	0.04201
237	Chitragarh	0.23680	-0.07753	-0.39643
238	Durgapur	-0.71334	-0.28822	0.31955
239	Banswara	-0.85048	-0.36106	0.31782
240	Bundi	-0.23268	-0.03932	-0.40060
241	Kota	0.12409	0.19584	-0.33072
242	Jhalawar	-0.81897	-0.34778	0.29882
243	Uttar Kashi	-0.83557	-0.36539	0.31765
244	Chamoli	-0.83374	-0.36416	0.31772
245	Pithoragarh	-0.83482	-0.56496	0.31769

DISTT CODE	NAME	1st Factor	2nd Factor	3rd F
246	Tehri Garhwal	-0.83557	-0.36539	[illegible]
247	Garhwal	-0.79828	-0.33855	0.30786
248	Almora	-0.83431	-0.36487	0.31763
249	Naimital	-0.48697	-0.05499	-0.11557
250	Bijnor	-0.52986	0.04662	-0.15134
251	Moradabad	-0.15656	0.42586	-0.17610
252	Budaur	-0.81651	-0.30650	0.25640
253	Rampur	-0.74228	0.18263	-0.13398
254	Bareilly	-0.47002	0.71709	-0.47780
255	Pillibhit	-0.68850	-0.19585	0.09851
256	Shahjanpur	-0.57541	0.10054	0.00312
257	Dehra Dun	-0.43514	-0.39381	0.13549
258	Saharanpur	-0.52321	0.10357	-0.13929
259	Muzaffarnagar	-0.74064	0.27072	-0.17312
260	Meerut	-0.31855	0.69440	-0.41212
261	Bhulandshahr	-0.81291	0.52069	-0.42350
262	Aligarh	-0.71542	0.27528	-0.18173
263	Mathura	-0.61003	0.00210	0.10243
264	Agra	0.01296	0.79415	-0.23411
265	Etah	-0.81478	-0.11990	0.11367
266	Mainpuri	-0.80671	-0.11711	0.62230
267	Farrukhabad	-0.80591	0.20498	-0.15751
268	Etawah	-0.82087	-0.09526	0.10238
269	Kanpur	0.59744	1.25005	0.16823

DISTT CODE	NAME	Ist Factor	2nd Factor	3rd Factor
270	Fatehpur	-0.82015	-0.30956	0.27918
271	Allahabad	0.66760	0.10625	-0.38970
272	Jhansi	-0.28783	-0.10258	-0.15583
273	Jalaur	-0.80907	-0.21266	0.20630
274	Hamirpur	-0.71873	-0.16335	0.09618
2975	Banda	-0.60319	0.02704	-0.09540
276	Kheri	-0.09944	-0.48413	-0.56001
277	Sitapur	-0.64077	-0.07722	-0.01934
278	Hardoi	-0.71169	-0.30435	0.11404
279	Unnao	-0.79174	-0.29106	0.27447
280	Lucknow	-0.16329	0.15133	0.15106
281	Rai Bareli	-0.82606	-0.34957	0.30742
282	Bahraich	-0.67919	-0.22620	0.14608
283	Gonda	-0.59713	-0.26077	-0.05879
284	Bara Banki	-0.72794	-0.26993	0.25274
285	Faizabad	-0.65937	-0.22521	0.12427
286	Sultanpur	-0.82419	-0.35014	0.30351
287	Pratapgarh	-0.82842	-0.35657	0.31220
288	Basti	-0.76678	-0.25498	0.13958
289	Gorakhpur	-0.60090	-0.12556	0.10930
290	Deoria	-0.65688	-0.03316	-0.14498
291	Azamgarh	0.06309	0.25614	0.32056
292	Jaunpur	-0.82904	-0.34101	0.29661
293	Ballia	-0.80728	-0.24448	0.19496

DISTT CODE	NAME	1st Factor	2nd Factor	3rd Factor
294	Ghazipur	-0.82576	-0.30618	0.26796
295	Varanasi	-0.69562	-0.22747	0.20485
296	Mirzapur	1.46853	0.00645	-0.30933
297	Darjeeling	-0.67428	-0.25632	0.27052
298	Jalpaiguri	-0.34859	-0.23430	0.14105
299	Cooch Behar	-0.77952	-0.32105	0.25680
300	West Dinajpur	-0.81429	-0.34420	0.27419
301	Malda	-0.75473	-0.34060	0.25285
302	Murshidabad	-0.77449	-0.38156	0.26824
303	Nandia	-0.80383	-0.37300	00028086
304	24 Parganas	0.04965	-0.41713	0.37339
305	Calcutta	7.77205	0.77537	0.87113
306	Howrah	-0.77283	-0.36760	0.31836
307	Hooghly	-0.69980	-0.36088	0.32076
308	Burdwan	14.22988	-0.69608	7.71024
309	Birbhum	-0.41415	0.00251	0.06159
310	Bankura	-0.81357	-0.34615	0.30038
311	Midnapur	-0.60577	-0.19599	0.22015
312	Purulia	-0.61542	-0.33850	0.53384
313	Delhi	1.31510	0.73291	0.34015
315	Chamba	-0.83492	-0.36540	0.31771
316	Mandi	-0.83543	-0.36533	0.31766
317	Bilaspur	-0.83556	-0.36539	0.31765
318	Mahasu	-0.83557	-0.36540	0.31765

DISTT CODE	NAME	1st Factor	2nd Factor	3rd Factor
319	Sirmaur	-0.83548	-0.36534	0.31766
322	Manipur	-0.83399	-0.36486	0.31775
323	Tripura	-0.77214	-0.33130	0.24884
325	Goa, Daman, Diu	-0.55164	0.17822	0.09369
328	Pondicherry	-0.76435	-0.23330	0.32347
329	Karaikal	-0.83503	-0.36555	0.31763
330	Mahe	-0.83279	-0.36599	0.31798
332	Kohima	-0.066815	-0.14830	0.31330
335	Sikkim	-0.83557	-0.36539	0.31765

APPENDIX V

FACTOR SCORES(INDUSTRIAL RECEIPTS)

Dist.Code	Factor score	Dist Code	Factor score
001	-0.70408	022	-0.36986
002	12.27488	023	-0.45698
003	0.76741	024	0.05358
004	-1.26206	025	-1.41283
005	-0.44358	026	-0.82569
006	-0.38992	027	-0.14069
007	0.09495	029	-1.62189
008	-1.11073	030	-1.46279
009	-1.40585	031	-1.62230
010	-0.99253	032	0.59664
011	-1.23337	033	-1.00499
012	-1.54982	034	1.11983
013	4.95620	035	1.24136
014	-1.61281	036	0.08591
015	-1.41876	037	-0.48461
016	-0.52886	038	-0.24893
017	-0.93737	039	-0.44413
018	-1.10756	040	-1.06165
019	-0.28000	041	-1.25409
020	-1.54257	042	-0.73404
021	-1.12451	043	-1.24183

Dist.Code	Factor score	Dist. Code	Factor score
044	0.01654	073	-1.47440
045	3.18000	074	-1.62300
046	0.30235	075	-1.15190
047	10.43067	076	-0.44218
048	11.12752	077	-1.17214
049	0.76079	078	-1.08240
050	-0.40135	079	2.45279
051	-1.23414	080	-1.26008
052	-0.45168	081	-1.27760
053	-1.36344	082	-1.01652
054	-0.79725	083	-1.00420
055	-0.59176	084	-1.20052
056	-1.15098	085	-1.56929
057	-0.96852	086	-0.70520
058	1.59145	087	-1.58449
059	7.40808	088	-1.58271
060	0.12451	089	-1.43125
061	-0.86249	090	-1.61149
062	0.94141	091	-1.56511
063	-0.95153	093	-0.96054
064	3.06102	094	-1.62156
066	-1.62291	095	-1.23964
067	-1.41576	097	-1.30425
071	-1.61806	098	-0.92954
072	-0.28362	099	1.98119

Dist Code	Factor score	Dist Code	Factor score
100	-1.55346	126	-1.61290
101	-1.61995	127	13.57362
102	0.24169	128	-0.80355
103	-1.38773	129	-0.32891
104	-1.55550	130	-0.67338
105	-0.07540	131	-0.44587
106	-1.40148	132	0.53478
108	-1.42786	133	-1.37558
109	-0.00623	134	-0.16397
110	-1.43279	135	0.20496
111	-0.42264	136	-0.73473
112	-1.09302	137	-0.69065
113	-1.09486	138	-0.05553
114	-1.49895	139	-1.61462
115	3.31536	140	25.85329
116	-1.53713	141	2.70408
117	-1.53767	142	-0.64673
118	-1.38892	144	1.39710
119	-1.55549	145	-0.96128
120	-1.55375	146	0.17293
121	-1.35086	147	-0.40079
122	2.13146	148	6.43497
123	-1.50181	149	-0.68230
124	16.77606	150	6.28307
125	-0.50027	151	-0.24601

Dist. Code	Factor score	Dist Code	Factor score
152	-0.77789	177	-1.01551
153	-0.53359	178	-0.67304
154	0.90375	179	-0.61802
155	-1.18045	180	-1.03551
156	-1.28054	181	-0.04575
157	-1.46575	182	-0.61621
158	-1.40237	183	-1.52841
159	-0.56565	184	-1.07021
160	-1.08016	185	-1.48968
161	-1.45849	186	-0.26192
162	-0.09956	187	1 .96937
163	2.27904	188	-1.55709
164	-0.76987	189	-1.62294
165	0.05500	190	-0.96079
166	4.21134	191	7.61373
167	-1.36557	192	-1.18904
168	-1.14912	193	-0.69730
169	-1.46085	194	-1.46489
170	-0.47057	195	1.17710
171	-0.68064	196	-1.57570
172	-0.85298	197	-1.24145
173	-1.59828	198	0.55834
174	-1.18123	199	0.45048
175	-0.64840	200	1.05068
176	-1.52935	201	-0.52824

Dist. Code	Factor score	Dist Code	Factor score
202	4.08277	228	-1.37211
203	-1.41859	229	-0.33977
204	-1.32008	230	-1.06585
206	-0.50224	231	-1.49956
207	1.80161	232	-1.39562
208	0.75566	233	-1.49107
209	0.18913	234	-1.43332
210	0.54113	235	-1.45254
211	3.05226	236	-1.07616
212	-1.33380	237	-1.40885
213	0.15749	238	-1.54631
214	-0.72581	239	-1.62267
215	0.30292	240	-1.39002
216	-1.33730	241	-0.10514
217	-0.21790	242	-1.53794
218	-0.26800	243	-1.62188
219	-1.30723	244	-1.62184
220	-1.06288	245	-1.61168
221	-1.22715	246	-1.62287
222	-0.48215	247	-1.46902
223	-0.04390	248	-1.60892
224	0.27462	249	-0.76791
225	-1.36340	250	-0.80106
226	-0.93380	251	-0.41329
227	-1.58355	252	-1.44308

Dict. Code	Factor score	Dict Code	Factor score
253	-1.23948	278	-1.29213
254	0.41131	279	-0.99750
255	-1.47952	280	3.11769
256	-0.82166	281	-1.20382
257	0.42335	282	-1.14553
258	0.51544	283	-1.06322
259	-0.91725	284	-0.90698
260	4.19832	285	-0.97088
261	-1.04629	286	-1.44302
262	0.46791	287	-1.48993
263	-0.64556	288	-1.21693
264	3.29955	289	-0.38624
265	-1.33070	290	-0.81282
266	-1.11737	291	-1.37990
267	-1.21070	292	-1.13397
268	-1.13351	293	-1.35602
269	5.10280	294	-1.45004
270	-1.41737	295	3.29516
271	1.13981	296	1.21517
272	-0.47742	297	-0.87451
273	-1.23023	298	0.12548
274	-1.30912	299	-1.42296
275	-1.26925	300	-1.42408
276	-0.83323	301	-1.17108
277	0.00196	302	-1.25779

Dist. Code	Factor score	Dist Code	Factor score
303	-1.32789	332	-0.67385
304	2.85960	335	-1.62299
305	31.49599		
306	-1.33121		
307	0.09460		
308	14.60618		
309	-1.33748		
310	-1.37608		
311	0.14877		
312	-1.16900		
314	18.31844		
315	-1.62004		
316	-1.62071		
317	-1.62113		
318	-1.62299		
319	-1.62208		
322	-1.52204		
323	-1.14667		
325	0.49308		
328	-1.38070		
329	-1.56297		
330	-1.61645		

BIBLIOGRAPHY

Books

Ahmad Qazi, Indian Cities: Characteristics and Correlates, Department of Geography, University of Chicago, Chicago, Research Paper No. 102, 1965.

Ashton, W.D., The Theory of Traffic Flow, Methuen, London, 1966.

Bedenkova, M.S., Rational Transport-Economic Link in the Process of Development of Territorial Division of Labour in USSR, Location of Productive Forces and Development of Economic Regions, Moscow, 1964.

Berry, B.J.L. and Marble, D.F., eds., Spatial Analysis: A Reader in Statistical Geography, Prentice-Hall, Inc., 1971

Berry, B.J.L., A Synthesis of Formal and Functional Regions Using a General Field Theory of Spatial Behaviour in B.J.L. Berry and D.F. Marble, ed., Spatial Analysis: A Reader in Statistical Geography, p. 419-28.

_____ Essays on Commodity Flows and the Spatial Structure of the Indian Economy, Research Paper No. 111, Department of Geography, University of Chicago, Illinois, 1966.

Brown, R.H., Transport and the Economic Integration of South America, The Brookings Institution, Washington, 1966

Chenery, H.B. and Clark, P.G., Inter-Industry Economics, Wiley, New York, 1959.

Chisholm, M. and Manners, G., eds, Spatial Policy Problems of the British Economy, Cambridge University Press, 1971.

Chisholm Michael, and O'Sullivan Patrick, Freight Flows and Spatial Aspects of the British Economy, Cambridge University Press, Cambridge, 1973.

Currier, A.W., The Economics of Canadian Transportation, University of Toronto Press, Toronto, 1954.

Duncan, O.P., et.al., Metropolis and the Regions, John Hopkins Press, 1960.

Friedmann, John and Alonso, William, eds, Regional Development and Planning, MIT Press, Cambridge, 1964.

Fertiliser Association of India, Fertiliser Statistics of India: 1973-74, FAI, New Delhi, 1974.

Ghosh, A., Efficiency in Location and Inter-regional Flows: The Indian Cement Industry during Five Year Plans, North Holland, 1965.

Harris, C.D., The Geography of Manufacturing, American Geography Inventory & Prospect, edited by P.E. James and C.B. Jones, Syracuse University Press, Syracuse, 1954.

Hoover E.M., The Location of Economic Activity, McGraw-Hill, New York, 1948.

Hurst, M.E., ed., Transportation Geography: Comments and Readings, McGraw Hills, 1974.

Indian Statistical Institute, Mysore State, ed., S. N. L. Learmonth and L.S. Bhat (ISI Series No. 13 & 16), 1961-62.

Isard Walter, Location and Space Economy, M.I.T. Press, Cambridge, 1956, pp. 1-9.

_____ Methods of Regional Analysis: An Introduction to Regional Science, M.I.T. Press, Cambridge, 1960.

Longbrake, D.B., The Regional and Inter-regional Relations of the Port of Madras, Unpublished Master's dissertation, Department of Geography, University of Chicago, 1964.

Myrdal, G., Economic Theory of Under-Developed Regions, Duckworth, 1957.

National Council of Applied Economic Research, Economic Atlas of Madras State, NCAER, New Delhi, 1962.

_____ Transport Requirements of Iron & Steel Belt, NCAER, New Delhi, 1965.

Olsson, G., Distance and Human Interaction: A Review and Bibliography, Regional Science Institute, 1965.

Owen, W., Distance and Development: Transport and Communication in India, The Brookings Institution, 1968.

Potts, R.B. and Oliver, R.M., Flows in Transport Networks, Academic Press, 1972.

Rao, M.A., Indian Railways Series: India - The Land and People, National Book Trust, 1975.

Reed, W.E., Areal Interactions in India: Commodity Flows of the Bengal-Bihar Industrial Area, Research Paper No. 110, Department of Geography, University of Chicago, 1967.

Rosenbluth, G., Concentration of Canadian Manufacturing Industries, National Bureau of Economic Research, Princeton University Press, Princeton, 1957.

Singh, J., Transport Geography of South Bihar, Banaras Hindu University Press, 1967.

Singh, R.L., Banaras: A Study of Urban Geography, Nand Kishore & Bros., Banaras, 1955.

Taaffe, E.J. and Gauthier, H.L., Jr., Geography of Transportation, Foundations of Economic Geography Series, Prentice-Hall, Inc., 1973.

Tiwari, R.D., Railways in Modern India, New Book Co., 1941.

Ullman, E.L., American Commodity Flow, A Geographical Interpretation of Rail & Water Traffic Based on Principles of Spatial Interchange, University of Washington Press, Seattle, 1957.

_____ The Role of Transportation and the Bases of Interaction, Man's Role in Changing the Face of Earth, edited by William L. Thomas, University of Chicago Press, Chicago, 1956, pp. 862-880.

Articles

Alampiev, P.M., "Economic Regionalization of USSR", Economic Literature, Moscow, 1959.

Barker, D.A., "The Railway Policy in India", Indian Journal of Economics, Vol. 1, 1961, pp. 434-439.

Berry, B.J.L., "Recent Studies Concerning the Role of Transportation in Space Economy", Annals of the Association of American Geographers, Vol. 49, No. 3, 1959, p. 328.

Fuoton, Maurice and Hoch, Clurton, "Transportation Factors Affecting Location Decisions", Economic Geography, Vol. XXXV, January 1959, pp. 51-59.

Garrison, W.L., "Spatial Structure of the Economy", Annals of the Association of American Geographers, Vol. XLIX, 1959, pp. 232-239 and 471-482; Vol. L, 1960, pp. 357-373.

Gidadhubli, R.G., and Bhat, L.S., "Economic Regions and Regional Flows - A Case Study in the Flow Patterns and Trends in Selected Commodities in India in Economic and Socio-Cultural Dimensions of Regionalisation. An Indo-USSR Collaborative Study, Census of India 1971, Census Centenary Monograph No. 7, Office of the Registrar General of India, Ministry of Home Affairs, New Delhi, p. 175.

Gould, P.R. and Smith, R.H.T., "Methods in Commodity Flows Analysis, Australian Geographers, Vol. 8, 1961, p. 73.

Greenhut, M.L., "Space & Economic Theory", Papers & Proceedings of the Regional Science Association, Vol. V, 1959, pp. 267-280.

Harris, C.D., "The Market as a Factor in the Location of Industry in the United States", Annals of Association of American Geographers, Vol. XLIV, December 1954, pp. 315-348.

Isard, W., "Regional Commodity Balance and Inter-Regional Commodity Flows", The American Economic Review, Vol. XLIII, No. 2, May 1953, p. 167.

Kar, N.B., "Economic Character of Metropolitan Sphere of Influence of Calcutta", Geographical Review of India, Vol. XXX, No. 2, June 1963.

Kistanov, V.V., "Complex Development Specialization of the Economies of the Economic Regions, ECONOMIKA, Moscow, 1969.

Meyer John R., "Regional Economics: A Survey", American Economic Review, Vol. LII, March 1963, pp. 47-48.

Mitsuhashi, S., "Japanese Commodity Flows", Selection Papers, Vol. II, Economic Geography, 21st International Geographical Congress, India, 1968, National Committee for Geography, 1970, p. 177.

Owen, W., "Transport and Economic Development", American Economic Review, Vol. 49, 1959, p. 179.

Pal, M.N., "Regional Disparities in the Level of Development in India", Indian Journal of Regional Science, Vol. 7, No. 1, 1975.

Pred, A., "Toward a Typology of Manufacturing Flows", Geographical Review, Vol. 54, 1964, pp. 65-84.

Probst, A.E., "Location of Industry under Socialism" (Theoretical Essay), EKONOMIZAT MOSCOW, 1962.

Raza, Moonis and Chattopadhyay, Baudhayan, "Regional Development: Analytical Framework and Indicators", Indian Journal of Regional Science, Vol. 7, No. 1, 1975.

Sdyasuk, G., "Transport and Formation of Economic Regions in India", in Sengupta, P. and Sdyasuk, G., eds, Economic Regionalisation of India - Problems and Prospects, Census of India, 1961, Monograph Series, Vol. 1, No. 8, 1968.

Singh, J., "A Perspective on the Patterns and Problems of Coal Transport in India", National Geographical Journal of India, Vol. 12, No. 2, 1966, p. 96.

_____ "Transport Network, Traffic Flow and Location of Industries in the Iron and Steel Belt of India", Selected Papers Vol. II Economic Geography, 21st International Geographical Congress, India National Committee for Geography, 1970, p. 257.

Smith, R.H.T. and Hay, A.M., "A Theory of Spatial Structure of Internal Trade in Underdeveloped Countries", Geographical Analysis, Vol. 1, 1969, pp. 121-136.

Taaffe, R.N., "Transportation and Regional Specialization: The Example of Soviet Central Asia", Annals of Association of American Geographers, Vol. 52, 1962, pp. 80-98.

Thorner, Daniel, "The Pattern of Railway Development in India", Far Eastern Quarterly, Vol. 14, 1955, p. 201.

Wallace, I, "The Relationship Between Freight Transport Organization and Industrial Linkage in Britain", Institute of British Geographical Transactions, No. 62, July 1974, p. 25.

Wilson, A.G., "A Statistical Theory of Spatial Distribution Models", Transportation Research, Vol. 1, 1967, pp. 253-69.

Govt. Publications

Govt. of India, Department of Commercial Intelligence and Statistics, Accounts Relating to the Inland (Rail-Review Borne) Trade in India, Calcutta.

Govt. of India, Central Statistical Organization, Economic Surveys for Various Years.

Govt. of India, Ministry of Railways, Annual Report and Accounts for Various Years.

Govt. of India, Ministry of Railways, Statistical Aid to Railway Operations, Technical Paper No. 330.

Govt. of India, Central Statistical Organization, National Income Statistics.

Govt. of India, Planning Commission, Draft Five Year Plan 1978-83.