

# **THE STRUCTURE OF THE INDIAN ECONOMY**

**Paramita Dasgupta & Debesh Chakraborty**

**Paramita Dasgupta**

Lecturer

Department of Economics

Ananda Chandra College

P.O & Dist. Jalpaiguri

Pin- 735101

West Bengal, India

Tel: 91-03561 255554 / 91-03561 227982

[paramita\\_dasgupta23@rediffmail.com](mailto:paramita_dasgupta23@rediffmail.com)

**Debesh Chakraborty**

Department of Economics

Jadavpur University

Calcutta- 700032

India

Tel: 91-33 24146328

[debesh\\_chakraborty@hotmail.com](mailto:debesh_chakraborty@hotmail.com)

Abstract and paper submitted for the Fifteenth International Input-Output Conference to be held at the Renmin University in Beijing, China, June 27- July1, 2005.

# THE STRUCTURE OF THE INDIAN ECONOMY

Paramita Dasgupta\* & Debesh Chakraborty\*\*

## Abstract

The study explores the structure of the Indian economy with an input based scheme of classification of sectors. On the basis of the factors of production (natural resource, research & development and labour & capital) intensively used in the production process, all economic activities are classified into three broad categories - Ricardo sectors (natural resource intensive), High-Technology sectors (high-technology intensive) and Heckscher – Ohlin sectors (capital-labour intensive). In order to explore the structure of the Indian economy Input – Output technique developed by Leontief, has been used as it offers important insights into the structure of an economy. The relative strength of linkages of the three categories of sectors have been studied and the key sectors of the Indian economy are identified.

Rasmussen's most widely used methods of measuring forward and backward linkages are used to identify the key sectors. Forward linkages of different sectors are also measured within the Ghosian framework where a matrix of fixed output coefficients is used for this purpose.

When we use Rasmussen's method for measuring both forward and backward linkages, key sectors are mostly Heckscher – Ohlin (H-O) sectors. Among the ten key sectors, the numbers of the Ricardo and High Technology (H-T) sectors are two and one respectively. Again when Rasmussen's method for measuring backward linkage and Ghosian framework for measuring forward linkage are used, the number of the key sectors has substantially increased to eighteen. The numbers of both the Ricardo and H-T sectors have increased while the number of the H-O sectors remains same.

In order to get a better picture about the structure of the Indian economy, another framework is presented in the paper. The I-O model is partially closed for which sectors are divided into two groups, durable sectors and non-durable sectors. The non-durable sectors are endogenised to form an addition vector on the transaction matrix and the durable sectors are treated as exogenous. In the augmented structure there has been a significant improvement in the absolute values of both forward and backward linkages but the qualitative characters of the sectors have not seen to be changed significantly. In the augmented structure, the number of the key sectors is seen to be less than that of the identified key sectors

in the Leontief and Ghose models. Interestingly, none of the H-T sectors qualifies as the leading sector in this structure.

Finally in the paper the components of final demand are identified which act as the driving force behind the entire analysis of linkages in the input-output static open framework. The study concludes with some policy implications.

\* Department of Economics, Ananda Chandra College, P.O & Dist. Jalpaiguri, Pin-735101, West Bengal, India.

E-mail address: [paramita\\_dasgupta23@rediffmail.com](mailto:paramita_dasgupta23@rediffmail.com)

\*\* Department of Economics, Jadavpur University, Kolkata 700032, India.

E-mail address: [debesh\\_chakraborty@hotmail.com](mailto:debesh_chakraborty@hotmail.com)

# THE STRUCTURE OF THE INDIAN ECONOMY

## Introduction

Over the last 56 years, the Indian economy has experienced a gradual structural change. Though the pace of the structural transformation was more or less slow throughout the pre-reform period, it has become rapid after the introduction of new economic reforms in the decade of the nineties. At the time of independence, Indian economy was predominantly rural and agricultural. At the beginning years of the First Five-year Plan, contribution of the primary sector (agriculture, forestry and logging, fishing) in GDP at factor cost was largest followed by tertiary sector and secondary sector respectively. Thereafter the major drive towards diversification and modernization of the Indian economy in the following plans resulted in increased shares of the secondary and tertiary sectors and declined share of the primary sector in the national product. The share of the primary sector in GDP at factor cost declined from 54.56% in 1950-51 to 27.87% in 1999-00 while share of the secondary sector was 16.11% in 1950-51 and increased to 25.98% in 1999-00. The share of the tertiary sector increased from around 29% to 46% during this period. Indian economy also experienced a major structural change within the industrial sector as a result of the major drive for industrial diversification in the mid-fifties. While the share of the capital goods industries and the basic goods industries in the total industrial value added increased more or less rapidly, the share of the consumer goods in total industrial value added declined considerably over the years.

However, the pace of transition of the Indian economy from an agricultural economy to an industrial one was quite slow since 1951. It was in the decade of the eighties the economy emerged from the phase of slow growth rate and deceleration. Finally, a major shift in the macroeconomic policies in the decade of the nineties accelerated the pace of the structural transformation of the Indian economy and set India on a high growth trajectory. In terms of average growth rate, the performance in the nineties (6.5%) was better than that recorded in the eighties (5.8%). While both the industrial and service sectors registered relatively high growth rates during recent period, agriculture and allied activities experienced a relatively low rate of growth as compared to the eighties. This underlines a major structural shift in the Indian economy in recent years, with economic growth becoming more vulnerable to the performance of industrial and service sectors and less to the performance of the agricultural sector. In order to keep the momentum of the structural transformation of the Indian economy, investment should be concentrated to those sectors which are strongly integrated with the rest of the economy and have a larger multiplier effect on growth and development. In other words, the key or priority sectors are those which can stimulate greater economic activities in other sectors and investment should be concentrated to these sectors, particularly to achieve the target rate of growth of 8% of real GDP as envisaged in the Tenth Five-year Plan.

This paper has studied the structure of the Indian economy with an objective to identify the key sectors which could accelerate the overall growth rate of the economy in the post-liberalization period. While exploring the structure of the Indian economy a new scheme of classification of sectors based on the factors of production used intensively in the production process of different sectors, has been used. All economic activities are classified into three broad categories - Ricardo sectors (natural resource intensive), High-Technology sectors (high-technology intensive) and Heckscher - Ohlin sectors (capital-labour intensive), on the basis of inputs (natural resource, research & development and labour & capital) used intensively in the production process. Such classification is completely different from the usual way of classifying the sectors like primary sector, secondary sector and tertiary sector. The input based scheme for classification of the sectors in the study of the structure of the Indian economy is expected to reveal the importance of the resource intensive, technology intensive and labour and capital-intensive sectors in the production structure of the Indian economy.

The structural relationship of an economy can be examined by using the input-output tables. The study of the sectoral linkages and the identification of the key sectors based on the input-output technique shows the nature and the degree of interdependence of an economy. Thus in order to study the structure of the Indian economy with the classification of sectors based on input usage input-output technique is appropriate. For this purpose we have used the Indian Input-Output Transaction Table of the year 1993-1994, sourced from Central Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India. All the figures are given in Rs(lakh). We have aggregated the commodities and reduced the transaction matrix into a (72 x 72) one. The aggregation scheme is given in the appendix table A. All the subsequent analysis has been in terms of aggregated transaction matrix.

There are several studies on the linkage analysis and the structural interdependence of the Indian economy. The pioneers in this field were Baradwaj (1966), Hashim (1970) and Hazari (1970). The other studies related to the sectoral linkages in India are done by Bhalla (1974), Mehta (1977), Venkatramaiah and Argade, Saxena and Bhatnagar (1987). Saxena and Dhawan (1992) have studied the intersectoral linkages in the Indian economy and identified the key sectors by using the supply side model for calculating the forward linkages and demand side model for calculating the backward linkages. A more recent study on linkages of the Indian economy is conducted by Sastry, Singh, Bhattacharya and Unnikrishnan (2003). They have examined the linkage of growth among the agriculture, industry and service sectors of the economy using both input-output and simultaneous equations framework.

The plan of the paper is as follows: In section 1 the definitions of three categories of sectors are given and input based scheme for classification of sectors are discussed. Section 2 begins with a discussion on the input-output methodology used in this study. The forward and backward linkage results are discussed and key sectors of the Indian economy are identified in this section. The linkage analysis is further discussed within an

augmented structure in section 3. In section 4 the components of final demand acting as stimulant for different sectors are identified. The summary and conclusions drawn on the basis of the empirical results are discussed in section 5.

## Section 1

### CLASSIFICATION OF SECTORS

All economic activities can be classified into three broad categories according to the factors used intensively in the production process. These three categories are:

- (a) Ricardo sectors.
- (b) High technology sectors
- (c) Heckscher - Ohlin sectors.

All seventy-two sectors (after aggregation) are distributed into these three categories depending on the resources or factors, intensively used in their production process.

**RICARDO SECTORS:** Ricardo sectors are those which use natural resources intensively in their production process. Production of agricultural crops and other allied activities like milk and milk products, animal services, forestry and logging, fishing are basically natural resource intensive and therefore treated as Ricardo sectors. By the same argument minerals like coal and lignite, crude petroleum and natural gas, iron ore, metallic and non metallic minerals are included in the category of Ricardo sectors. Apart from that, the agro-based sectors like sugar and khandsari boora, cotton textiles, jute, mesta, hemp textiles, other textiles, food and beverages, tobacco and tobacco products, wood and wood products, paper and paper products etc can also be regarded as Ricardo sectors as resource intensive agricultural commodities are the most important factors of production used in the production process of these sectors. The industries like leather products, petroleum products, cement are characterized by intensive use of natural resources and therefore are regarded as Ricardo sectors. Twenty-seven out of seventy two sectors are regarded as Ricardo sectors.

**HIGH-TECHNOLOGY SECTORS:** The sectors requiring relatively higher proportion of research and development are included into the second category called High-Technology sectors (H-T sectors). This category contains most of the sophisticated technology-using manufacturing sectors like industrial electrical and non-electrical machines, electronic equipment, transport equipment, communication equipment, pesticides, heavy chemicals etc. Education and research, medicines and drugs, medical and health, communication are also regarded as H-T sectors because these sectors require higher proportion of research and development. There are all total twenty-three sectors in this category.

**HECKSCHER-OHLIN SECTORS:** The sectors that use relatively standardized production technologies are regarded as Heckscher-Ohlin sectors (H-O sectors). In other words, H-O category contains the sectors which are either capital or labour intensive. This category consists of capital intensive sectors like iron & steel, fertilizers, synthetic fiber and resin, non-ferrous basic metals, rubber and plastic products etc. and labour intensive sectors like printing and publishing, furniture and fixtures, miscellaneous manufacturing etc. Being

labour intensive sectors banking and insurance, transport services, trade, other services and public administration also find place in this category .The number of H-O sectors is twenty-two.

The classification of sectors on the basis of production characteristics are given in appendix table B.

## Section 2

### METHODOLOGICAL FRAMEWORK

Input-Output technique developed by Leontief (1956) is an important analytical tool to understand and grasp the nature and the degree of integration of an economy. Only an input-output frame of reference can provide the picture of interdependence of sectors within an economy. The concepts of backward and forward linkages related to this method are very useful for assessing the impact associated with the growth of a particular sector. This in turn helps in formulating different economic policies. So in order to study the structure of Indian economy with the classification based on production characteristics, this technique is appropriate.

Leontief static open input-output model is represented as,  
 $x = [X]e + f$ , where  $[X]$  is the  $(n \times n)$  transaction matrix,  $e$  is the  $(n \times 1)$  unit vector and  $f$  and  $x$  are the  $(n \times 1)$  final demand vector and gross output vector respectively.

The solution of the system is

$x = (I - A)^{-1} f$ , where  $A$  is the  $(n \times n)$  technical coefficient matrix or fixed input coefficient matrix, the elements of  $A$ ,  $a_{ij} = X_{ij} / x_j$ .  $(I - A)^{-1}$  is the Leontief Inverse. The elements of the technical coefficient matrix  $A$  indicate only the direct requirements per unit of output while the elements of the matrix  $(I - A)^{-1}$  give both direct and indirect requirement per unit of output. The forward linkages and backward linkages in Leontief framework measure the degree of integration of a particular sector with the rest of the economy. While studying the structural changes in Denmark overtime, Rasmussen (1956) developed the measurement of the industrial linkages using Leontief inverse matrix. Hirschman (1958) used Rasmussen's indices for identification of key sectors in his analysis about disequilibrium development strategy. However, the demand led Leontief model is criticized as being inadequate for measuring the forward linkages. So Rasmussen's measure for forward linkages based on Leontief inverse is said to have a serious qualitative inconsistency. In fact in the Rasmussen index for the sector  $j$  forward linkage consists only of commodity  $j$  and is therefore completely different from the real nature of forward linkage (which, if correctly evaluated, should be expressed in terms of all commodities) (Cella, 1984). An alternative measure for the forward linkages can be obtained by using the supply driven Ghose model (1958).

The Ghosh model is given by

$x' = e' [X] + v'$ , where  $v'$  denotes the transpose of the value added vector .  $e'$  and  $x'$  are the transpose of the unit vector and gross output vector respectively.

The solution of the Ghosh model is

$x' = v' (I - B)^{-1}$ , where B is the supply coefficient matrix or fixed output coefficient matrix. The elements of B,  $b_{ij} = X_{ij} / x_i$ .

Thus in the Leontief model, an element of  $(I - A)^{-1}$  shows the increase in the gross output of industry i if the final output of industry j increases by a unit; while in the Ghosh model, an element of  $(I - B)^{-1}$  denotes the increase in the output of the jth industry required to utilize the increased output of the ith industry.

**BACKWARD LINKAGES:** Backward linkage of a sector shows the relationship between the activity in the sector and its purchases. The backward linkage of a particular sector is defined as the change in gross output of all sectors in an economy if the final demand for that particular sector increases by a unit. In matrix notation, backward linkages are defined as,

$$Q = e' (I - A)^{-1}$$

where e is the unit vector and Q is the vector for backward linkages. Leontief Inverse is premultiplied by the transpose of unit vector i.e. the backward linkages are nothing but the column-sums of the Leontief inverse. The k-th column sum would indicate a change in output of the whole economy if the final demand of the k-th sector increases by one unit. The backward linkages are also treated as output multipliers in the input-output framework.

**FORWARD LINKAGES:** Forward linkage shows the relationship between the total output of a sector and the sale of its output as intermediate input to other sectors. The measure of forward linkages in demand led model is defined as the row-sums of the Leontief inverse i.e. forward linkage of a particular sector shows the change in the total output of the sector if the final demand of each sector increases by one unit.

In matrix notation the forward linkages in the demand led model are

$$R_1 = (I - A)^{-1} e$$

where the vector for forward linkages is denoted by  $R_1$ . An alternative measure of forward linkages is obtained in the supply led model where the forward linkages are defined as the row sums of the matrix  $(I - B)^{-1}$ , that is,

$$R_2 = (I - B)^{-1} e, \text{ where the vector for forward linkages is denoted by } R_2.$$

**BACKWARD AND FORWARD LINKAGE INDICES:** Backward and forward linkage indices reveal the relative linkage strength of a particular sector in terms of backward and forward linkages respectively. Backward linkage index is defined by the ratio of average of j-th column of Leontief inverse to the total average, that is,

$$I_1 = c / L$$

where  $c = \sum_{\forall i} p_{ij} / n$ , the column - wise average and  $L = \sum_{\forall i,j} p_{ij} / n^2$ , the total average and  $p_{ij}$  denotes



the elements of Leontief inverse . Similarly, the index constructed for measuring the strength of forward linkage in the demand side model is defined as the ratio of average of i-th row sum of Leontief Inverse to the total average.

$$I_2 = r / L$$

where  $r = \sum_{\forall j} p_{ij} / n$  the row-wise average . Rasmussen however has labeled these two types of

indices as the ‘ power of dispersion’ and ‘sensitivity of dispersion’ respectively. Similar measure is used to calculate the forward linkage index in the supply led model, where the row sums are obtained from the matrix  $(I - B)^{-1}$ .

$$I_3 = h / G$$

where  $h = \sum_{\forall j} q_{ij} / n$  and  $G = \sum_{\forall i,j} q_{ij} / n^2$  and  $q_{ij}$  denotes the elements of  $(I - B)^{-1}$

If the column-wise average (row-wise average) is greater than the total average, then the sectors are said to have a strong integration with the rest of the economy in terms of backward linkages (forward linkages), while the other sectors have either moderate or weak linkage strength. Based on the index values, all the seventy-two sectors are divided into three groups namely strong intermediate and weak. The sectors with index values either greater than or equal to one are grouped into the strong category. The intermediate group contains the sectors with index values less than one but greater than or equal to .8 while the rest are included in the weak group, that is,

Strong:  $LI \geq 1$

Intermediate:  $1 > LI \geq .8$

Weak:  $LI < .8$ ,  $LI =$  Linkage Indices.

As averages are said to be sensitive to extreme values, a measure for variability of the linkages is required to measure the stability of the linkages strength provided by the sectors. For this purpose coefficients of variation for the Leontief backward and forward linkage indices and Ghosian forward linkage indices are measured. Coefficients of variation for Leontief backward and forward linkage indices and Ghosian forward linkage indices denoted by CV1, CV2 and CV3 respectively are defined as,

$$CV_1 = [ (1/n-1) \sum_{\forall i} \{p_{ij} - (1/n) \sum_{\forall i} p_{ij}\}^2 ]^{1/2} [(1/n) \sum_{\forall i} p_{ij}]^{-1}$$

$$CV_2 = [ (1/n-1) \sum_{\forall j} \{p_{ij} - (1/n) \sum_{\forall j} p_{ij}\}^2 ]^{1/2} [(1/n) \sum_{\forall j} p_{ij}]^{-1}$$

$$CV_3 = [ (1/n-1) \sum_{\forall j} \{q_{ij} - (1/n) \sum_{\forall j} q_{ij}\}^2 ]^{1/2} [(1/n) \sum_{\forall j} q_{ij}]^{-1}$$

Smaller the value coefficient of variation, greater is stability of the linkage provided by the sector. The backward linkage indices, forward linkage indices in Leontief framework and forward linkage indices in the Ghosian framework along with their values of coefficient of variation are enclosed in the appendix tables C, D and E respectively.

### **Empirical results and discussions**

From appendix table C, it is very heartening to observe that out of the seventy two sectors, the number of the sectors with strong backward index is forty seven, that is around sixty five percent of the sectors has the capacity of affecting the gross output of the economy significantly. Any change in final demand in these sectors will effectively influence the economic activities of the other sectors. Seven and eighteen sectors are found to be moderately and weakly linked with the rest of the economy respectively in terms of backward linkages. If we look into the input usage based classification of these forty-seven sectors we will find that the number of the H-T sectors is highest, followed by the H-O and Ricardo sectors. Out of the forty-seven sectors, twenty-one sectors are highly technology intensive, while the numbers of the H-O and Ricardo sectors are fourteen and twelve respectively (Table 1).

From table 1, it can be seen that among H-T sectors, industrial and non industrial machines, both electrical and non electrical, electronic equipment, motor vehicles, other transport equipment, heavy chemicals, pesticides, communication equipment, tractors and agricultural implements, rail equipment etc are found to be strongly integrated with the rest of the economy. On the other hand, Iron and steel, electricity, construction, rubber and plastic products, non ferrous basic metals, fertilizers, paints, varnishes and lacquers, printing and publishing, miscellaneous manufacturing, synthetic fiber and resin etc are the H-O sectors which can stimulate greater economic activities in other sectors of the economy. Except animal services, most of the Ricardo sectors are either agro based industries like cotton textiles, jute, mesta, hemp textiles, other textiles, other food products and beverages, leather products, paper and paper products, sugar and khandsari boora etc or related to mining like coal tar products, petroleum products, other non metallic mineral products.

Intermediate group contains only seven sectors. All of them except transport services and hotels and restaurants are Ricardo sectors while no H-T sector features among them.

**TABLE 1 : SECTORS WITH STRONG BACKWARD LINKAGES (LEONTIEF)**

RICARDO SECTORS	H-T SECTORS	H-O SECTORS
Paper and paper products, newsprint	Pesticides	Iron and steel
Other textiles	Industrial machinery	Non ferrous basic metals
Leather products	Tractors and agri. Implements	Fertilizers
Cement	Electrical wires, cables and appliances	Hand tools and metal products
Other food products and beverages	Electronic equipment	Soaps, cosmetics and glycerin
Coal tar products	Batteries	Paints, varnishes, lacquers
Cotton textiles	Motor Vehicles	Rubber and plastic products
Petroleum products	Other transport equipment	Synthetic fiber and resin
Jute, hemp and mesta textiles	Electrical industrial machinery	Misc. manufacturing
Animal services	Ships and boats	Printing and publishing
Other non metallic mineral products	Other non electrical machines	Tea and coffee processing
Sugar and khandsari boora	Drugs and medicines	Electricity
	Communication equipment	Construction
	Heavy chemicals	Structural clay products
	Rail equipment	
	Watches and clocks	
	Other chemicals	
	Medical and health	
	Other electrical machinery	
	Machines tools	
	Office computing machines	

Let us now examine the percentage share of each category of sectors in three groups of linkage strength, which would reflect the strength or capacity of each category of sectors in percolating the effects of growth to the rest of the economy. Table 2 displays the percentage share of each category of sectors in the case of backward linkages.

**TABLE 2: PERCENTAGE SHARE OF EACH CATEGORY OF SECTORS IN BACKWARD LINKAGES (LEONTIEF)**

CATEGORY: GROUP:	RICARDO SECTORS	H-T SECTORS	H-O SECTORS
STRONG	12(44.44)	21(91.30)	14(63.64)
INTERMEDIATE	5(18.52)	0(0.0)	2(9.09)
WEAK	10(37.04)	2(8.70)	6(27.27)

The H-T sectors play the most dominating role in this case as 91.30% of H-T sectors have strong backward index values. Changes in the final demand of around 44.44% of Ricardo sectors have strong impact on the gross output of the economy. However, the percentage of these sectors with weak backward linkage values is not an insignificant one (37.04%). In the case of the H-O sectors, fourteen out of twenty two sectors i.e. 63.64% of sectors have strong impact on the gross output of the economy in terms of backward linkages.

In the case of Leontief forward linkage indices, nineteen sectors are seen to have a higher than average forward linkage index value. The forward index values of the sectors in demand side model are given in appendix table D. Out of the nineteen sectors with strong index values, twelve sectors are from H-O category and most of them are basic industries and services like trade, transport services, electricity, iron and steel, banking and insurance, construction, non ferrous basic metals etc. The only H-T sector showing strong integration with the rest of the economy in terms of Leontief forward linkage is heavy chemicals. In the demand side model only six Ricardo sectors possess strong forward linkage index values. They are crude petroleum and natural gas, other crops, coal and lignite, commercial crops, petroleum products and paper and paper products. Most of the Ricardo sectors and H-T sectors are found to be weakly linked with the other sectors. (Table 3 )

**TABLE 3: SECTORS WITH STRONG FORWARD LINKAGES (LEONTIEF)**

RICARDO SECTORS	H-T SECTORS	H-O SECTORS
Crude petroleum and natural gas	Heavy chemicals	Transport services
Other crops	Other chemicals	Trade
Coal and lignite		Electricity
Petroleum products		Iron and steel
Paper and paper products, newsprint		Banking and insurance
Commercial crops		Other services
		Non ferrous basic metals
		Synthetic fiber and resin
		Hand tools and other metal products
		Construction
		Rubber and plastic products

Let us now find the degree of sensitivity of these three categories of sectors with respect to changes in the final demand. The conclusion that we can draw from the table 4 is that a substantial proportion of the H-O sectors (50 %) is strongly sensitive to the changes of final demand in all sectors and at the same time weak sensitivity is also present in significant percentage (40.91). Most of the H-T sectors are weakly sensitive to the changes in the final demand. In case of the Ricardo sectors we observe a fairly high percentage (62.96%) of weak sensitivity to changes in final demand.

**TABLE 4: SHARE OF EACH CATEGORY IN FORWARD LINKAGES (LEONTIEF)**

CATEGORY: GROUP:	RICARDO SECTORS	H-T SECTORS	H-O SECTORS
STRONG	6(22.22)	2(8.70)	11(50.00)
INTERMEDIATE	4(14.81)	3(13.04)	2(9.09)
WEAK	17(62.96)	18(78.26)	9(40.91)

However, the empirical results obtained in the Ghosh's supply side model are quite different from those found in the Leontief demand side model. Appendix table E displays the index values of the sectors in the supply side model. The numbers of Ricardo and H-T sectors with strong forward linkage values have significantly increased while the number of the H-O sectors has declined in the Ghosh model. Total number of sectors with strong index values has also increased from nineteen to twenty six of which twelve sectors are resource intensive. The number of Ricardo sectors with strong linkage indices in the supply side model is twice the number of these sectors in the demand side model. Apart from heavy chemicals and other chemicals, other electrical machinery, pesticides, communication, industrial machinery also qualify as the other H-T sectors strongly integrated with the rest of the economy in terms of forward linkage (Table 5).

The number of H-O sectors has declined to eight in the supply side model. Among the H-O sectors, paints, varnishes and lacquers, fertilizers, structural clay products, are the newly included sectors in the group of the strong index values, while the sectors which do not find place in the strong group are trade, transport, construction, rubber and plastic products and hand tools and other metal products.

**TABLE 5: SECTORS WITH STRONG FORWARD LINKAGES (GHOSH)**

RICARDO SECTORS	H-T SECTORS	H-O SECTORS
Other non metallic minerals	Heavy chemicals	Electricity
Crude petroleum and natural gas	Other electrical machinery	Iron and steel
Coal tar products	Pesticides	Banking and insurance
Coal and lignite	Communication	Fertilizers
Other metallic minerals	Industrial machinery	Non ferrous basic metals
Paper and paper products, newsprint	Other chemicals	Synthetic fiber and resin
Petroleum products		Structural clay products
Iron ore		Paints, varnishes and lacquers
Jute, hemp and mesta textiles		
Animal services		
Wood and wood products		
Cement		

So far as the percentage share of each category of sectors in the each group of index values is concerned, the share of Ricardo sectors in the strong group has increased substantially from 22.22% to 44.44%. The

percentage share of the H-T sectors are increased from 8.70% to 26.09%. In the case of the H-O sectors, the share in the strong group has declined from 50% to 36.36% and that in the intermediate group has increased from 9.09% to 27.27%. (Table 6).

**TABLE 6: SHARE OF EACH CATEGORY IN FORWARD LINKAGES (GHOSH)**

CATEGORY: CLASS:	RICARDO SECTORS	H-T SECTORS	H-O SECTORS
STRONG	12(44.44)	6(26.09)	8(36.36)
INTERMEDIATE	2(7.41)	5(21.74)	6(27.27)
WEAK	13(48.15)	12(52.13)	8(36.36)

### Identification of key sectors

According to Hirschman (1958), the sectors which possess strong forward and backward linkage indices qualify as the key sectors of an economy. This study of exploring the structure of the Indian economy identifies the following sectors as the key or priority sectors of the Indian economy. Table 7 shows the key sectors obtained in the Leontief model while the identified key sectors, when backward linkages are measured in Leontief framework and forward linkages are measured in the Ghosh framework are given in the Table 8.

**TABLE 7: KEY SECTORS WHEN DEMAND LED MODEL USED FOR MEASURING FORWARD AND BACKWARD LINKAGES IS USED**

SL. NO.	KEY SECTORS	CATEGORY
23	PAPER AND PAPER PRODUCTS	RICARDO
27	PETROLEUM PRODUCTS	RICARDO
29	HEAVY CHEMICALS	H-T
36	OTHER CHEMICALS	H-T
35	SYNTHETIC FIBRE , RESIN	H-O
40	IRON AND STEEL	H-O
41	NON FERROUS BASIC METALS	H-O
42	HAND TOOLS AND OTHER METAL PRODUCTS	H-O
60	CONSTRUCTION	H-O
61	ELECTRICITY	H-O
26	RUBBER AND PLASTIC PRODUCTS	H-O

When the demand side model is used for measuring both forward and backward linkages, the key sectors are mostly H-O sectors. Among the ten key sectors, the numbers of the Ricardo and H-T sectors are two each. Heavy chemicals and other chemicals are the only two H-T sectors strongly integrated with the rest of the economy. Paper and paper products, newsprint and petroleum products are the two Ricardo sectors qualified as the key sectors in the demand side model. The remaining seven sectors are either capital or labour intensive and are basically the basic industries and infrastructure like iron and steel, construction, electricity,

non ferrous basic metals, rubber and plastic products etc. The development of these sectors as the key sectors of the Indian economy is perhaps be the result of the planned economic development in India. Investment in these sectors will be channeled back into the other sectors of the economy.

**TABLE 8: KEY SECTORS WHEN DEMAND LED MODEL USED FOR MEASURING BACKWARD LINKAGES AND SUPPLY LED MODEL USED FOR MEASURING FORWARD LINKAGES ARE USED**

SL . NO.	KEY SECTORS	CATEGORY
28	COAL TAR PRODUCTS	RICARDO
23	PAPER AND PAPER PRODUCTS , NEWSPRINT	RICARDO
27	PETROLEUM PRODUCTS	RICARDO
20	JUTE, HEMP AND MESTA TEXTILES	RICARDO
6	ANIMAL SERVICES	RICARDO
38	CEMENT	RICARDO
29	HEAVY CHEMICALS	H-T
52	OTHER ELECTRICAL MACHINERY	H-T
31	PESTICIDES	H-T
44	INDUSTRIAL MACHINERY	H-T
36	OTHER CHEMICALS	H-T
41	NON FERROUS BASIC METALS	H-O
35	SYNTHETIC FIBRE, RESIN	H-O
40	IRON AND STEEL	H-O
61	ELECTRICITY	H-O
30	FERTILIZERS	H-O
32	PAINTS, VARNISHES AND LACQUERS	H-O
37	STRUCTURAL CLAY PRODUCTS	H-O

When the demand side model for measuring backward linkage and supply side model for measuring forward linkage are used, the number of the key sectors has substantially increased to eighteen. The numbers of both the Ricardo and H-T sectors have increased while the number of the H-O sectors remains same. Along with the Heavy chemicals and other chemicals, the other H-T sectors identified as key sectors are other electrical machinery, pesticides and industrial machinery. The number of the Ricardo sectors has substantially increased to six. The other Ricardo key sectors which are added in this case are coal tar products, jute, hemp and mesta textiles, animal services and cement.

### **Section 3**

#### **ALTERNATIVE APPROACH**

It has been argued that the production structure of the developed economies differs from that of the underdeveloped and developing economies. In developed economies, degree of integration is found to be high due to high intermediate industry component in the input structure. On the other hand, values of most of the intermediate components are found to be either zero or small in the production structure of the developing and the underdeveloped economies.

Apart from the linkage analysis, the percentage of the non-zero coefficients also shows the degree of integration among the sectors. Higher the percentage value, greater is the degree of interconnectedness. In our study the percentage of non-zero coefficients in the original 115 x 115 technical coefficient matrix is 54.59% . As the percentage of the intermediate industry components is found to be low, it would not be justified to identify the key sectors purely in a technological manner.

In order to get a better picture, the sectors are divided into two groups, durable sectors and non-durable sectors. The non-durable sectors are endogenised to form an additional vector in the transaction matrix and the durable sectors are treated as exogenous. This generates an augmented matrix of order 73 x 73. The last row of the augmented matrix shows the value added of the endogenous sectors(non durable sectors) and the last column includes the private consumption demand for the final output of these sectors. The first column of the appendix table F displays the names of those sectors which produce non durable goods and the second column shows the sectors which produce durable goods.

The augmented structure can be represented in the following way.

Let  $X_a$  represents the transaction matrix in the augmented structure whose last column consists of purchases of non durable commodities by the final users and the last row consists of the value added of the sectors producing the non durable goods. Let us also suppose that  $f_a$  is the final demand in the augmented structure, which is obtained by subtracting the private consumption demand from the total final demand. Therefore we can rewrite the open model in the following way,

$x_a = [X_a]e + f_a$  where  $x_a$  is the vector of final output. In the augmented structure, the coefficient matrix is denoted by  $A_n$ . Each element of the added column is the ratio of private consumption demand of a sector to the value added. The added row consists of the elements, each of them is obtained by dividing the value added of a sector by gross output. The backward and forward linkages and linkage indices are given in the appendix tables G and H respectively.

It is found from the appendix table G that the absolute values of the backward linkages are increased in the augmented structure. Except in one or two cases, there is not much of qualitative change in the character of the sectors, which have the strongest linkage values. Trade shows a strong linkage with the other sectors while in the previous structure it is weakly linked with the rest of the economy. The number of sectors having the linkage values greater than the overall average has declined in the augmented structure. The number of sectors showing strong backward linkages is twenty-eight. As far as input based classification of these sectors are concerned H-T sector category once again shows a strong linkage with the other sectors in terms of backward linkages. Twelve out of twenty three H-T sectors (around 52% of the H-T sectors) have strong index values while the number of the Ricardo and H-O sectors are six and ten respectively.

There has been a significant improvement in the absolute values of forward linkages also and the qualitative characters of the sectors have not seen to be changed significantly. Only the positions of milk and milk products, other food products and beverages and cotton textiles have improved significantly in the augmented structure (appendix table H ). Unlike the backward linkages, in this case the number of sectors



showing strong linkages has increased by one. Among the sectors having strong forward linkages the Ricardo sectors are dominant over the other two categories of sectors, which is almost similar to the results obtained in the Ghosian framework. The numbers of Ricardo, H-T and H-O sectors in the strong group are twelve, one and seven respectively.

Let us now identify the key sectors in the augmented structure which is based on the same technique as before. The sectors with linkage values more than the overall average both in terms of forward and backward linkages are known as key sectors. In the augmented structure, the identified key sectors are given in the table 9. The number of the key sectors in this case is seen to be less than the number of the identified key sectors in the previous cases. Apart from iron and steel, non ferrous basic metals, paper and paper products, newsprint which are also the identified key sectors in the 72 x 72 model, the sectors qualified as the leading sectors in the augmented structure are trade, transport services, other food products and beverages, other textiles and cotton textiles. The numbers of Ricardo key sectors and H-O key sectors are four each. The only H-T sector qualifies as the leading sector in this structure is other chemicals.

**TABLE 9: KEY SECTORS IN THE AUGMENTED STRUCTURE**

SL NO.	KEY SECTORS	CATEGORY
17	OTHER FOOD PRODUCTS AND BEVERAGES	RICARDO
23	PAPER, PAPER PRODUCTS, NEWSPRINT	RICARDO
19	COTTON TEXTILES	RICARDO
21	OTHER TEXTILES	RICARDO
36	OTHER CHEMICALS	H-T
66	TRADE	H-O
64	TRANSPORT SERVICES	H-O
40	IRON AND STEEL	H-O
41	NON FERROUS BASIC METALS	H-O

#### **Section 4**

#### **DEPENDENCE ON THE COMPONENTS OF FINAL DEMAND**

The driving force behind the entire analysis of linkages in the input-output static open framework is the final demand. The identification of the component / components of final demand, affecting significantly the gross output of each sector is important from the point of view of policy making. As the key sectors are supposed to drive the economy towards increasing sectoral interdependence and generate greater growth and development, the components of final demand with greater stimulating effects for these sectors are required to be identified as far as policy-making is concerned.

The final demand is defined as follows:

Final demand (f) = private consumption demand [f (1)] + government consumption demand [f (2)]+Gross domestic capital formation [f (3)] + change in stock [f (4)] + export demand [f (5)] - Import demand [f (6)].

The six components influence the gross output of a sector in varying degrees. The vector that shows the gross output produced by different sectors to meet total final demand is  $(I - A)^{-1} f$ . We can write

$$(I - A)^{-1} f = (I - A)^{-1} [f (1) + f (2) + f (3) + f (4) + f (5) - f (6) ]$$

or,  $(I - A)^{-1} f = (I - A)^{-1} f (1) + (I - A)^{-1} f (2) + (I - A)^{-1} f (3) + (I - A)^{-1} f (4) + (I - A)^{-1} f (5) - (I - A)^{-1} f (6) \dots\dots\dots(1),$

where  $(I - A)^{-1} f (i)$ ,  $i=1,2,3,4,5,6$  is the vector whose elements are the gross output of different sectors to cater the i-th type of demand . For example,  $(I - A)^{-1} f(2)$  gives the vector showing gross output produced by different sectors to meet final government consumption. However  $(I - A)^{-1} f (6)$  is different from  $(I - A)^{-1} f (i)$ ,  $i = 1,2,3,4,5$ .While  $(I - A)^{-1} f (i)$ ,  $i = 1,2,3,4,5$  shows sectoral output produced in the domestic economy to cater the remaining five different types of final demand,  $(I - A)^{-1} f (6)$  gives the gross output produced not on the domestic soil but in the foreign countries to meet the final import demand generated in the domestic economy . However, the same technical coefficient matrix is used to measure the gross output generated to meet the final import demand of the domestic country.

Both sides of equation (1) are premultiplied by the inverted diagonal matrix of gross output  $\langle x \rangle^{-1}$ , which will show the relative strength of each component of final demand in influencing the gross output of a sector.

$$\langle x \rangle^{-1} (I - A)^{-1} f = \langle x \rangle^{-1} [(I - A)^{-1} f (1) + (I - A)^{-1} f (2) + (I - A)^{-1} f (3) + (I - A)^{-1} f (4) + (I - A)^{-1} f (5) - (I - A)^{-1} f (6)]$$

where  $\langle x \rangle^{-1} (I - A)^{-1} f(i)$ ,  $i = 1,2,3,4,5,6$  show the share of gross output generated by i-th components of final demand.

Let us start our discussion on the relative importance of different components of final demand with the Ricardo sectors. Table 10 displays the relative strength of each component of final demand in stimulating the gross output of the Ricardo sectors including the key sectors in this category.

As most of the Ricardo sectors primarily produce consumer goods, private consumption is the most important stimulant for these sectors. For the Ricardo key sectors animal services, other food products and beverages, cotton textiles, jute, hemp and mesta textiles, other textiles, paper and paper products, news print

and petroleum products, private consumption demand is dominant over the other components of final demand. Gross capital formation significantly affects the output levels of the sectors coal tar products and cement. However, a substantial amount of coal tar products are required to be imported to meet the final demand generated by the other five components. The only Ricardo key sector significantly affected by the export demand is other non metallic mineral products. (Table 10)

<b>RICARDO SECTORS</b>	<b>f(1)</b>	<b>f(2)</b>	<b>f(3)</b>	<b>f(4)</b>	<b>f(5)</b>	<b>f(6)</b>
1.Paddy	0.9585	0.0038	0.0032	0.0063	0.0319	0.0038
2.Wheat	0.9877	0.0057	0.0038	0.0014	0.0111	0.0096
3.Other crops	0.9404	0.0110	0.0373	0.0030	0.0391	0.0308
4.Commercial crops	0.8682	0.0064	0.0207	0.0314	0.0974	0.0242
5.Milk and milk products	0.9658	0.0222	0.0020	0.0006	0.0139	0.0045
<b>6.Animal services(agricultural)[Key Sector]</b>	<b>0.9399</b>	<b>0.0084</b>	<b>0.0241</b>	<b>0.0071</b>	<b>0.0425</b>	<b>0.0219</b>
7.Other livestock products	0.8684	0.0189	0.0687	0.0211	0.0404	0.0176
8.Forestry and logging	0.8491	0.0246	0.1369	0.0056	0.0703	0.0865
9.Fishing	0.8212	0.0041	0.0067	-0.0004	0.1799	0.0115
10.Coal and lignite	0.5444	0.0694	0.4752	-0.0101	0.1604	0.2394
11.Crude petroleum, natural gas	2.0670	0.2175	0.6594	-0.1010	0.4560	2.2990
12.Iron ore	0.1664	0.0327	0.4489	-0.0383	0.6063	0.2160
13.Other metallic minerals	0.4028	0.0757	0.6660	0.1714	0.3352	0.6510
14.Other non metallic minerals	1.0232	0.2371	2.7044	0.0483	0.7477	3.7607
16.Sugar and khandsari boora	0.9725	0.0034	0.0031	-0.0047	0.0336	0.0079
<b>17.Other food products and beverages[Key Sector]</b>	<b>0.9130</b>	<b>0.0054</b>	<b>0.0039</b>	<b>0.0147</b>	<b>0.1001</b>	<b>0.0372</b>
18.Tobacco products	0.9666	0.0001	0.0004	0.0087	0.0251	0.0009
<b>19.Cotton textiles[Key Sector]</b>	<b>0.8027</b>	<b>0.0064</b>	<b>0.0235</b>	<b>0.0230</b>	<b>0.1713</b>	<b>0.0269</b>
<b>20.Jute, hemp, mesta textiles[Key Sector]</b>	<b>0.5698</b>	<b>0.0323</b>	<b>0.2230</b>	<b>-0.0006</b>	<b>0.2988</b>	<b>0.1233</b>
<b>21.Other textiles[Key Sector]</b>	<b>0.6970</b>	<b>0.0083</b>	<b>0.0360</b>	<b>0.0072</b>	<b>0.3270</b>	<b>0.0755</b>
22.Wood and wood products	0.4090	0.0631	0.4959	0.0246	0.0995	0.0921
<b>23.Paper, paper prods. &amp; newsprint[Key Sector]</b>	<b>0.8259</b>	<b>0.1262</b>	<b>0.2032</b>	<b>0.0480</b>	<b>0.1886</b>	<b>0.3920</b>
25.Leather products	0.4773	0.0031	0.0149	-0.0012	0.5714	0.0654
<b>27.Petroleum products[Key Sector]</b>	<b>0.9723</b>	<b>0.1009</b>	<b>0.2453</b>	<b>0.0091</b>	<b>0.2018</b>	<b>0.5294</b>
<b>28.Coal tar products[key Sector]</b>	<b>0.3531</b>	<b>0.0987</b>	<b>1.2712</b>	<b>-0.0645</b>	<b>0.1474</b>	<b>0.8058</b>
<b>38.Cement[Key Sector]</b>	<b>0.0958</b>	<b>0.0578</b>	<b>0.7992</b>	<b>0.0168</b>	<b>0.0523</b>	<b>0.0219</b>
<b>39.Other non-metallic mineral prods.[Key Sector]</b>	<b>0.2861</b>	<b>0.0147</b>	<b>0.1165</b>	<b>-0.0741</b>	<b>0.9705</b>	<b>0.3137</b>

Among the non-key Ricardo sectors a significant proportion of total output of paddy, wheat, other crops, commercial crops, milk and milk products, forestry and logging, fishing, food and beverages, tobacco products, sugar and khandsari boora etc. is produced to cater private consumption only. None of the Ricardo sectors is significantly affected by government consumption. Both private consumption and capital formation have strong influence on the gross output of crude petroleum and natural gas, coal and lignite, other metallic minerals, wood and wood products, non metallic minerals. However, a large proportion of total output of crude petroleum and natural gas, other metallic minerals and non-metallic minerals is required to be imported. For crude petroleum and natural gas, the sector has to import an amount of total output which is almost same as the amount of total output required to cater total private consumption. Similarly, a large amount of non-metallic minerals is required to be imported to meet both private consumption demand and gross capital

formation. Apart from Ricardo key sector other non-metallic mineral products; export demand is also dominant over the other components of final demand for leather products and iron ore.

For most of the H-T sectors like both electrical and non electrical industrial machines, other non electrical machines, communication equipment, tractor and agricultural machines, machine tools, electrical wires and cables, rail equipment, ships and boats and motor vehicles gross domestic capital formation generates a substantial direct and indirect requirement of the gross output but except tractor and agricultural machines, machine tools, electrical wires and cables, ships and boats, most of these sectors are heavily dependent on imports (Table 11).

While studying the relative strength of each component of final demand in influencing the gross output of the key high technology sectors, we find that, private consumption and gross capital formation could have been the potential stimulants for heavy chemicals and for other electrical machinery and industrial machinery respectively but these sectors also are found to be heavily dependent on imports. Although efforts have been given to develop machine industry for attaining self-sufficiency and smooth running of the industrialization process, Indian economy is found to be short of this target even after fifty years of planned economic development. On the other hand, the impact of export demand on the gross output of all technology intensive sectors is found to be negligible. Private consumption demand is found to be significantly affecting the gross output of other chemicals.

<b>H -T SECTORS</b>	<b>f(1)</b>	<b>f(2)</b>	<b>f(3)</b>	<b>f(4)</b>	<b>f(5)</b>	<b>f(6)</b>
<b>29.Heavy chemicals[Key Sector]</b>	<b>0.9103</b>	<b>0.1303</b>	<b>0.3739</b>	<b>0.0285</b>	<b>0.4872</b>	<b>0.9303</b>
<b>31.Pesticides[Key Sector]</b>	<b>0.8442</b>	<b>0.0121</b>	<b>0.0603</b>	<b>-0.0015</b>	<b>0.1277</b>	<b>0.0427</b>
33.Drugs and medicines	0.3476	0.2490	0.0131	0.3229	0.1006	0.0334
<b>36.Other chemicals[Key Sector]</b>	<b>0.7339</b>	<b>0.1129</b>	<b>0.2785</b>	<b>0.0087</b>	<b>0.2034</b>	<b>0.3374</b>
43.Tractors and agri. implements	0.1332	0.0026	0.9058	-0.0043	0.0135	0.0507
<b>44.Industrial machinery[Key Sector]</b>	<b>0.3338</b>	<b>0.0233</b>	<b>1.5521</b>	<b>-0.2040</b>	<b>0.1837</b>	<b>0.8889</b>
45.Machine tools	0.1819	0.0189	1.0841	-0.0023	0.1348	0.4174
46.Office computing machines	0.3961	0.0536	0.4019	0.2123	0.1356	0.1996
47.Other non-electrical machinery	0.1751	0.1578	1.2333	-0.1150	0.1185	0.5697
48.Electrical industrial Machinery	0.1171	0.0146	1.2142	-0.1016	0.0732	0.3175
49.Electrical wires,cables and appliances	0.1922	0.0331	0.9075	-0.1698	0.1604	0.1234
50.Batteries	0.5687	0.0172	0.5172	-0.1348	0.0904	0.0588
51.Communication equipments	0.2477	0.0393	1.0374	-0.0900	0.1433	0.3776
<b>52.Other electrical Machinery[Key Sector]</b>	<b>0.4230</b>	<b>0.0695</b>	<b>1.6729</b>	<b>-0.3085</b>	<b>0.3255</b>	<b>1.1823</b>
53.Electronic equipments(incl.TV)	0.2613	0.0530	0.8227	-0.0833	0.0992	0.1530
54.Ships and boats	0.2865	0.3680	1.0507	-0.5324	0.0648	0.2375
55.Rail equipments	0.2988	0.0205	0.6387	0.0155	0.0808	0.0543
56.Motor vehicles	0.2311	0.0371	1.4661	-0.2315	0.1064	0.6093
57.Other transport equipment	0.6411	0.0125	0.2667	-0.0073	0.1238	0.0370
58.Watches and clocks	0.5474	0.0008	0.4664	-0.0005	0.0471	0.0612
65.Communication	0.5771	0.1769	0.2578	-0.0070	0.0975	0.1023
69.Education and research	0.5106	0.4887	0.0005	0.0000	0.0003	0.0002
70.Medical and health	0.6625	0.3172	0.0160	0.0001	0.0101	0.0059

Finally, in the case of Heckscher-Ohlin sectors we find that private consumption acts as a stimulant for printing and publishing, tea and coffee processing, soaps, cosmetics and glycerin, gas, hotels and restaurants, banking and insurance and other services and for key sectors like fertilizers, electricity, synthetic fiber and resin, transport services, trade (Table 12). While capital formation significantly stimulates the gross output levels of the H-O sectors like iron and steel, non ferrous basic metals, structural clay products and construction, hand tools and other metal products and paints , varnishes and lacquers, both capital formation and private consumption are the stimulants for the activities for rubber and plastic products. However, the sector producing non-ferrous basic metals has to depend on import in order to satisfy the direct and indirect requirement of its output generated by the other components of final demand. Miscellaneous manufacturing is the only H-O sectors whose gross output level is affected by the changes in export demand but not in a substantial extent. None of the key sectors is found to be significantly affected by export demand. For public administration only government consumption demand plays a key role.

<b>H-O SECTORS</b>	<b>f(1)</b>	<b>f(2)</b>	<b>f(3)</b>	<b>f(4)</b>	<b>f(5)</b>	<b>f(6)</b>
15.Tea and coffee processing	0.6606	0.0030	0.0030	0.1355	0.2000	0.0022
24.Printing and publishing	0.7851	0.1212	0.0729	0.0823	0.0534	0.1149
<b>26.Rubber and plastic products[Key Sector]</b>	<b>0.4397</b>	<b>0.0719</b>	<b>0.4041</b>	<b>0.0299</b>	<b>0.1715</b>	<b>0.1171</b>
<b>30.Fertilizers[Key Sector]</b>	<b>1.1456</b>	<b>0.0117</b>	<b>0.0335</b>	<b>0.0009</b>	<b>0.0676</b>	<b>0.2593</b>
<b>32.Paints, varnishes and lacquers[Key Sector]</b>	<b>0.3320</b>	<b>0.0580</b>	<b>0.5007</b>	<b>-0.0099</b>	<b>0.2674</b>	<b>0.1481</b>
34.Soaps, cosmetics & glycerin	0.7354	0.0043	0.0113	0.0704	0.2282	0.0497
<b>35.Synthetic fibers, resin[Key Sector]</b>	<b>0.5649</b>	<b>0.1673</b>	<b>0.3579</b>	<b>0.0219</b>	<b>0.2244</b>	<b>0.3364</b>
<b>37.Structural clay products[Key Sector]</b>	<b>0.0980</b>	<b>0.0607</b>	<b>0.8408</b>	<b>0.0022</b>	<b>0.0278</b>	<b>0.0295</b>
<b>40.Iron and steel[Key Sector]</b>	<b>0.2804</b>	<b>0.0630</b>	<b>0.8907</b>	<b>-0.0567</b>	<b>0.1627</b>	<b>0.3401</b>
<b>41.Non-ferrous basic metals[Key Sector]</b>	<b>0.4667</b>	<b>0.0934</b>	<b>0.8057</b>	<b>0.0025</b>	<b>0.2767</b>	<b>0.6450</b>
<b>42.Hand tools &amp; other metal pdts [Key Sector]</b>	<b>0.4766</b>	<b>0.0320</b>	<b>0.5430</b>	<b>-0.0369</b>	<b>0.1359</b>	<b>0.1507</b>
59.Miscellaneous manufacturing	0.4274	0.2345	0.4442	-0.0493	0.4531	0.5098
<b>60.Construction[Key sector]</b>	<b>0.0930</b>	<b>0.0608</b>	<b>0.8473</b>	<b>-0.0003</b>	<b>0.0148</b>	<b>0.0157</b>
<b>61.Electricity[Key Sector]</b>	<b>0.6343</b>	<b>0.0720</b>	<b>0.3195</b>	<b>-0.0056</b>	<b>0.1355</b>	<b>0.1556</b>
62.Gas	0.8878	0.0041	0.0042	0.0840	0.0230	0.0032
63.Water supply	0.3712	0.4736	0.1636	0.0006	0.0606	0.0696
<b>64.Tarnsport services[Key Sector]</b>	<b>0.6594</b>	<b>0.0458</b>	<b>0.2261</b>	<b>0.0014</b>	<b>0.1476</b>	<b>0.0803</b>
<b>66.Trade[Key Sector]</b>	<b>0.6682</b>	<b>0.0377</b>	<b>0.2119</b>	<b>-0.0001</b>	<b>0.1435</b>	<b>0.0612</b>
67.Hotels and restaurants	0.7768	0.0389	0.0369	0.0000	0.1614	0.0139
68.Banking and insurance	0.6064	0.1190	0.2985	-0.0097	0.1230	0.1372
71.Other services	0.8834	0.0414	0.0935	-0.0062	0.1028	0.1149
72.Public administration	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000

## Section 5

### Summary and conclusion

The study explores the structure of the Indian economy with a classification of sectors which is based on the resource (natural resource, research and development and labour & capital) intensively used in the production process. For this purpose Input - Output methodology has been used as it offers important insights into the structure of economies. The relative strength of linkages of the three categories of sectors i.e. Ricardo sectors, high - technology sectors, Heckscher - Ohlin sectors have been studied and the key sectors of the Indian economy are identified. The key sectors are also identified within the augmented structure where the non durable sectors are endogenised with an objective to obtain better results of the linkage analysis for a developing country like India. Along with it, the components of final demand, which are the driving force behind the growth of a particular sector, are identified for all sectors.

The study of exploring the structure of Indian economy reveals the following results.

The H-T sectors are found to be strongly integrated with other sectors in terms of backward linkages but are weakly linked in terms of the forward linkages. However, the share of the H-T sectors slightly improves in the supply led model. Most of the H-O sectors have also shown strong backward linkages and weak forward linkages. Finally, most of the Ricardo sectors are found to be either strongly or weakly linked with the rest of the economy, particularly the agricultural crops and other primary sectors have shown weak linkage strength while the agro-based industries have a relatively higher linkage effects.

The identified key sectors display a structure of the Indian economy which is neither traditional nor a highly modernized one. The study of the structure of the Indian economy reveals that the capital intensive basic industries like iron and steel, electricity, non ferrous basic metals, construction etc are supposed to play the role of engine in the process of growth. The development of these basic industries as channels of transmitting the benefits of growth is, no doubt, the consequence of the attempt to diversify the production structure of the Indian economy over the years. The agro based industries like cotton textiles, jute, hemp and mesta textiles, other textiles, paper and paper products and other resource intensive sectors like non metallic mineral products, coal tar products etc have shown strong linkage in terms of both forward and backward linkages. Services like trade and transport services and capital-intensive sectors like fertilizers, paints, varnishes and lacquers, synthetic fiber and resin etc have qualified as key sectors of the Indian economy. Investment in these sectors can speed up the industrialization process, as such sectors will stimulate greater economic activities in other sectors. However, among the Ricardo key sectors, coal tar products and petroleum products and among H-O key sectors non-ferrous basic metals are seen to be dependent on import to some extent.

In spite of that India is definite not a well diversified, highly interconnected, highly productive and modernized economy. The role of the high technology sectors in the production structure of the Indian economy is an insignificant one. The number of H-T key sectors in twenty-seven key sectors, identified in

three different models, is only five, while the numbers of Ricardo and H-O sectors are ten and twelve respectively. Moreover, among the technology intensive sectors pesticides and other chemicals are seen to have greater multiplier effect on growth and development but heavy chemicals, industrial machinery and other electrical machinery are found to be heavily dependent on import. On the other hand none of the H-T sectors are found to be significantly dependent on export demand. So modernization and further diversification of the production structure is the necessity to face the challenges arising out from the recent changes in the world economy.

With the dramatic and momentous changes in the nature of markets, institutions, industrial organizations and structures in various countries of the world during the decade of late eighties and nineties, India has also started to respond to all these changes particularly to the increasing globalization of economic reforms. But while facing the trend of globalization, the developing countries have to prepare themselves to face the challenges of international competitiveness. Although India is possessing a large domestic market, broad based industrial and infrastructure sectors, abundant supply of cheap labour, a huge number of educated and trained manpower and adequate natural resources to attain competitiveness India has yet to reap the benefits of such changes to the fullest extent. In order to achieve success in the path of globalization Indian producers should improve their competitiveness. This requires attainment of higher growth in productivity, improved quality products and innovations in products. The New Economic policy has been providing high priority to the introduction of modern techniques in production system. In order to introduce better and improved technology the government is permitting all foreign collaboration proposals related to the import of high technology. But development of indigenous technology is the indispensable necessity at this hour. Industries should be encouraged to develop their own technology by research and development. This is important for attaining self-reliance and also for cost reduction and the production of the high quality goods required for both internal consumption and export.

Otherwise, India would emerge as a producer of resource intensive goods instead of producer of high technology and capital goods which would be inconsistent with dynamics of economic growth.

**APPENDIX TABLE A: SCHEME FOR AGGREGATION**

<b>SI no. &amp; name of sector in the original Input-Output table for the year 1993-1994</b>		<b>SI no. &amp; name of the aggregated sector</b>
1	Paddy	1.Paddy
2	Wheat	2.Wheat
3	Jowar	
4	Bajra	
5	Maize	3.Other crops
6	Gram	
7	Pulses	
17	Other crops	
8	Sugarcane	
9	Groundnut	
10	Jute	
11	Cotton	
12	Tea	4.Commercial crops
13	Coffee	
14	Rubber	
15	Coconut	
16	Tobacco	
18	Milk and milk products	5.Milk and milk products
19	Animal services(agricultural)	6.Animal services(agricultural)
20	Other livestock products	7.Other livestock products
21	Forestry and logging	8.Forestry and logging
22	Fishing	9.Fishing
23	Coal and lignite	10.Coal and lignite
24	Crude petroleum, natural gas	11.Crude petroleum, natural gas
25	Iron ore	12.Iron ore
26	Manganese ore	
27	Bauxite	
28	Copper ore	
29	Other metallic minerals	13.Other metallic minerals
30	Lime stone	
31	Mica	
32	Other non metallic minerals	14.Other non metallic minerals
37	Tea and coffee processing	15.Tea and coffee processing
33	Sugar	
34	Khandsari, boora	16.Sugar and khandsari boora
35	Hydrogenated oil(vanaspati)	
36	Edible oils other than vanaspati	
38	Miscellaneous food products	
39	Beverages	17.Other food products and beverages



**APPENDIX TABLE A: SCHEME FOR AGGREGATION**

<b>SI no. &amp; name of sector in the original Input-Output table for the year 1993-1994</b>	<b>SI no. &amp; name of the aggregated sector</b>
40 Tobacco products	18.Tobacco products
41 Khadi, cotton textiles(handlooms)	
42 Cotton textiles	19.Cotton textiles
46 Jute, hemp, mesta textiles	20.Jute, hemp, mesta textiles
43 Woolen textiles	
44 Silk textiles	
45 Art silk, synthetic fiber textiles	
47 Carpet weaving	
48 Readymade garments	
49 Miscellaneous textile products	21.Other textiles
50 Furniture and fixtures-wooden	
51 Wood and wood products	22.Wood and wood products
52 Paper, paper prods. & newsprint	23.Paper, paper prods. & newsprint
53 Printing and publishing	24.Printing and publishing
54 Leather footwear	
55 Leather and leather products	25.Leather products
56 Rubber products	
57 Plastic products	26.Rubber and plastic products
58 Petroleum products	27.Petroleum products
59 Coal tar products	28.Coal tar products
60 Inorganic heavy chemicals	
61 Organic heavy chemicals	29.Heavy chemicals
62 Fertilizers	30.Fertilizers
63 Pesticides	31.Pesticides
64 Paints, varnishes and lacquers	32.Paints, varnishes and lacquers
65 Drugs and medicines	33.Drugs and medicines
66 Soaps, cosmetics & glycerin	34.Soaps, cosmetics & glycerin
67 Synthetic fibers, resin	35.Synthetic fibers, resin
68 Other chemicals	36.Other chemicals
69 Structural clay products	37.Structural clay products
70 Cement	38.Cement
71 Other non-metallic mineral prods.	39.Other non-metallic mineral prods.
72 Iron, steel and ferro alloys	
73 Iron and steel casting & forging	
74 Iron and steel foundries	40.Iron and steel
75 Non-ferrous basic metals	41.Non-ferrous basic metals

**APPENDIX TABLE A: SCHEME FOR AGGREGATION**

<b>SI no. &amp; name of sector in the original Input-Output table for the year 1993-1994</b>	<b>SI no. &amp; name of the aggregated sector</b>
76 Hand tools, hardware	
77 Miscellaneous metal products	42.Hand tools and other metal products
78 Tractors and agri. implements	43.Tractors and agri. implements
79 Industrial machinery(F & T)	
80 Industrial machinery(others)	44.Industrial machinery
81 Machine tools	45.Machine tools
82 Office computing machines	46.Office computing machines
83 Other non-electrical machinery	47.Other non-electrical machinery
84 Electrical industrial Machinery	48.Electrical industrial Machinery
85 Electrical wires & cables	
87 Electrical appliances	49.Electrical wires,cables and appliances
86 Batteries	50.Batteries
88 Communication equipments	51.Communication equipments
89 Other electrical Machinery	52.Other electrical Machinery
90 Electronic equipments(incl.TV)	53.Electronic equipments(incl.TV)
91 Ships and boats	54.Ships and boats
92 Rail equipments	55.Rail equipments
93 Motor vehicles	56.Motor vehicles
94 Motor cycles and scooters	
95 Bicycles, cycle-rickshaw	
96 Other transport equipments	57.Other transport equipment
97 Watches and clocks	58.Watches and clocks
98 Miscellaneous manufacturing	59.Miscellaneous manufacturing
99 Construction	60.Construction
100 Electricity	61.Electricity
101 Gas	62.Gas
102 Water supply	63.Water supply
103 Railway transport services	
104 Other transport services	64.Tarnsport services
106 Communication	65.Communication
107 Trade	66.Trade
108 Hotels and restaurants	67.Hotels and restaurants
109 Banking	
110 Insurance	68.Banking and insurance
112 Education and research	69.Education and research
113 Medical and health	70.Medical and health

**APPENDIX TABLE A: SCHEME FOR AGGREGATION**

<b>SI no. &amp; name of sector in the original Input-Output table for the year 1993-1994</b>	<b>SI no. &amp; name of the aggregated sector</b>
105 Storage and warehousing	
111 Ownership of dwellings	71.Other services
114 Other services	.
115 Public administration	72.Public administration

**APPENDIX TABLE B: CLASSIFICATION OF SECTORS ON THE BASIS OF INPUT USAGE**

<b>SL NO.</b>	<b>RICARDO SECTORS (27)</b>	<b>SL NO.</b>	<b>HIGH TECHNOLOGY SECTORS (23)</b>
1	Paddy	29	Heavy chemicals
2	Wheat	31	Pesticides
3	Other crops	33	Drugs and medicines
4	Commercial crops	36	Other chemicals
5	Milk and milk products	43	Tractors and agri. implements
6	Animal services(agricultural)	44	Industrial machinery
7	Other livestock products	45	Machine tools
8	Forestry and logging	46	Office computing machines
9	Fishing	47	Other non-electrical machinery
10	Coal and lignite	48	Electrical industrial Machinery
11	Crude petroleum, natural gas	49	Electrical wires,cables and appliances
12	Iron ore	50	Batteries
13	Other metallic minerals	51	Communication equipments
14	Other non metallic minerals	52	Other electrical Machinery
16	Sugar and khandsari boora	53	Electronic equipments(incl.TV)
17	Other food products and beverages	54	Ships and boats
18	Tobacco products	55	Rail equipments
19	Cotton textiles	56	Motor vehicles
20	Jute, hemp, mesta textiles	57	Other transport equipment
21	Other textiles	58	Watches and clocks
22	Wood and wood products	65	Communication
23	Paper, paper prods. & newsprint	69	Education and research
25	Leather products	70	Medical and health
27	Petroleum products		
28	Coal tar products	<b>SL NO.</b>	<b>HECKSCHER-OHLIN SECTORS (22)</b>
38	Cement	15	Tea and coffee processing
39	Other non-metallic mineral prods.	24	Printing and publishing
		26	Rubber and plastic products
		30	Fertilizers
		32	Paints, varnishes and lacquers
		34	Soaps, cosmetics & glycerin
		35	Synthetic fibers, resin
		37	Structural clay products
		40	Iron and steel
		41	Non-ferrous basic metals
		42	Hand tools and other metal products
		59	Miscellaneous manufacturing
		60	Construction
		61	Electricity
		62	Gas
		63	Water supply
		64	Transport services
		66	Trade
		67	Hotels and restaurants
		68	Banking and insurance
		71	Other services
		72	Public administration

**APPENDIX TABLE C : LEONTIEF BACKWARD LINKAGES , LINKAGE INDICES  
AND COEFFICIENT OF VARIATION**

<b>SI no.</b>	<b>SECTORS</b>	<b>Leontief Backward Linkages(Q)</b>	<b>Leontief Backward Linkage Indices(I1)</b>	<b>CV1</b>
40	Iron and steel	2.7337	1.3140	4.7071
31	Pesticides	2.7064	1.3009	3.9642
28	Coal tar products	2.5842	1.2422	3.5737
44	Industrial machinery	2.5675	1.2342	4.1709
41	Non-ferrous basic metals	2.5440	1.2229	4.4238
43	Tractors and agri. implements	2.5420	1.2219	3.9535
30	Fertilizers	2.5359	1.2189	3.9338
49	Electrical wires,cables and appliances	2.5272	1.2148	3.5799
42	Hand tools and other metal products	2.5218	1.2122	3.8326
6	Animal services(agricultural)	2.5209	1.2117	4.3933
23	Paper, paper prods. & newsprint	2.5045	1.2038	4.3325
34	Soaps, cosmetics & glycerin	2.4917	1.1977	3.7097
53	Electronic equipments(incl.TV)	2.4721	1.1883	3.6412
50	Batteries	2.4692	1.1869	3.5968
36	Other chemicals	2.4678	1.1862	3.9414
56	Motor vehicles	2.4648	1.1848	4.0021
57	Other transport equipment	2.4478	1.1766	4.3917
48	Electrical industrial Machinery	2.4462	1.1758	3.7469
45	Machine tools	2.4455	1.1755	3.8592
21	Other textiles	2.4350	1.1704	4.2552
54	Ships and boats	2.4301	1.1681	3.9981
26	Rubber and plastic products	2.4129	1.1598	3.8551
52	Other electrical Machinery	2.4084	1.1577	3.7543
32	Paints, varnishes and lacquers	2.3957	1.1516	3.8910
47	Other non-electrical machinery	2.3896	1.1486	4.1256
33	Drugs and medicines	2.3874	1.1476	4.3671
35	Synthetic fibers, resin	2.3727	1.1405	4.4158
51	Communication equipments	2.3644	1.1365	4.1006
25	Leather products	2.3326	1.1212	4.7651
29	Heavy chemicals	2.3254	1.1178	4.4257
38	Cement	2.3223	1.1163	3.8166
46	Office computing machines	2.3099	1.1103	3.9596
15	Tea and coffee processing	2.2937	1.1025	4.2935
19	Cotton textiles	2.2776	1.0948	4.2796
17	Other food products and beverages	2.2775	1.0948	3.9936
59	Miscellaneous manufacturing	2.2563	1.0845	4.0268
55	Rail equipments	2.2555	1.0842	4.4277
24	Printing and publishing	2.2514	1.0822	4.1538
58	Watches and clocks	2.2327	1.0732	4.3808
20	Jute, hemp, mesta textiles	2.2324	1.0731	4.0323
61	Electricity	2.2318	1.0728	5.1089
60	Construction	2.1784	1.0471	4.0412
27	Petroleum products	2.1633	1.0399	4.9052
16	Sugar and khandsari boora	2.1528	1.0348	4.4823
39	Other non-metallic mineral prods.	2.1089	1.0137	4.2195

**APPENDIX TABLE C : LEONTIEF BACKWARD LINKAGES , LINKAGE INDICES  
AND COEFFICIENT OF VARIATION**

<b>SI no.</b>	<b>SECTORS</b>	<b>Leontief Backward Linkages(Q)</b>	<b>Leontief Backward Linkage Indices(I1)</b>	<b>CV1</b>
37	Structural clay products	2.0885	1.0039	4.1948
70	Medical and health	2.0880	1.0037	4.4329
67	Hotels and restaurants	2.0259	0.9738	4.2508
64	Transport services	2.0048	0.9637	4.5681
18	Tobacco products	1.9945	0.9587	4.4902
2	Wheat	1.8429	0.8858	5.2589
22	Wood and wood products	1.8039	0.8671	5.1488
1	Paddy	1.7662	0.8490	5.6226
10	Coal and lignite	1.7354	0.8342	5.0290
63	Water supply	1.6189	0.7782	5.4265
12	Iron ore	1.6091	0.7735	5.2854
71	Other services	1.5473	0.7438	5.5967
7	Other livestock products	1.5088	0.7252	5.7418
13	Other metallic minerals	1.4672	0.7052	5.7938
3	Other crops	1.4607	0.7021	6.2652
66	Trade	1.4379	0.6912	6.0424
62	Gas	1.4031	0.6745	6.0974
4	Commercial crops	1.3821	0.6644	6.4329
5	Milk and milk products	1.3403	0.6443	6.4070
65	Communication	1.3196	0.6343	6.5183
9	Fishing	1.3116	0.6305	6.5859
14	Other non metallic minerals	1.3007	0.6252	6.5224
11	Crude petroleum, natural gas	1.2920	0.6210	6.6587
68	Banking and insurance	1.2369	0.5945	7.4435
69	Education and research	1.2164	0.5847	6.9740
8	Forestry and logging	1.1935	0.5737	7.1331
72	Public administration	1.0000	0.4807	8.4853

**APPENDIX TABLE D : LEONTIEF FORWARD LINKAGES , LINKAGE INDICES  
AND COEFFICIENT OF VARIATION**

Sl.no	SECTORS	Leontief Forward Linkages(R1)	Leontief Forward Linkage Indices(I2)	CV2
66	Trade	8.2494	3.9653	1.0419
64	Tarnsport services	8.1034	3.8951	1.1384
61	Electricity	7.1660	3.4445	1.5501
40	Iron and steel	6.6286	3.1862	2.1417
68	Banking and insurance	5.5458	2.6658	1.6649
11	Crude petroleum, natural gas	4.2107	2.0240	2.4769
3	Other crops	3.8877	1.8687	2.9445
71	Other services	3.8712	1.8608	2.3090
29	Heavy chemicals	3.7767	1.8154	2.8128
41	Non-ferrous basic metals	3.6581	1.7584	3.1543
10	Coal and lignite	3.4862	1.6757	2.5661
4	Commercial crops	3.1284	1.5037	3.3702
36	Other chemicals	3.0653	1.4734	3.0732
27	Petroleum products	2.6711	1.2839	3.2070
23	Paper, paper prods. & newsprint	2.5760	1.2382	4.2312
35	Synthetic fibers, resin	2.4721	1.1883	4.2624
42	Hand tools and other metal products	2.3911	1.1494	3.7437
26	Rubber and plastic products	2.2689	1.0906	3.9074
60	Construction	2.2055	1.0601	3.9009
14	Other non metallic minerals	2.0466	0.9838	4.2411
59	Miscellaneous manufacturing	1.9605	0.9423	4.5313
65	Communication	1.8461	0.8874	4.6280
30	Fertilizers	1.7685	0.8501	5.4957
21	Other textiles	1.7339	0.8335	5.8612
22	Wood and wood products	1.7232	0.8283	5.2634
47	Other non-electrical machinery	1.7147	0.8242	5.4997
33	Drugs and medicines	1.6767	0.8059	6.3648
8	Forestry and logging	1.6652	0.8004	5.2203
44	Industrial machinery	1.6073	0.7726	6.4813
19	Cotton textiles	1.5992	0.7687	5.9002
32	Paints, varnishes and lacquers	1.5316	0.7362	5.8429
7	Other livestock products	1.5073	0.7245	5.6398
28	Coal tar products	1.4554	0.6996	5.8767
56	Motor vehicles	1.4184	0.6818	6.7562
49	Electrical wires, cables and appliances	1.4040	0.6749	6.1046
1	Paddy	1.3951	0.6706	7.1904
31	Pesticides	1.3675	0.6573	7.6482
57	Other transport equipment	1.3621	0.6547	7.8098
48	Electrical industrial Machinery	1.3553	0.6515	6.5304
25	Leather products	1.3310	0.6398	8.2685
55	Rail equipments	1.3249	0.6368	7.2744
6	Animal services(agricultural)	1.3238	0.6363	6.6125
17	Other food products and beverages	1.2942	0.6221	6.8614
2	Wheat	1.2937	0.6218	7.4451
52	Other electrical Machinery	1.2921	0.6211	6.8723
13	Other metallic minerals	1.2787	0.6146	6.6371
51	Communication equipments	1.2695	0.6102	7.5105

**APPENDIX TABLE D : LEONTIEF FORWARD LINKAGES , LINKAGE INDICES  
AND COEFFICIENT OF VARIATION**

<b>Sl.no</b>	<b>SECTORS</b>	<b>Leontief Forward Linkages(R1)</b>	<b>Leontief Forward Linkage Indices(I2)</b>	<b>CV2</b>
5	Milk and milk products	1.2425	0.5973	6.8991
39	Other non-metallic mineral prods.	1.2298	0.5911	7.1196
24	Printing and publishing	1.2267	0.5896	7.2872
67	Hotels and restaurants	1.2056	0.5795	7.0343
38	Cement	1.1780	0.5662	7.2132
43	Tractors and agri. implements	1.1726	0.5637	8.2810
20	Jute, hemp, mesta textiles	1.1671	0.5610	7.3556
70	Medical and health	1.1429	0.5494	7.6614
63	Water supply	1.1414	0.5486	7.6019
58	Watches and clocks	1.1316	0.5439	8.4797
54	Ships and boats	1.1261	0.5413	8.1746
34	Soaps, cosmetics & glycerin	1.1186	0.5377	7.9652
45	Machine tools	1.1181	0.5374	7.7103
15	Tea and coffee processing	1.1123	0.5347	8.2461
53	Electronic equipments(incl.TV)	1.1098	0.5335	7.9448
16	Sugar and khandsari boora	1.0942	0.5260	7.8397
37	Structural clay products	1.0866	0.5223	7.8707
12	Iron ore	1.0784	0.5183	7.8641
9	Fishing	1.0673	0.5130	8.1065
18	Tobacco products	1.0453	0.5024	8.4768
46	Office computing machines	1.0441	0.5019	8.4303
50	Batteries	1.0282	0.4942	8.2914
62	Gas	1.0065	0.4838	8.4297
69	Education and research	1.0062	0.4837	8.4475
72	Public administration	1.0000	0.4807	8.4853



**APPENDIX TABLE E : GHOSHIAN FORWARD LINKAGES, LINKAGE INDICES  
AND COEFFICIENT OF VARIATION**

<b>SI no.</b>	<b>SECTORS</b>	<b>Ghoshian Forward Linkages(R2)</b>	<b>Ghoshian Forward Linkage Indices(I3)</b>	<b>CV3</b>
14	Other non metallic minerals	8.2227	3.7691	3.1578
11	Crude petroleum and natural gas	7.8971	3.6198	2.3652
29	Heavy chemicals	4.4559	2.0425	2.3725
28	Coal tar products	4.2122	1.9307	3.2558
10	Coal and lignite	3.8962	1.7859	2.6883
13	Other metallic minerals	3.8820	1.7794	2.8843
41	Non ferrous basic metals	3.6357	1.6665	3.1784
23	Paper, paper products and newsprint	3.2157	1.4740	3.4054
35	Synthetic fiber and resin	3.1751	1.4554	3.5634
52	Other electrical machinery	3.1594	1.4482	3.3190
61	Electricity	3.1305	1.4350	3.6432
40	Iron and Steel	3.1058	1.4236	4.2233
36	Other chemicals	3.0814	1.4124	3.0691
30	fertilisers	2.9740	1.3632	3.7621
27	Petroleum products	2.9023	1.3304	3.5139
31	Pesticides	2.7345	1.2534	4.1288
68	Banking and Insurance	2.6086	1.1957	3.6236
12	Iron ore	2.6065	1.1947	4.0024
20	Jute , hemp and mesta textiles	2.5144	1.1525	3.6439
6	Animal services(agricultural)	2.5108	1.1509	4.0955
32	Paints, varnishes and lacquers	2.4603	1.1277	3.8828
65	Communication	2.2933	1.0512	3.8219
44	Industrial machinery	2.2862	1.0479	4.5610
37	Structural clay products	2.2757	1.0431	5.2431
22	Wood and wood products	2.2701	1.0406	4.2305
38	Cement	2.2062	1.0112	5.2765
42	Hand tools and other metal products	2.1183	0.9709	4.2995
26	Rubber and plastic products	2.0922	0.9590	4.3724
55	Rail equipment	2.0353	0.9329	5.0656
64	Transport services	2.0310	0.9310	4.4797
46	Office computing machines	2.0104	0.9215	4.5349
59	Miscellaneous manufacturing	1.9590	0.8979	4.6421
63	Water supply	1.9513	0.8944	4.5237
4	Commercial crops	1.8795	0.8615	4.8683
49	Electrical wires, cables and appliances	1.8768	0.8603	4.7250
33	Drugs and medicines	1.8619	0.8534	5.9154
66	Trade	1.8412	0.8439	4.7077
45	Machine tools	1.8165	0.8327	4.7461
8	Forestry and logging	1.7483	0.8014	4.9502
47	Other non electrical machinery	1.7094	0.7835	5.5312
24	Printing and publishing	1.6566	0.7593	5.4212
51	Communication equipment	1.6102	0.7381	5.9366
48	Electrical industrial machinery	1.6041	0.7353	5.5585
56	Motor vehicles	1.5810	0.7247	6.1175
3	Other crops	1.5645	0.7171	5.8572
57	Other transport equipment	1.5638	0.7168	6.8066

**APPENDIX TABLE E : GHOSHIAN FORWARD LINKAGES, LINKAGE INDICES AND COEFFICIENT OF VARIATION**

<b>Sl no.</b>	<b>SECTORS</b>	<b>Ghoshian Forward Linkages(R2)</b>	<b>Ghoshian Forward Linkage Indices(I3)</b>	<b>CV3</b>
54	Ships and boats	1.5621	0.7160	6.0606
19	Cotton textiles	1.4893	0.6826	6.3681
50	Batteries	1.4833	0.6799	5.8307
71	Other services	1.4769	0.6770	5.8787
39	Other non metallic mineral products	1.4615	0.6699	5.9922
21	Other textiles	1.4264	0.6538	7.1391
25	Leather products	1.3946	0.6392	7.8877
43	Tractor and agricultural implements	1.3828	0.6338	7.0259
67	Hotels and restaurants	1.3314	0.6103	6.4062
7	Other live stock rproducts	1.3205	0.6053	6.4359
2	Wheat	1.3054	0.5983	7.3836
1	Paddy	1.2989	0.5954	7.7209
60	Construction	1.2411	0.5689	6.9509
70	Medical and Health	1.1956	0.5480	7.3346
16	Sugar and khandsari boora	1.1912	0.5460	7.2290
15	Tea and coffee processing	1.1842	0.5428	7.7547
34	Soaps, cosmetics and glycerin	1.1712	0.5368	7.6024
17	Other food products and beverages	1.1697	0.5361	7.5852
58	Watches and clocks	1.1595	0.5315	8.2712
5	Milk anf milk products	1.1578	0.5307	7.3859
9	Fishing	1.1412	0.5231	7.5861
53	Electronic equipment	1.1292	0.5176	7.8049
62	Gas	1.1251	0.5157	7.5547
18	Tobacco products	1.0492	0.4809	8.4451
69	Education and Research	1.0063	0.4612	8.4468
72	Public administration	1.0000	0.4584	8.4853

**APPENDIX TABLE F: CLASSIFICATION OF SECTORS IN THE AUGMENTED STRUCTURE**

<b>SL NO.</b>	<b>NON DURABLE SECTORS</b>	<b>SL NO.</b>	<b>DURABLE SECTORS</b>
1	Paddy	27	Petroleum products
2	Wheat	29	heavy chemicals
3	other crops	38	Cement
4	commercial crops	39	Other non-metallic mineral prods.
5	Milk and milk products	40	iron and steel
6	Animal services(agricultural)	41	Non-ferrous basic metals
7	Other livestock products	42	hand tools and other metal products
8	Forestry and logging	43	Tractors and agri. implements
9	Fishing	44	Industrial machinery
10	Coal and lignite	45	Machine tools
11	Crude petroleum, natural gas	46	Office computing machines
12	Iron ore	47	Other non-electrical machinery
13	other metallic minerals	48	Electrical industrial Machinery
14	other non metallic minerals	49	electrical wires,cables and appliances
15	Tea and coffee processing	50	Batteries
16	sugar and khandsari boora	51	Communication equipments
17	other food products and beverages	52	Other electrical Machinery
18	Tobacco products	53	Electronic equipments(incl.TV)
19	cotton textiles	54	Ships and boats
20	Jute, hemp, mesta textiles	55	Rail equipments
21	other textiles	56	Motor vehicles
22	wood and wood products	57	other transport equipment
23	Paper, paper prods. & newsprint	58	Watches and clocks
24	Printing and publishing	60	Construction
25	leather products		
26	rubber and plastic products		
28	Coal tar products		
30	Fertilizers		
31	Pesticides		
32	Paints, varnishes and lacquers		
33	Drugs and medicines		
34	Soaps, cosmetics & glycerin		
35	Synthetic fibers, resin		
36	Other chemicals		
37	Structural clay products		
59	Miscellaneous manufacturing		
61	Electricity		
62	Gas		
63	Water supply		
64	transport services		
65	Communication		
66	Trade		
67	Hotels and restaurants		
68	banking and insurance		
69	Education and research		
70	Medical and health		
71	other services		
72	Public administration		

**APPENDIX TABLE G: BACKWARD LINKAGE INDICES IN THE AUGMENTED STRUCTURE**

<b>SI No.</b>	<b>SECTORS</b>	<b>Backward Linkages</b>	<b>Backward Linkage Indices</b>
6	Animal services(agricultural)	3.7481	3.0472
40	Iron and steel	3.1952	1.1684
31	Pesticdes	3.1711	1.1111
28	Coal tar products	3.1606	1.1067
36	Other chemicals	3.1514	1.1025
21	Other textiles	3.0295	1.0765
23	Paper , paper products and newsprint	3.0071	1.0656
54	Ships and boats	3.0053	1.0588
44	Industrial machinery	3.0040	1.0581
30	Fertilisers	2.9924	1.0521
17	Other food products and beverages	2.9834	1.0514
34	Soaps , cosmetics and glycerin	2.9664	1.0482
43	Tractors and agricultural implements	2.9304	1.0421
41	Non ferrous metal products	2.9217	1.0408
66	Trade	2.9100	1.0394
42	Hand tools and other metal products	2.9035	1.0389
19	Cotton textiles	2.9006	1.0277
49	Electrical wires, cables and appliances	2.8947	1.0268
64	Transport services	2.8931	1.0199
26	Rubber and plastic products	2.8872	1.0164
15	Tea and coffee processing	2.8734	1.0140
33	Drugs and medicines	2.8676	1.0094
25	Leather products	2.8606	1.0083
56	Motor vehicles	2.8595	1.0072
53	Electronic equipments	2.8447	1.0072
57	Other transport equipment	2.8355	1.0049
50	Batteries	2.8320	1.0039
48	Electrical industrial machinery	2.8283	1.0014
32	Paints, varnishes and lacquers	2.8242	0.9996
61	Electricity	2.8223	0.9975
45	Machine tools	2.8124	0.9902
52	Other electrical machinery	2.7951	0.9887
35	Synthetic fiber and resin	2.7827	0.9874
20	Jute, hemp and mesta textiles	2.7616	0.9862
38	Cement	2.7535	0.9742
47	Other non electrical machinery	2.7466	0.9713
46	Office computing machines	2.7436	0.9665
16	Sugar and khandsari boora	2.7344	0.9660
29	Heavy chemicals	2.7248	0.9612
3	Other crops	2.7031	0.9571
51	Communication equipments	2.7003	0.9550
59	Miscellaneous manufacturing	2.6723	0.9450
24	Printing and publishing	2.6394	0.9399
67	Hotels and restaurants	2.5894	0.9228
58	Watches and clocks	2.5862	0.9107
71	Other services	2.5836	0.9089
60	Construction	2.5650	0.9069

**APPENDIX TABLE G: BACKWARD LINKAGE INDICES IN THE AUGMENTED STRUCTURE**

<b>SI No.</b>	<b>SECTORS</b>	<b>Backward Linkages</b>	<b>Backward Linkage Indices</b>
70	Medical and health	2.5470	0.9046
55	rail equipments	2.5274	0.8916
1	Paddy	2.5120	0.8782
37	Structural caly products	2.4402	0.8625
18	Tobacco products	2.4371	0.8538
39	Other non metallic mineral products	2.4340	0.8526
27	Petroleum products	2.4056	0.8499
2	Wheat	2.3401	0.8187
22	Wood and wood products	2.1015	0.7354
7	Other livestock products	2.0711	0.7226
10	Coal and lignite	2.0484	0.7179
5	Milk ana milk products	2.0016	0.6982
4	Commercial crops	1.9174	0.6696
68	Banking and insurance	1.8347	0.6461
12	Iron ore	1.7856	0.6413
63	Water supply	1.7730	0.6255
13	Other metallic minerals	1.6167	0.5661
69	Education and research	1.5938	0.5597
62	Gas	1.5864	0.5527
72	Public administration	1.5235	0.5337
65	Communication	1.5179	0.5309
9	Fishing	1.5134	0.5279
11	Crude petroleum and natural gas	1.4574	0.5121
14	Other non metallic minerals	1.4194	0.4975
8	Forestry and logging	1.3704	0.4824

**APPENDIX TABLE H: FORWARD LINKAGE INDICES IN THE AUGMENTED STRUCTURE**

<b>SI No.</b>	<b>SECTORS</b>	<b>Forward Linkages</b>	<b>Forward Linkage Indices</b>
66	Trade	13.1576	4.7550
64	Transport services	12.0308	4.3478
3	Other crops	9.0843	3.2830
61	Electricity	8.7705	3.1696
71	Other services	8.4823	3.0654
40	Iron and steel	7.0631	2.5525
68	Banking and insurance	7.0248	2.5387
4	Commercial crops	4.9003	1.7709
11	Crude petroleum and natural gas	4.8532	1.7539
29	Heavy chemicals	4.1943	1.5158
1	Paddy	3.9964	1.4443
10	Coal and lignite	3.8580	1.3942
41	Non ferrous basic metals	3.8570	1.3939
36	Other chemicals	3.5145	1.2701
5	Milk and milk products	3.4246	1.2376
27	Petroleum products	3.2198	1.1636
17	Other food products and beverages	3.0743	1.1110
23	Paper , paper products and newsprint	2.9582	1.0691
21	Other textiles	2.9198	1.0552
19	Cotton textiles	2.7686	1.0005
35	Synthetic fiber and resin	2.7621	0.9982
60	Construction	2.7092	0.9791
2	Wheat	2.7090	0.9790
26	Rubber and plastic products	2.6505	0.9579
7	Other livestock products	2.6111	0.9436
42	Hand tools and other metal products	2.5684	0.9282
30	Fertilisers	2.4007	0.8676
59	Miscellaneous manufacturing	2.3875	0.8628
65	Communication	2.1704	0.7844
8	Forestry and fishing	2.1636	0.7819
14	Other non metallic minerals	2.1628	0.7816
22	Wood and wood products	1.9128	0.6913
33	Drugs and medicines	1.9079	0.6895
67	Hotels and restaurants	1.8836	0.6807
47	Other non electrical machinery	1.7918	0.6475
69	Education and research	1.7740	0.6411
70	Medical and health	1.7481	0.6317
6	Animal services (agricultural)	1.7145	0.6196
44	Industrial machinery	1.6857	0.6092
16	Sugar and khandsari boora	1.6729	0.6046
32	Paints , varnishes and lacquers	1.6134	0.5831
9	Fishing	1.5195	0.5491
56	Motor vehicles	1.5168	0.5482
25	Leather products	1.5102	0.5458

**APPENDIX TABLE H: FORWARD LINKAGE INDICES IN THE AUGMENTED STRUCTURE**

<b>SI No.</b>	<b>SECTORS</b>	<b>Forward Linkages</b>	<b>Forward Linkage Indices</b>
28	Coal tar products	1.4993	0.5418
24	Printing and publishing	1.4967	0.5409
31	Pesticides	1.4904	0.5386
49	Electrical wires, cables and appliances	1.4597	0.5275
18	Tobacco products	1.4451	0.5222
55	Rail equipments	1.4187	0.5127
57	Other transport equipments	1.4040	0.5074
48	Electrical industrial machinery	1.3980	0.5052
34	Soaps , cosmetics and glycerin	1.3834	0.4999
15	Tea and coffee processing	1.3070	0.4723
52	Other electrical machinery	1.3068	0.4723
51	Communication equipment	1.2983	0.4692
13	Other metallic minerals	1.2958	0.4683
39	Other non metallic mineral products	1.2664	0.4577
20	Jute , hemp and mesta textiles	1.2206	0.4411
38	Cement	1.2114	0.4378
43	Tractors and agricultural implements	1.1971	0.4326
63	Water supply	1.1877	0.4292
54	Ships and boats	1.1445	0.4136
45	Machine tools	1.1355	0.4104
58	Watches and clocks	1.1324	0.4092
53	Electronic equipment	1.1167	0.4036
37	Structural clay products	1.1023	0.3984
12	Iron ore	1.0843	0.3918
62	Gas	1.0510	0.3798
46	Office computing machines	1.0474	0.3785
50	Batteries	1.0361	0.3744
72	Public administration	1.0000	0.3614

## References:

- Bharadwaj K (1966): 'A Note on the Structural Interdependence and the Concept of a Key Sector, *Kyklos*, 19.
- Cella G (1984): 'The Input-Output Measurement of Interindustry linkages', *Oxford Bulletin of Economics and Statistics*, 46, pp. 73-84.
- CSO: *Input-Output Transaction Tables*, Central Statistical Organisation, Department of Statistics, Ministry of Planning, Government of India.
- Dhawan S and K K Saxena (1992): 'Structural Linkages and Key Sectors of the Indian Economy', *Indian Economic Review*, 27, pp. 195-210.
- Ghosh A (1964) : '*Experiments with Input-Output Model*', Cambridge University Press, U.K.
- Hazari B(1970): 'Empirical Identification of key sectors of the Indian economy', *Review of Economics and Statistics*, 52(3), pp. 173-195.
- Leontief W (1951): 'The Structure if the American Economy 1919-1939', 2<sup>nd</sup> edition, Oxford University Press, New York.
- Nambiar R G, B L Mungekar and G A Tadas (1999): 'Import Liberalisation Hurting Domestic Industry and Employment?', *Economic and Political Weekly*, February 13, 1999, pp. 417-424.
- Sastry D V S, Balwant Singh, Kaushik Bhattacharya and N K Unnikrishnan(2003):Sectoral Linkages and Growth Prospects, Reflections on the Indian Economy', *Economic and Political Weekly*, June 14, 2003, pp. 2390-2397.