Structural Changes in Indian Economy : An Analysis with Input-Output Tables, 1951-63

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THE GOKHALE INSTITUTE OF POLITICS & ECONOMICS
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FOREWORD

Preparation of Input-Output Tables for India began soon after Planning exercises started in the 50's. The Centre for Research in Planning and Development in the Institute, sponsored by the Planning Commission, has been one of the three Centres in the country where such Tables have been prepared from time to time.

The present study brings together all the Input-Output tables prepared for the period 1951-1963, in order to assess the validity of the underlying assumptions of the input-output model based on Indian experience and analyse the intertemporal structural changes that have taken place in the economy. The study finds that most input-output coefficients were reasonably stable for about 8 years; beyond this, changes were significant. Of course not all coefficients were equally stable: some exhibited a trend, while the values of some others did not show any particular pattern, which makes continuous evaluation of these coefficients necessary. The development of various linkages have been traced. The study indicates definite structural changes in the economy by the end of the 50's.

It is hoped planners and students of the structure of the Indian economy will find this study useful and relevant.

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4th August, 1984

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Latika Argade

ERRATA

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Structural Changes in Indian Economy :

An Analysis with Input-Output Tables, 1951-63

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CHAPTER I

INTRODUCTION AND OVERVIEW

The input-output system is a convenient means of representing a huge mass of heterogenous data into a coherent whole such that the structural relationships underlying the economy are meaningfully revealed. The system is widely used in the planning exercises of many countries. The heart of the framework of reasoning consists in applying an input-output model for estimating consistent output levels. The model has varied uses and its rich information content yields answers to several economic aspects such as equilibrium prices, maximal growth possibilities etc. The constancy of the technical coefficients of the model over time however is the crucial assumption in the analysis.

In India the work on the preparation of input-output tables started in the early fifties and tables for different years are constructed and are widely used in preparing the five year plans. But as yet there has been no systematic attempt in analysing the intertemporal structural changes in the input-output frame as also to assess the extent of the validity of the underlying assumptions of the input-output model based on Indian experience.

The purpose of this study is to examine the structural changes that have taken place in the Indian economy covering the period 1951 to 1963 i.e. the initial decade of the plan period using the available input-output tables and to further examine the changes in input-output coefficients over the period and assess the impact of these coefficient changes on the projections of output levels.

Subsequent to 1963 three more input-output tables for 1965, 1968-69 and 1973-74 have become available. The 1965 table was constructed by the Gokhale Institute of Politics and Economics (Venkatramiah, 1980) and the other two by the Central Statistical Organization, Government of India (1978, 1981). Some analysis for this study was already underway by the time these tables became available, but

more importantly consideration of too long a time period, it was felt, would perhaps confound the input-output coefficient changes, which is the main purpose of this study, with those of long term inherent structural changes. Hence these subsequent tables were not included.

Thus the study, analysing the interindustry data of the 1951-63 vintage, apparently gives the look as an exercise in economic history of the recent past. But the latest input-output data available for the Indian economy is for the year 1973-74. In fact the "Technical note on the Sixth Plan of India (1980-85) is based on the updated version (1979-80) of the 1968-69 input-output table, noted above (Planning Commission, 1981). Even so, this is not the orientation of the present study at all, as the more important purpose was to bring together and empirically test the methodology of analysis of structural change in input-output framework by using the Indian input-output tables. However, this should not be mistaken to be a study only on the methodology of analysis of structural change in input-output framework, with the empirical data used merely for illustrative purposes. Though of the recent past, the results of the analysis are important *per se* and also because of the importance of the said time vintage when the traditional Indian economy launched the process of modernisation and industrialisation through planned effort and the results of the analysis embody the impact of the said planning process of the initial decade. Thus the two strands viz. methodology and empirics run side by side throughout the study equally importantly.

1.2 *The Data*

The data base for this study consists of five input-output tables for the years 1951-1952, 1952-1953, 1959, 1961 and 1963. The first two tables were constructed by the Indian Statistical Institute, the 1959 table is constructed by the Planning Commission, Government of India, the 1961 table is by Manne and Rudra while the 1963 table was constructed in purchaser prices at the Gokhale Institute. Before these tables can be used for the analysis they need to be made comparable. Chapter II deals with the details of data adjustments to make the tables comparable and outlines the limitations. Differences existed in regard to the sectoral classification, in the use of producers' or purchasers' prices in evaluating inputs and outputs and finally in the price systems used for respective years. After examining the individual sectors of each of the tables, a uniform 18 sector classification was evolved and all the tables were cast into these 18 sectors, of which one belongs to Agriculture, two to Mining, 12 to Manufacturing and the rest three to the 'Other Industries' and Transport. The service sectors do not figure in the tables. Thus the economy that is analysed pertains mainly to the material production sphere and excludes the service sector segment. The description of the sectors is given in

Table 2.2.1. The 1963 table was converted into producer prices. Finally all the inputs and outputs in each of the tables were evaluated at 1952-53 prices by price indices constructed for this purpose. The comparable 18 sector input-output transaction matrices at 1952-53 prices, for each of the five time periods are given in Appendix, Table Nos. A2.4.3a to e. The corresponding column coefficient matrices and their Leontief Inverses are presented in Appendix Table B3.3.1a to e and B3.4.2a to e respectively. The row coefficient matrices are also evaluated and presented in Appendix Table B3.3.2a to e.

In spite of all these adjustments the input-output tables are not strictly comparable as the methods of construction differ in details in estimating some of the individual coefficients as these tables were constructed by different agencies. While construction of input-output tables by a single agency with uniform methodology has its merits, it also suffers from the undesirability of built-in stability of the coefficients in the estimation as one is prone to base the later year's estimate on that of the earlier year in cases where basic data gaps exist. The present data base of our study at least does not suffer from such bias while such difference in details of estimation that could not be adjusted would affect the comparability. To check whether these tables provide truly a checker board description over time as 5 point snapshots of the economy, the value added estimates derived from these tables both in current and constant prices were compared with those derived from the national income accounts and the limitations of our data thrown from such comparison were noted. Overall we found that the worked out comparable input-output matrices depicted the underlying structure of the respective years reasonably well.

1.3 *Structural Change in the Economy as a Whole*

Chapter III deals with the structural changes in the Indian economy as a whole leaving the consideration of sectoral changes for the subsequent chapter. After a review of literature on the techniques to study structural change in input-output framework the three following aspects were examined.

a) What is the change in the nature of interdependence amongst various sectors?

b) How is the technology changing over the period?

c) What is the effect of technological change and that of final demand change on production levels?

1.3.1 *Change in the Interdependence Amongst Sectors*

Over the period 1951-1963, it was found, the proportion of inter-industry use to the total output in the

economy was around 34 per cent and this proportion was almost stagnant or at best showed only a marginal increase. If we exclude agriculture, both from the rows and columns of the transaction matrices a different picture emerges. The proportion of non-agricultural products that went into inter-industry use showed a gradual rise, increasing from 24 per cent in 1951 to 37 per cent in 1963.

The changes that have taken place in the individual sectors and their contribution to overall inter-industry use were analysed by the well known Chenery-Watanabe method of four-fold categorisation of the sectors based on the strength of forward and backward linkages in section 3.2.2 of the third chapter. The analysis showed that there is a significant shift of the sectors from intermediate primary production to intermediate manufactures over the time. Non-ferrous metals (12) was the only sector which had high forward and backward linkages in the year 1951-52. By 1959 Non-metallic minerals (8), Chemicals (9), Iron and steel (11), and Machinery (13) were found to have moved into intermediate manufactures category thereby showing that the output of these sectors had become more sophisticated, undergoing increasing quantum of processing. The Second Five Year Plan which laid greater emphasis on industrialization did have a significant impact on the character and quality of the industrial base of the economy.

1.3.2 *Technological Change*

Intertemporal changes in the technology as revealed by the changes in the input-output coefficients are examined in section 3.3 of chapter III.

Using the Tilanus method of coefficient of variation over the five time points it was observed that 81 per cent of the input coefficients with magnitude less than 0.05 exhibit a coefficient of variation more than 100 per cent. Relatively fewer coefficients of larger magnitudes have high coefficient of variation. Thus there exists a negative correlation between the size of the coefficient and its temporal change as exhibited by coefficient of variation. The behaviour of the distribution (row) coefficients is found to be similar.

The changes in the input coefficients between two time points for the economy as a whole, which is a measure of the technological change, were worked out using Maria Augustinovic formulation. If there is no technological change at all the measure has a zero value and the upper limit of the measure is 2 indicating that the technologies are entirely different. As the time gap between two input-output tables increases, as is to be expected, the technological change from time gap of one year to 12 years increases but with two exceptions. These exceptions occur when comparisons are made with the table for 1959. The said exceptions, however, may be treated either as aberrations in view of the numerous data adjustments that were

made or as indicating a significant structural change around the year 1959. Subsequent analysis in chapter IV does seem to justify the later conclusion.

To get some idea about the direction in which technological change was taking place Leontief's method of fitting a frequency distribution to the relative change index of input coefficients was used (3.3.4). We have fitted two such distributions, one to compare the years 1951-1952 and 1953-1954 and the other to compare the years 1951-1952 and 1963. The statistical means and standard deviations of the two distributions are calculated. The distributions were found to be nearly normal and the means of the distributions give a measure of the magnitude of overall change. It was seen that from 1951 to 1953 the input coefficients for the economy as a whole increased on the average by 3 per cent. The average increase was of the order of 6 per cent during the period 1951 to 1963. Increased input use signifies lower productivity. While in a developed economy the inputs in the later period are expected to be less than the former, in a developing economy a greater input usage for the economy as a whole indicating the entry of newer products in the domestic manufacture, is to be expected. The standard deviation of the distributions also showed an increase from 0.1709 in 1951-1953 to 0.7383 in 1951-1963 indicating that the growth of the sectors was not uniform.

1.3.3 *Impact of Technological Change and of Final Demand Change on Production Levels*

The change in the production levels between two time periods is because of two effects. One effect is due to the change in technology i.e. change in the input-output coefficient matrices and the other due to changes in the final demand vectors. What is the contribution of each of these factors? Section 3.4.1 deals with this aspect.

We have observed that final demand changes have a larger impact than technological changes. For as large a gap as that of 8 years, when output changed by 24.1 per cent in the mining and manufacturing branches of the economy the technological change accounted for only 5.5 per cent and the rest of 18.6 per cent is due to changes in final demand. If Agriculture (1) is also included, the output changes by 28.8 per cent from 1951 to 1959 and only 2.4 per cent of it is due to technological change. These low values indicating high stability of technology are to an extent due to positive changes in some sectors being compensated by negative changes in other sectors. If this factor is allowed for by considering absolute changes, change in technology was found to account for 14.2 per cent while final demand changes account for 21.8 per cent for a time gap of 8 years, considering only the mining and manufacturing branches of the economy. If Agriculture (1) is also included, up to a time gap of 8 years, the technological change accounted for about 6 per cent of the output

change while final demand accounted for over 26 per cent of the change. Further the output changes due to technology changes which were found to hover around 6 per cent up to a time gap of 8 years sharply rose to nearly 15 per cent for a time gap of more than 8 years. Earlier it was observed that there was some evidence to suggest a significant structural change around 1959. The sharp rise in output changes due to technological change for a gap of more than 8 years strengthens this conclusion. The use of an input-output table for more than 8 year vintage would therefore lead to sizable errors in forecasting production levels. The Indian experience from 1951 to 1963 indicates that the crucial assumption of the constancy of input-output coefficients in the Leontief model can be considered as valid for a period of 8 years. The evidence of the Western industrial economies suggests that the input-output coefficients change relatively slowly over time and consequently little error is introduced if input-output tables of older vintages are used to generate gross outputs. It was found in the case of Soviet Union that over the seven year period the overall material input-output ratios did not change drastically.

Thus the Indian experience reveals that the final demand changes are more important than technological changes, the constancy of input-output coefficients appears to be reasonable up to an eight year time period and the Indian economy has experienced a significant structural change around 1959.

1.4 *Sector Level Changes*

Sectoral changes in the economy forms the subject matter of the fourth chapter and the following questions are dealt with.

1. How is the relative position of the sectors changing over time in gross output, final demand and inter-industry demand?

2. What is the magnitude of the linkages, forward and backward, of different sectors and how have they been changing during the period?

3. What is the technological change in the different sectors of the economy?

4. What is the impact of changes in technology on sectoral production levels?

1.4.1 *Relative Position of Sectors*

Agriculture (1) and agro-based industries of Food, drink and beverages (4), and Textiles (5) are found to be the most important sectors in that order contributing more than 70 per cent output and remain so throughout the period

under consideration. The share of Agriculture (1) which increased from 55.8 per cent in 1951-52 to 59.2 per cent in 1959 declined to 53.6 per cent in 1963, Food, Drinks and Beverage (4) sector's share in output showed a continuous decline while the share of the Textiles (5) sector fluctuated in the range 6.4 per cent to 8.9 per cent. The shares of the output of the rest of the sectors increased from 1951-52 to 1963 with the exception of the Transport sectors (16,17) and that of other Mining (3).

In the final demand the share of Agriculture (1) and Textile (5) sectors had increased over the period while that of Food, Drinks and Beverages (4) sector had gone down. A sharp increase in the trend of final demand shares was observed in the Metallic Products and Machinery (13) sector. On the contrary Construction (14) sector showed a sharp decline. The Transport sectors (16,17) also showed a decline after 1959. The shares of the rest of the sectors, with the exception of Mining (2,3) sectors which suffered large fluctuations, showed a slight increase in their percentage share of final demand over the period.

The ratio of inter-industry demand to gross output of Agriculture (1), Textiles (5) and Metallic Products and Machinery (13), declined over the period. For the rest of the sectors the interindustry demand share of the output showed an increase by and large.

1.4.2 *Linkages*

The backward and forward linkages are inducement mechanisms that may encourage production activities and the measures of linkages and their role in the development strategy is widely discussed in the literature. After a review of the literature, the forward and backward linkages for different sectors are presented in Table 4.2.1 (a). Food, Drinks and Beverages (4), Non-ferrous Metals (12), and Textiles (5) had very high backward linkages while the Mining sectors (2,3), Non-metallic Minerals (8), Railway Transport (16) and Agriculture (1), had low backward linkages. While Cement (10), Non-ferrous Metals (12), Iron and Steel (11) had high forward linkages, Other Transport (17), Metallic Products and Machinery (13), Food, Drinks and Beverages (4) had relatively low forward linkages. The intertemporal rank correlation coefficients of the ranks of sectors were found to be high and positive. Between the two linkage types, the said correlation coefficients were found to be of a higher order for forward linkage ranks indicating that the forward linkage structure had remained more rigid than the backward linkage during the period.

Over the time period, it was observed that Non-metallic Minerals (8), Chemical and Petroleum (9), Cement (10), Iron and Steel (11) and Metallic Products and Machinery (13) sectors had an increasing trend of backward linkages while showing a declining trend in forward linkages. It is these

sectors which have shifted their position in the tetrapartite Chenery Watanabe classification from 1959 onwards from intermediate primary production category to intermediate manufactures, with the exception of Metallic Products and Machinery (13) which moved to final manufactures.

The ordering of the sectors based on the direct and indirect backward linkages based on Leontief Inverse was found to be quite similar to that of direct backward linkages.

The intertemporal comparison of the rank correlation coefficients of direct and indirect linkages showed that they were the lowest when compared with the year 1959. This is in tune with the conclusion reached earlier that the year 1959 seems to indicate that perhaps it was sort of a watershed receiving old trends and transmitting new departures.

1.4.3 *Technological Change*

Technological change in each of the sectors was measured by using the measures developed by Chenery, Maria Augustinovics and Leontief. The basic notion of differences in the current input coefficients as a measure of technological change is common to all these measure, while the differences pertain to the weights attached to the individual cell level coefficients. The Leontief measure indicates the direction of the change also.

It was observed that the traditional sectors of Food (4), Textiles (5), Paper and Printing (6), and Leather and Rubber (7) experienced relatively low technological change. The Mining sectors (2,3) showed a technological change greater than that of the economy as a whole and in the direction of increasing input usage. This seems to indicate the phenomenon of decreasing returns in the mining sector. The modern sectors of Chemicals and Petroleum (9), Non-ferrous Metals (12) and the sector of Metal Products and Machinery (13) were surprisingly found to occupy border line positions with respect to the level of technological change.

Considering the direction of technological change during the period the Leontief Index revealed that in all the binary comparisons most of the sectors showed greater input usage. The exceptions were Agriculture (1) which showed input reduction between 1953-59 and 1951-59, Coke and Coal (2), Food, Drinks and Beverages (4), Paper and Printing (6), Non-ferrous Metals (12) and Electricity (15) which exhibited decreased input consumptions in one or two binary comparisons out of the six comparisons attempted.

For the economy as a whole it was noted earlier that larger the time gap greater was the change in the technology. In 9 out of 14 sectors it was observed that initially the magnitude of technological change increases and

then shows a decline. One possible explanation of the later decline might be due to the changes in vertical integration of processes that might have taken place in these manufacturing sectors or due to import substitutions. Juxtaposing the different measures of technological change one gets an idea of the nature of technological change. In Other Mining (3), Textiles (5) and Chemicals and Petroleum (9) the major inputs seemed to be either increasing or constant while the minor inputs were found to be declining. On the other hand, relative decline in respect of major inputs was noticed in Metal Products and Machinery (13) and Food, Drinks and Beverages (4). The sectors of Paper and Printing (6), Leather and Rubber (7), Cement (10), Iron and Steel (11), were seen to experience the said relative decline in respect of both major and minor input items. The abrupt change in the direction leading to decline in technological change noticed in case of the 9 sectors takes place when the calculations involve the calendar year 1959 which the earlier analysis shows as a sort of demarcating year for structural change.

1.4.4 *Impact of Technological Change on Sectoral Output Levels*

The impact of technological change and final demand changes on the sectoral output levels is discussed in 4.5. The impact of technological changes on the sectoral outputs of Agriculture (1), Food, Drinks and Beverages (4) and Metal Products and Machinery (13) was within 10 per cent limits in all the binary comparisons between time points. For the Textiles (5) sector also it was within 10 per cent limits except when comparisons involved the year 1963. These being final demand goods, changes in technology have obviously only minor impact on their production levels. The sectors of Coke and Coal (2), Non-metallic Minerals (8), and Cement (10), showed more pronounced impact of technological change on their output levels whenever comparisons were made with 1963 technology and the impact was positive in the sense that the use of these inputs in other industries had increased. In the case of Paper and Printing (6), Leather and Rubber (7) and Electricity the use of their outputs as inputs showed an increasing trend from 1951 to 1963. It might be possible to forecast these inputs by fitting an appropriate trend. In the case of Chemicals and Petroleum (9), Iron and Steel (11), and Non-ferrous Metals (12) no uniform pattern of impact was observable. Estimation of output levels based on input-output tables of earlier vintages for these sectors results in large errors. The output flows of these sectors into different absorbing sectors of the economy needs serious attention while using an input-output table for forecasting purposes.

The question whether changes in final demand and changes in technology complement or off set each other in influencing output levels was examined. The analysis suggests that the behaviour is generally complementary as was found out to be the case with U.K. and U.S.A. data.

1.5 *Limitations*

The structural change was analysed only in the input-output frame. The study does not throw any light on the role of changing relative prices, substitution between labour and capital, etc., which revolve about knowledge of production functions. Even within the input-output frame, the changing product mix and the role of capital coefficients, could not be considered.

Changes in the input-output flow coefficients were equated with technological change while in reality technological change is a much broader concept. Many data adjustments that were made for making the input-output tables comparable, add further limitation. The conclusions drawn are based on the data for 1951 to 1963 and all the tendencies observed may not remain valid for other durations of time as history rarely repeats itself in all its manifestations.

CHAPTER II

INTERINDUSTRY DATA

DATA ADJUSTMENTS AND LIMITATIONS

2.1 *Interindustry Data*

In India the preparation of interindustry tables started on the eve of the formulation of the Second Five Year Plan of the Government of India, around 1954 (Mukherjee, 1967). In the following table we list the different interindustry tables consulted for this study according to the data year to which they refer.

Table 2.1.1 : INTERINDUSTRY TABLES OF INDIAN ECONOMY

Sr. No.	*Data Year*	*Interindustry Table*
1.	1948-49	23 sector Table by T.P. Chowdhury (1954)
2.	1949-50	4 sector Table by M. Mukherjee (1954)
3.	1949-50	15 sector Table by Uma Dutta (1954)
4.	1950-51	12 sector Table by Godwin and Chowdhury (1955)
5.	1951-52	36 sector Table by Indian Statistical Institute (1960)
6.	1952-53	19 sector Table by Indian Institute of Public Opinion (1954)
7.	1953-54	36 sector Table by Indian Statistical Institute (1961)
8.	1951-52 to 1953-54	4 x 5 Tables by W. Malenbaum (1955)
9.	1955-56	36 sector Table by Indian Statistical Institute (Saluja, 1980)
10.	1959	29 sector Table by Planning Commission (*Artha Vijnana*, 1967)

For the purpose of our study we have selected those Tables that have a larger disaggregation into sectors of the economy. But we could not lay our hands on the 36 sector Table of Indian Statistical Institute for the year 1955-56. Also the 66 sector Table of the Planning Commission is not published though the technical coefficients matrix updated to 1973-74 at 1971-72 producers' prices got published after the bulk of our analysis for this study was completed. M.R. Saluja's 77 sector transactions matrix for 1964-65 is based on the 1961 norms and hence we have not used it. Thus our analysis of the structural changes in the Indian economy is based on the following input-output tables listed in Table 2.1.2 and covers the period from 1951 to 1963 i.e. from the start of the First Five Year Plan till the middle of the Third Five Year Plan.

Table 2.1.1 : INTERINDUSTRY TABLES OF INDIAN ECONOMY (Contd..)

Sr. No.	*Data Year*	*Interindustry Table*
11.	1960-61	30 sector Table by Manne and Rudra (1965)
12.	1963	84 sector Table by Gokhale Institute of Politics & Economics (Venkatramiah, 1972)
13.	1964-65	77 sector Table by M.R. Saluja (1968)
14.	1965	66 sector Table by Planning Commission (1973)

The ISI Tables for 1951-52 and 1953-54 have an identical scheme of sector classification. In these tables, the economy is mainly divided into four parts viz. primary industries, large scale manufacturing, small scale manufacturing, and tertiary activities. The large scale manufacturing covers in 14 sectors all production activities coming under the Indian Factories Act, 1948 including both the Census and sample sectors. The small scale or the unorganised production is covered in 7 sectors. The tertiary activities, covered in 10 sectors, comprise railways and communication, other transport, trade and distribution, bank, insurance and co-operative professions, construction, residential property, public administration, defence materials, and unclassified of large scale sector. The Tables are at producers' prices for the specific years.

The sector classification of the 1959 Table of the Planning Commission is different from the ISI Tables. It does not maintain the distinction between the registered factory sector and the small scale, unorganised sector. Though this Table has larger number of sectors for agriculture and mining than the ISI Tables, the manufacturing sector is less disaggregated and the other 3 sectors cover only the transport and distribution activities. This Table does not cover construction activity. It is given at 1959 producers' prices.

In the 1960-61 Table prepared by A.S. Manne and Ashok Rudra, though the number of sectors for manufacturing activity is the same as that of the 1959 Table the definition of individual sectors in terms of their composition is not the same in all cases. The distinction between the organised and unorganised sectors has been done away with in this Table also.

In addition, this table does not cover the Paper and Paper products sector. Further, it gives only the rows for "industries not included elsewhere" and trade, transport and indirect taxes. This table does not give the cellwise break-up of the transport rows. The table is at 1959-60 producers' prices.

Table 2.1.2 : SELECTED INPUT-OUTPUT TABLES

Sr. No.	*Data Year*	*Author/Organisation*	*Number of Sectors*					*Prices used*
			Agriculture	*Mining*	*Manufacturing*	*Others*	*Total*	
1.	1951-52	Indian Statistical Institute (ISI)	3	2	21	10	36	Producer
2.	1953-54	- do -	3	2	21	10	36	Producer
3.	1959	Planning Commission	6	3	17	3	29	Producer
4.	1960-61	Manne and Rudra	6	3	17	4	30	Producer
5.	1963	Gokhale Institute of Politics & Economics	11	9	59	5	84	Purchaser

The Gokhale Institute 1963 Table is the most disaggregated of the five input-output tables considered here. Also this is the only table at purchasers' prices, used in this study. It identifies 59 sectors in the manufacturing division at the 3 digit level of Annual Survey of Industries (ASI) classification, but it covers only the organised (Census and sample) sectors of the manufacturing activity. Happily for us, for the same year 1963, a 33 sector transaction matrix for the unorganised sector is available (Kamath, 1971) which has 26 sectors for manufacture, 3 for mining, 2 for transport and 1 each for agriculture and trade margins.

2.2 *Data Adjustments*

From the salient features of the input-output tables noted earlier it is clear that they have different sector classifications and coverage and are evaluated at different price systems. It is necessary, therefore, to make these tables comparable before we use them for our study. In the following we briefly narrate the adjustments we have made for this purpose.

The first adjustment is to recast these tables to a uniform sector classification by redefining the sectors. Scrutinising the tables, for the minimum number of sectors for any particular activity, we have taken the minimum number of sectors available in that table and by aggregation we have derived the corresponding sectors for the particular activity in the other tables, keeping in mind that the activity or industry-mix of the sectors remains the same. However, though all the tables have more than one sector for agriculture, the classifications of these are such that it is not possible to recast them into more than one sector. We have, therefore, reluctantly aggregated all agricultural sectors in the different tables into a single sector covering agriculture, animal husbandry, fisheries and forestry. This is highly aggregative indeed, and may colour our subsequent analysis. Besides agriculture, we have adopted one sector for construction, 2 sectors for mining and transport and 12 sectors for manufacturing industries. The trade margin sector is not taken into account in this study. The following table gives the 18 sector classification into which the 5 input-output tables were uniformly recast for the purpose of our study.

The principal effect of aggregation on the variability of input-output coefficients is that, aggregation generates both the tendencies to make coefficients more stable as also more variable in the input-output model (Per Seveldson, 1970; Vaccara,1970). Even so, our recasting the disaggregated five input-output tables, into an aggregated uniform 18 sector basis is not a voluntary choice. However, we propose to consider the possible effects of such an aggregation as and when they crop up during the course of our analysis and colour our results.

Table 2.2.1 : COMMON SECTOR CLASSIFICATION ADOPTED FOR RECASTING THE DIFFERENT TABLES

Sector	*Name of the Sector*
1	Agriculture
2	Coke and Coal
3	Other Mining
4	Food, Drinks and Beverages
5	Textiles
6	Paper and Printing
7	Leather and Rubber
8	Non-metallic Minerals
9	Chemical and Petroleum
10	Cement
11	Iron and Steel
12	Non-ferrous Metals
13	Metallic Products and Machinery
14	Construction
15	Electricity
16	Railway Transport
17	Other Transport
18	Other Industries

Our second adjustment related to the coverage in different tables. As noted earlier in 1959 Table does not have the Construction sector and the 1960-61 Table lacks the Paper and Paper products sector. It may be noted that in the input-output current flow matrix the row for construction normally does not exist. But it is difficult even to estimate a column for it for the current flow matrix. So, no correction has been attempted by us in this regard. But we have inserted the Paper and Paper products sector in the 1960-61 Table with the help of M.R. Saluja's Table (1980). As Saluja's Table for 1964-65 uses the 1960-61 input norms, we have used the same to construct the input structure for Paper and Paper products sector, with appropriate adjustment in the aggregation of sectors. For estimating the sector's output for 1960-61, we have deflated the 1964-65 output by the production index at 1960-61 base, as given in the Monthly Statistics of Production of Selected Industries (C.S.O. MSPSI). This output estimate has been converted to 1960-61 prices by using the wholesale price index for the sector. (Economic Adviser, 1962, 1966).

As regards the non-coverage of the unorganised manufacturing sector in the 1963 Table, we have noted that a separate 33 sector Table constructed by Kamath J. for un-

organised manufacturing sector is available for the same year. We have used this table to correct for the under-coverage by appropriate aggregation after abridging the sector classification of the 1963 Table for organised manufacturing sector, as agriculture and mining activities have full coverage in the main table for 1963.

Our last adjustment relates to the different pricing systems adopted in the Tables. In particular we need to recast the 1963 table to the producer price basis to make it comparable with the others. Since this table is available only in the form of technical coefficients matrix, the first step was to convert it to the transactions matrix form and aggregate to 33 x 33 order. As the producers' price represents that price which is less than the purchasers' by the amount of trade and transport margins, we have subtracted sectorwise the trade and transport row from the associated output vector giving us the sectoral outputs at producers' prices. The ratio of output at producers' price by that at purchasers' price thus obtained is assumed to be the producer/purchaser price ratio for inputs as well, at the sectoral level. These ratios were applied rowwise to the abridged 33 x 33 transactions matrix of 1963 table and the cellwise difference in the two input values was calculated and summed up columnwise. This total, which comprises the transport and trade margins at producers' price, is split up into transport and trade margin components on the basis of the proportion observed in the 1963 table at purchasers' price. The transactions matrix, now obtained, is at producers' prices. But this adjustment gives the matrix covering only the organised manufacturing sector. However the unorganised sector table does not have the producer-purchaser price distinction.[1] Assuming the same at producers' price, cellwise addition of the two matrices has given us the 1963 transactions matrix at producers' price.

2.3 *A Check for Consistency with National Accounts*

If the above tables, duly adjusted and made mutually comparable by recasting them into a uniform sector format and pricing system, are to be used for our study of structural change in the Indian economy, the first thing is to find out whether these tables exhaustively cover all the activities and provide truly a checker board description over time as 5-point snapshots of the economy. We propose to check these tables by comparing the value added estimates i.e. income generated by the input-output tables with the official national income estimates, as that is the only set of statistics with which a comparison can be made. In fact there is a close relation between input-output accounting and national income accounting. Though both of them are derived from the same or similar sets of primary data, any deviations or discrepancies in the numerical values of these estimates need not be taken to mean that the estimates derived from the input-output tables are wrong as diverse data are used and assumptions made in both the estimates at least in certain segments of the economy to cover up

the statistical deficiencies and data gaps. Our principal aim in comparing the value added estimates of the input-output tables with national income estimates is not to find out their numerical tally but to find out whether such a comparison or contrast will show us the limitations of our tables which we can bear in mind in our subsequent analysis and qualify the results appropriately.

Since the estimates of national income by industry of origin are not as disaggregated as the sector classification of our input-output tables, the comparisons had to be carried out at a very aggregate level. Secondly, in respect of certain activities for which the coverage etc. is known to be different in both the sources, the said comparison could not be instituted. The following tables, 2.3.1 (a) and 2.3.1 (b) present the estimates of value added by industry of origin as per input-output tables and the official estimates of the same from national income statistics. Table 2.3.1 (c) gives the detailed sectoral estimates of value added derived from the input-output tables.

It is observed from the tables that the value added estimates from both the sources are broadly comparable for agriculture, mining and manufacturing activities, giving deviations of a small order. However, the order of deviation for the manufacturing activity is more pronounced than the other two. It seems that this pronounced difference between the estimates for manufacturing activity is likely to be due to the data base, estimation and integration of the the unorganised manufacturing sector, in the manufacturing segment of our input-output tables. This is evident from the fact that the order of difference drops down to 1.4 per cent for the 1963 table which incorporates a separately compiled input-output table for the unorganised sector, and further except for the unorganised, the primary

Table 2.3.1(a) : ESTIMATES OF VALUE ADDED AS PER INPUT-OUTPUT TABLES

(In crore Rs. at Current Prices)

	Name of Sector	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1	Agriculture	5127	5336	5912	6752	9199
2	Mining	123	108	134	140	216
3	Manufacturing	1067	1067	1812	1546	2637
4	Construction	343	355	-	623	311
5	Transport	339	360	584	551	397
6	Electricity	26	30	71	66	104
7	Others	167	133	42	-	553
	Total	7192	7389	8555	9678	13417

Table 2.3.1(b) : ESTIMATES OF VALUE ADDED BY INDUSTRY OF ORIGIN AS PER NATIONAL INCOME STATISTICS*

(In crore Rs. at Current Prices)

Name of Sector	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1 Agriculture	5020	5310	6250	6821	8357
2 Mining	90	100	140	144	204
3 Manufacturing	1590	1670	2180	1856	2600
4 Transport	1670	1680	2030	569	787
Total	8370	8760	10600	9390	11948

* CSO (1964)

data base for the organised (factory) segment of the manufacturing activity is the same for the estimation of national income and compilation of input-output tables. We shall bear this result in mind as we proceed with our analysis and qualify the results as more applicable to large scale, organised, factory sector than to the unorganised small scale manufacturing sector. But it may also be noted that the proportion of unorganised in the total manufacturing activity is declining over the years. (Rao, V.K.R.V., 1979.)

The estimates in respect of transport activity are not comparable as the coverages of this activity are different in both the sources. Similar is the case in respect of the residual sector of "others". Also we could not compare the estimates in respect of 'construction' and 'electricity' as published estimates of the same are not available in the national income statistics prior to 1960.

Thus we take our tables as depicting a reasonably true picture of the economy, structurally at least, in respect of the primary and secondary activities, covering about 80 to 90 per cent of the total value added of the sectors considered here, bearing in mind that what we have attempted to compare here is an accounting entity at the margin of our input-output tables, that too in a highly aggregative way.

2.4 *Commodity Price Adjustments by Deflation*

Before we proceed to analyse the input-output tables to study structural change by comparing them over time, one more adjustment, perhaps the most important, complex and difficult is necessary. This refers to the elimination of the dissimilarity and changing character of the prices

Table 2.3.1(c) : SECTORAL ESTIMATES OF VALUE ADDED FROM INPUT-OUTPUT TABLES

(In lakh Rs. at Current Prices)

	Sector	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1	Agriculture	512673	533581	591200	675200	919942
2	Coke and Coal	4803	5765	7790	8920	14594
3	Other Mining	7517	5021	5590	5070	6980
4	Food, Drinks & Beverages	33005	35521	57380	27120	44735
5	Textiles	29301	28395	39410	32560	62485
6	Paper and Printing	3549	3357	6600	8428	9694
7	Leather & Rubber	6041	6441	7680	7200	20544
8	Non-metallic Minerals	10247	11319	10760	19800	27704
9	Chemicals & Petroleum	9524	6137	15300	18660	21203
10	Cement	1084	1132	2060	1950	3311
11	Iron and Steel	5474	5443	9380	11080	21079
12	Non-ferrous Metals	574	535	640	1280	2724
13	Metallic Products and Machinery	7997	8413	31980	26570	50228
14	Construction	34339	35464	-	62310	31128
15	Electricity	2552	2957	7120	6550	10399
16	Railway Transport	25714	24403	32450	37800	14986
17	Other Transport	8205	11609	25930	17290	24688
18	Other Industries	16660	13250	4160	-	55335
	Total	719259	738743	855430	967788	1341759

endowed in the input-output tables of different vintage, by re-pricing them to a constant base, to satisfy the requirements of input-output theory which is cast in terms of volume coefficients in constant prices of a base year or even in physical coefficients in contrast to value coefficients at current prices.[2]

The task of eliminating the price components from the analysis of structural change by deflating the input-output tables cannot be satisfactorily attained by using a set of sectoral gross output deflators, which are used uniformly across the row. It is necessary to derive price deflators appropriate for each cell of the input-output table. This becomes all the more necessary in the case of an aggregative input-output model which leaves a considerably larger room for variation in the composition of commodity basket that a given producing sector provides to different consuming sectors. For instance the output of chemical sector

entering as input into agriculture sector is fertilisers, insecticides and pesticides, while that entering as input in the construction sector is paints and varnishes etc. Obviously, the price deflators for these consuming sectors will be different as also for the producing sector's output. It becomes important, therefore, to derive price deflator for each cell of the input-output table, which represents as far as possible the particular commodity composition of the given cell. This is highly tedious, time consuming and data-intensive, indeed. The data necessary for this purpose are not available. Therefore, in practice price deflation at so detailed, cell-by-cell level is not usually possible and one has to be contented with a vector of price deflators (Reiner Staglin, 1972).

The input-output tables in our present study cover the period from 1951-52 to 1963. We have re-priced by deflation the transaction matrices of the five input-output tables to the 1952-53 commodity price base as the 'Revised series' of the index number of wholesale prices in India are available with that base (Economic Adviser, 1962, 1966). Further, in view of lack of detailed and adequate data we have derived a vector of general price deflators instead of a price deflator matrix covering each cell of the input-output table, thereby assuming that a sector's general price deflator remains the same over all the consuming sectors. We give below a brief account of the procedure adopted by us in deriving the general price deflators for re-pricing the input-output tables from current price to 1952-53 commodity price basis.

The only data base for the derivation of the required vectors of general price deflators is the Economic Adviser's Index Number of Wholesale Prices, together with the weighting diagram and classification of the commodities, referred to earlier and reproduced in Appendix A Table A2.4.1. As many as 114 single and composite commodities commonly entering the wholesale trade channels of the economy are covered here and are grouped into 24 sub-groups and 5 major groups. However, for each commodity the weight given is, its weight within the major group and for the major group, within the economy. We have converted this weighting diagram deriving the weight of each commodity in the economy and have grouped them appropriately into our 18 sectors which are defined on the basis of production or industry of origin.

For the purpose of calculating the sectoral price deflators we have assumed that the composition of the Wholesale-price-index-number-commodities comprising a sector derived as above is the same or representatively similar in composition to that produced in a sector. It may be possible that the actual commodity composition of a sector may be different, both in terms of individual commodities and the weights attached to them, from the one representatively derived on the basis of wholesale-price-index-number-commodity list. The validity of our assumption was

checked with the help of 1963 input-output table, in which case alone this was possible as its sector classification is more disaggregated. For the chemical sector, for instance, it was found that the actual price index of all inputs fell into two ranges viz.110-113 and 113 to 115. The calculated price index on the above assumption worked to 113.1 giving encouragingly close result. Similar check in respect of non-metallic mineral and other sectors showed nearby results. Thus, our assumption reasonably holds the ground and does not go wide apart from facts. Hence, using the Wholesale-price-index-number-series, and the sectoral composition of the commodities as noted above, we have calculated the average price index number for the sector as a deflator.

The sector of construction and the service sectors such as railway transport etc. pose a problem as the commodity composition of their input consumption is not known. For these sectors we have borrowed from CSO the commodity composition of inputs consumed together with their weighting pattern within the consuming sector as adopted in the Brochure on Revised Series of National Product for 1960-61 to 1964-65 (CSO, 1967). Thus for construction weighted price index was obtained on the basis of major input consumption of cement, timber, iron and steel, bricks and tiles, fixtures and fittings. For road transport the weighted price index of petrol and diesel was assumed. A weighted average price index of electricity, coal and other fuels was calculated for the railway sector.

Having derived the vectors of general price deflators, we have converted the adjusted input-output transaction matrices and the associated output vectors to constant prices of 1952-53 by using double deflation method i.e. repricing the intermediate inputs and the output to a constant price base, separately. The procedure of deflation was rowwise and was carried out at the given level of disaggregation for each input-output table and later aggregated to the uniform 18 sector level.

The deflator vectors used for each of the five input-output tables are given below in Tables 2.4.2(a), (b), (c) and (d). The 18 sector input-output transaction matrices at constant prices are given in Appendix A in Table Nos. A2.4.3 (a), (b), (c), (d) and (e) and the related data vectors of gross output, interindustry demand and final demand are also given in Appendix A in Tables A2.4.4 (a), (b), (c), (d) and (e).

2.5 *A Further Comparison with National Income Statistics*

A comparison of the value added estimates derived from the 18 sector input-output tables, at constant prices with the same derived from national income statistics is attempted below to check whether it throws any further limitations for our analysis.

For this purpose the required national income statistics at constant price base of 1952-53 are not available. Instead they are available at constant price base of 1948-49 and by industry of origin. As the price deflators for industry of origin level estimates are not available, a change of base method of computation has been adopted to arrive at the necessary income estimate. This requires the ratios of incomes of an industry in 1948-49 and 1952-53 prices. From these data the following conversion ratios were obtained:

Agriculture and allied activities	1.045
Mining and manufacturing	1.0759
Other activities	0.9944

Applying these ratios to all the years, the official estimates at 1952-53 constant prices were obtained.

Table Nos. 2.5.1 (a), (b) and (c) present the value added estimates derived from the input-output tables and the CSO estimates of national income, both in comparable categories and at constant prices to the 1952-53 base. In view of the nonavailability of published national income data for mining and manufacturing separately we had to put up with the clubbed estimates of these categories and carry out the comparison at a still more aggregate level than the one attempted earlier.

It is observed from the two sets of estimates that those for agriculture as estimated from national income statistics are on the higher side than the ones derived from the input-output tables, giving however a percentage deviation of a smaller order, except for the 1963 input-output table estimates.

The percentage derivations from estimates of national income statistics are of a similar smaller order in respect of mining and manufacturing segment of the economy except for the 1961 and 1963 input-output table estimates. Lastly, for agriculture as also for the three sectors of the economy taken together deviations are observed to increase as we move away from the base year of our price deflators. It is necessary to note here that our estimates of the value added derived from input-output tables at constant prices are based on the double deflation method noted earlier. The corresponding estimates derived from national income statistics are based on what is known as single-deflation method, with the exception of agriculture (CSO, 1967, 1980). The validity of estimates of net output or value added based on this method depends on the validity of the assumption inherent in the method that outputs and inputs, and especially inputs of the main intermediate commodities, tend to vary in proportion to each other. In many cases this assumption is a reasonable one, but clearly there are exceptions. The estimates of net ouput or value added as

Table 2.4.2(a) : SECTORAL PRICE INDICES FOR THE YEAR 1951-52 AND 1953-54

(Index for 1952-53 = 100)

	Sector	*Index for 1951-52*	*Index for 1953-54*
1	Agriculture	113.9	108.9
2	Plantation	129.1	112.4
3	Animal Husbandry	168.8	96.6
4	Jute and Other Fibres	137.1	100.4
5	Coke and Coal	100.0	100.0
6	All Other Mining	93.2	98.6
7	Food, Drinks and Tobacco	113.8	108.5
8	Cotton Textiles	100.0	99.2
9	Other Textiles	110.7	99.2
10	Paper, Printing and Stationery	99.0	81.9
11	Leather and Rubber	131.3	101.3
12	Glass and Ceramics	138.0	102.4
13	Other Building Material	105.6	94.3
14	Chemicals	95.5	94.1
15	Cement	96.6	91.3
16	Iron and Steel	90.3	107.2
17	Non-ferrous Metals	143.0	92.3
18	Engineering	87.2	98.3
19	Construction	96.0	100.7
20	Electricity	100.0	99.9
21	Railway and Communication	91.2	102.0
22	Other Transport	89.2	101.2
23	Other Industries	113.5	105.7

Table 2.4.2(b) : SECTORAL PRICE INDICES FOR THE YEAR 1959

(Index for 1952-53 = 100)

	Sector	*Index*
1	Foodgrains	104.3
2	Cotton	102.7
3	Jute	117.8
4	Oil Seeds	131.2
5	Plantation	127.6
6	Other Agriculture	118.2
7	Coal	134.0
8	Iron Ore	88.2
9	Other Mining	101.5
10	Food Beverages and Tobacco	117.5
11	Textiles	104.6
12	Jute and Coir	87.2
13	Paper and Newsprint	115.7
14	Rubber and Leather	109.2
15	Glass, Wood, Non-metallic Industries	121.1
16	Chemicals	114.8
17	Petroleum Products	162.8
18	Fertilizers	95.9
19	Cement	129.2
20	Iron and Steel	145.0
21	Aluminium and Non-ferrous Metals	123.1
22	Non-electrical Machinery	105.8
23	Transport Equipment etc.	105.8
24	Electrical Equipment	105.8
25	Construction	128.5
26	Electricity	113.8
27	Railway Transport	105.7
28	Road Transport	112.0
29	Other Industries	115.5

Table 2.4.2(c) : SECTORAL PRICE INDICES FOR THE YEAR 1960-61

(Index for 1952-53 = 100)

	Sector	*Index*
1	Plantation	127.6
2	Animal Husbandry	146.1
3	Foodgrains	104.3
4	Other Agriculture	118.2
5	Forestry Products	124.7
6	Coal	134.0
7	Iron Ore	88.2
8	Other Minerals	101.5
9	Crude Oil	101.5
10	Food Industries	117.5
11	Cotton and Other Textiles	104.6
12	Jute Textiles	104.6
13	Paper and Printing	115.7
14	Leather and Leather Products	108.1
15	Rubber Products	83.7
16	Rubber	118.7
17	Glass, Wooden and Non-metallic Mineral Products	121.1
18	Chemical Fertilizers	95.9
19	Petroleum Products	162.8
20	Chemicals	114.8
21	Cement	129.2
22	Iron and Steel	145.0
23	Other Metals (Non-ferrous Metals)	123.1
24	Electrical Equipment	105.8
25	Non-electrical Equipment	105.8
26	Transport Equipment	105.8
27	Construction Urban	128.5
28	Construction Rural	128.5
29	Electricity	113.8
30	Railway Transport	105.7
31	Motor Transport	112.0
32	Industries n.e.c.	115.5

Table 2.4.2(d) : SECTORAL PRICE INDICES FOR THE YEAR 1963

(Index for 1952-53 = 100)

	Sector	*Index*
1	Agriculture	132.7
2	Coal etc.	159.6
3	Iron Ore	89.6
4	Crude Oil	130.1
5	Food Industries	132.7
6	Beverages	115.4
7	Tobacco Manufactures	131.3
8	Textiles	127.3
9	Apparels	127.3
10	Paper	112.4
11	Printing	112.4
12	Leather Products	117.8
13	Rubber Products	112.3
14	Wood Products	149.6
15	Furniture and Mixtures	149.6
16	Non-metallic Minerals	119.9
17	Chemicals	113.1
18	Petroleum Products	204.5
19	Fertilizers	91.9
20	Cement	152.6
21	Iron and Steel	161.9
22	Basic Iron and Steel	182.7
23	Non-ferrous Metals	139.7
24	Metal Products	164.3
25	Non-electrical Machinery	122.6
26	Electrical Machinery	122.6
27	Transport Equipment	122.6
28	Construction	149.6
29	Electricity	127.0
30	Railway Transport	123.5
31	Road Transport	258.9
32	Miscellaneous Manufactures	132.5
33	Unspecified	132.5

Table 2.5.1(a) : ESTIMATES OF VALUE ADDED FROM INPUT-OUTPUT TABLES

(In crore Rs. at 1952-53 prices)

Name of Sector	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1. Agriculture	4271	5174	5623	5920	7057
2. Mining	183	165	115	118	178
3. Manufacturing	1546	1545	2029	1794	2716
4. Construction	460	460	-	706	293
5. Transport	481	418	610	555	255
6. Electricity	29	36	76	68	99
7. Others	167	174	44	-	482
Total	7137	7972	8497	9161	11080

Table 2.5.1(b) : ESTIMATES OF INCOME FROM CSO

(In crore Rs. at 1952-53 prices)

Name of Sector	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1. Agriculture	4643	5208	5762	6180	6242
2. Mining)	163	1775	2120	2270	2625
3. Manufacturing)					
4. Transport	1720	1820	2257	2446	2953
Total	7998	8803	10139	10896	11820

Table 2.5.1(c) : ESTIMATES OF VALUE ADDED FROM INPUT-OUTPUT TABLES

(In lakh Rs. at 1952-53 prices)

Name of Sector	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1. Agriculture	427093	517400	562337	592031	705690
2. Coke and Coal	5058	5930	5670	6536	10076
3. Other Mining	13244	10602	5844	5219	7735
4. Food, Drink and Beverages	50651	49940	65187	28641	45089
5. Textiles	38943	41321	49273	40165	68491
6. Paper and Printing	5007	6201	6651	8428	12148
7. Leather and Rubber	5909	8337	8413	13765	19195
8. Non-metallic Minerals	10317	13846	9510	19026	23513
9. Chemicals and Petroleum	16175	12255	13954	20908	27840
10. Cement	1661	1965	1625	1712	2663
11. Iron and Steel	7653	5764	6459	9632	13666
12. Non-ferrous Metals	867	1596	594	1228	3623
13. Metallic Products and Machinery	17442	13248	41271	35869	55416
14. Construction	46003	46000	-	70638	29247
15. Electricity	2853	3553	7581	6751	9866
16. Railway Transport	29555	24427	34152	37342	13273
17. Other Transport	18567	17365	26887	18123	12249
18. Other Induatries	16710	17410	4358	-	48242
Total	713708	797160	849766	916014	1108022

Table 2.5.2 : COMPARISON OF PERCENTAGE DEVIATIONS OF VALUE ADDED ESTIMATES DERIVED FROM INPUT-OUTPUT TABLES WITH THE CORRESPONDING ESTIMATES FROM NATIONAL INCOME STATISTICS

Table Year	*Agriculture Sector*		*Mining and Manufacturing Sectors*		*All three Sectors*	
	Current Price	*Constant Price*	*Current Price*	*Constant Price*	*Current Price*	*Constant Price*
1951-52	-2	+8	+29	- 6	+6	+ 4
1953-54	-0.5	-0.6	+33	+ 4	+8	+ 1
1959	+5	+2	+16	- 1	+8	+ 1
1960-61	+1	+4	+15	+16	+4	+ 7
1963	-10	-13	- 2	-10	-8	-12

derived by using double deflation method, however, are based on both outputs and intermediate inputs specifically obtained by subtracting intermediate inputs at constant prices from gross outputs at constant prices.

In view of the above, the important and pertinent consideration for our purpose here is to know in what way the earlier order of difference between the estimates at current price has been maintained or altered by repricing the input-output tables at current prices to constant price basis. In the table below we present a comparison of the deviations of value added estimates derived from input-output tables with the corresponding estimates from national income statistics both at current and constant price basis.

It is noted here with satisfaction that in most of the categories the deviations or descrepancy at current price basis observed earlier has decreased by and large. Broadly, our deflation procedure has slightly increased the differences in agriculture sector and decreased them considerably in the mining and manufacturing sector.

2.6 *Comparability of 1960-61 Table*

With all the adjustments relating to recasting into a uniform sectoral classification and repricing to a uniform price system of all the input-output tables reported above we found that the 1960-61 input-output table could not be made fully and satisfactorily comparable with the other tables, for reasons noted earlier viz. its sectoral classification and the intrasectoral composition of industries and lack of presentation of certain requisite data in the Table. In view of this we have omitted the 1960-61 input-output table in certain parts of our analysis.

CHAPTER III

STRUCTURAL CHANGES IN THE ECONOMY AS A WHOLE

Having got our input-output data ready for analysis, we explore in this chapter the structural changes that have taken place in the Indian economy as a whole, leaving the consideration of sectoral changes to the subsequent chapter. We begin with a brief resume on the techniques to study structural change in input-output framework. This is followed by an analysis of the temporal changes in the pattern of sectoral interdependence in the Indian economy, a study of intertemporal changes in technology by analysing the changes in individual input-output coefficients and finally the impact of changing technology on production levels in the economy.

3.1 *A Brief Resume on the Techniques to Study Structural Change in Input-output Framework*

Interregional and intertemporal comparisons of input-output tables have been attempted in recent years and techniques of analysis developed, to explore structural change with a view to establish meaningful relationship between the overall degree of industrialization and its pattern. Even in time frame the basic approach is that of "comparative statics" (Samuerson, 1948, p.8) in general and is confined, in particular to Leontief static model in the input-output framework.

Comparisons attempted so far relate to the following aspects of the input-output model.

1. The overall comparison of the structure of production on the basis of input-output coefficient matrices, (current flow).

2. Comparisons of individual input-output coefficients.

3. Overall comparison of direct and indirect effects, based on the Leontief inverse of the A matrix i.e. $(1-A)^{-1}$.

In the following we present a brief resume of the techniques developed for the analysis of structural change by considering a few of the important contributions in the literature and summarising them. Since we are using some of the techniques and measures and procedures discussed here in our subsequent empirical work, this resume will serve the purpose of orientation as also a methodological back-drop.

3.1.1 *Overall Comparison of the Production Structure*

The analysis based on this type of approach is developed in three directions, mostly pioneered by Chenery

and Watanabe (1958, 1964).

In this analysis the nature of interdependence of production sectors in the input-output model is studied in two aspects:

1. Types of production sectors in terms of statistics, U and W, as defined and

2. The positions of the sectors in the triangular arrangement of the input-output matrix.

The types of production sectors are identified by the ratio of intermediate input to total production:

$$U_j = \sum_i X_{ij}/X_j$$

and also by the ratio of intermediate demand to total demand:

$$W_i = \sum_j X_{ij}/X_i$$

where X_{ij} is the consumption of the jth sector of goods produced by the ith sector. According to the two-way U-W classification an individual production sector can be characterised as "Final Manufacture", "Final Primary Production", "Intermediate Manufacture" and "Intermediate Primary Production". By an application of this classification to actual input-output tables it is possible to assess the similarity or otherwise of the overall pattern of production between two regions or two time periods.

The second approach based on triangularisation of the input-output matrix is to find out the existence of one-way interdependence such as sequences of raw cotton - textiles - clothing, etc. Although strict triangularity cannot usually be obtained from the actual tables due to the existence of some degree of circularity as found in sequences like coal - steel - coal, etc., a considerable degree of triangularity can be detected in the input-output tables, being compared.

The third approach is by type of production, as developed by Chenery and Watanabe. This approach develops a measure which compares two input coefficient matrices taking the sum of absolute differences in all the coefficients in each column and relates this sum to the average total interindustry input of the sector. This ratio termed as "absolute column measure" is defined as

$$\gamma^{bc} = \frac{\sum_i \left| a^b_{ij} - a^c_{ij} \right|}{1/2 \sum_i (a^b_{ij} + a^c_{ij})}$$

where a_{ij} is the ijth element in the coefficient matrix and superscripts b and c refer to, say two time periods or two regions or countries.

The higher the degree of similarity in the structures of production in two time points the smaller will be the ratio. A similar measure is used by Leontief for single individual coefficients as will be noticed in sequel. If the inputs are completely uncorrelated, the above measure has an upper limit of 2.0, and if the input structures are identical the measure will be zero. It may also be noted that this measure avoids the necessity of choosing one time point as the basis of comparison.

3.1.2 *Comparison of Individual Input Coefficients*

A pioneering comparison of this type was originally applied to the historical data within a single country by Leontief (1953) to study structural change in the American economy using the data of input coefficients for 1919, 1929 and 1939. He devised an index to show the degree of change for each input coefficient, and worked out a weighted frequency distribution of the input coefficients showing different degrees of change. Leontief's relative change index of input coefficients is defined as

$$\bar{a}_{ij} = \frac{a^b_{ij} - a^c_{ij}}{1/2\ (a^b_{ij} + a^c_{ij})}$$

Rasmussen's study for Denmark (1956), adopts the Leontief method for 1947 and 1949 data. The Japanese Government carried out studies similar to, but simpler than, those of Leontief and Rasmussen, for 1951 and 1954.

Commenting on the above methodology Hatanaka notes that neither Leontief nor Rasmussen deal with the relative changes in the row coefficients and points out that "the effects on input coefficients of quality improvements and price substitution may be discovered with more facility by examining the input coefficients in the same row than by examining the input coefficients in the same column" (1960, p. 70).

The above technique of analysis of coefficient change is applicable to situations where a two point comparison is involved. In situations involving more than two point comparisons, particularly temporal comparisons, the well known classical methods of time series analysis have been tried by Tilanus (1966) for the Netherland economy, 1948-61, and by Per Sevaldson (1970) for the Norwegian economy, 1949-60, to study the temporal changes in individual coefficients by fitting trends by time regression methods, etc.

Tilanus' measurement of temporal change in input-output coefficients by the classical statistic, "the coefficient of variance", i.e. the ratio of the standard deviation to the mean of the observations, is essentially a modified version of Leontief's relative change index, incorporating more than two temporal observations for each cell of the input-output coefficient matrix. Another modified version of Leontief's relative change index which combines all the cell level indices into a single measure is due to Maria AUGUSTINOVICS (1970, p. 261) and is defined as

$$bc_{\alpha}(A_{n,m}) = \frac{2}{n.m} \sum_{i,j} \frac{\left| a^{b}_{ij} - a^{c}_{ij} \right|}{(a^{b}_{ij} + a^{c}_{ij})}$$

where α^{bc} is a measure of change in the matrix $A_{n,m}$ between periods b and c. This measure indicates "the average percentage change in the coefficients, without weighting by the size of coefficients or the production level of the user or delivering sectors".

3.1.3 *Over-all Comparison in terms of Inverse Matrices*

The basic framework of input-output theory gives the relation

$$G_b = (1-A_b)^{-1} fb$$

where gross production, G_b is the product of technology, A_b and final demand, f_b at a point of time b. On the hypothesis of invariance of technical coefficients, one can project forward or predict backward in time, the gross output level, given the final demand. A comparison of gross output thus obtained with the actuals will show structural change and a comparison with those obtained on alternative models will show the prediction accuracy of the input-output model. This approach is due to Leontief (1960) who carried out backward predictions for the years 1919 and 1929 by using 1939 technology matrix and compared the results with the projected gross national product (GNP) for the American economy.

Literature on the subject, (Hatanaka, 1960) besides GNP projection or blow-up, which forecasts that the gross output of each industry will change from the base period in the same proportion as the GNP, provides two more bases for appraising the prediction by the input-output model. One such is the final demand projection or blow-up which forecasts that the output of each industry will change from the base period in the same proportion as final demand for that industry. Another is the time series projection of output on GNP or the multiple regression of output on GNP and time which forecasts that the gross output of each specific industry is linearly related to GNP and time. Arrow and Hoffenberg's study (1959) of the American economy for the

same period as that by Leontief but at a more disaggregated level, compares the input-output estimates with the above listed models. Hatanaka (1960) has also worked out 1951 projections with 1947 input-output table for the American economy.

The above studies merely compare the gross output estimates as obtained from the input-output model with the actuals to estimate structural change. The following three studies attempt to factor out the total structural change according to "causes of change" viz. technological change and final demand change. The methodological approach in these studies is largely the same. The first study is due to Vaccara and Simon (1968) for the American economy for the period 1947-64, which uses 3 point input-output data for 1947, 1958 and 1964 all valued at the 1958 constant price base and factors out structural change into components in two sub-periods 1947-58 and 1958-64. The second study is by Reiner Staglin and Hans Wessels (1972) for the German economy for the period 1954-64, which also uses 3 point input-output data for 1954, 1958 and 1962, all valued at 1962 prices and structural change factored out also in two sub-periods, 1954-58 and 1958-62. This study further compares the results obtained for the German economy with those obtained in the first study for the American economy. The third one is by Alan Armstrong (1974) for the British economy for the period 1954-63, using again 3 point input-output data for 1954, 1960 and 1963 all valued at 1963 prices.

The mathematical formulation to factor out the changes in gross output levels into components, in these studies is of the following type, for instance, in Staglin and Wessels' notation

$$\begin{aligned} C^{58}Y^{58} - C^{54}Y^{54} &= (C^{58}Y^{58} - C^{58}Y^{54}) \\ &\quad + (C^{58}Y^{54} - C^{54}Y^{54}) \\ &\quad - C^{58}(Y^{58}-Y^{54}) + Y^{54}(C^{58}-C^{54}) \end{aligned} \qquad \ldots (1)$$

where C represents the Leontief inverse of the technical coefficients matrix, Y, the final demand vector, and the superscripts 54 and 58 stand for the respective years 1954 and 1958. In this formulation the terminal year technology is taken as fixed and changes in gross production levels is represented as the sum of final demand change weighted by the terminal year's technology and technological change weighted by the initial year's final demand. An equally valid alternative formulation by taking the initial year technology as fixed, gives the structural change as the sum of final demand change weighted by the initial year's technology and technological change weighted by the terminal year's final demand, viz.

$$C^{58}Y^{58} - C^{54}Y^{54}$$
$$= C^{54}(Y^{54}-Y^{58}) + Y^{58}(C^{54}-C^{58}) \quad \ldots (2)$$

In each of the above formulations the two components of change together exhaust the total change in the gross production levels "only under the particular procedure" noted above. But "a procedure which employed the same set of weights for each factor would leave a residual or 'interaction' factor" (Vaccara, 1968, p.24), as for instance in the following formulation

$$C^{58}Y^{58} - C^{54}Y^{54}$$
$$= C^{58}(Y^{54}-Y^{58}) + Y^{58}(C^{54}-C^{58}) + \{C^{54}(Y^{54}-Y^{58})-C^{58}(Y^{54}-Y^{58})\} \quad \ldots (3)$$

Taking technology of the terminal year as fixed, this formulation decomposes the change in the gross production levels by weighting both the technological change and final demand change by terminal year values, thus giving rise to the interaction component as represented by the third term of equation (3) above, which measures the differential effect on final demand change due to technological change. Alternately, it can be viewed as the differential effect of technological change due to change in final demand.[3]

This formulation also has its dual if the technology of the initial year is taken as fixed and the structural change decomposed into main effects by weighting them by the initial year values of technology and final demand, leaving the residual term of interaction.

However in the two earlier formulations (1 and 2) where the two components together exhausted the total change without explicit appearance of the interaction component, the method of measuring the relative importance of the two factors, i.e. from the stand point of fixed technocal coefficients of the initial year or terminal year, does not lead to a unique solution, as the forward and reverse movements of technology, in all likelihood give different numerical results. This is attributable to the implicit interaction element confounded in the two main effects.

This problem is not confronted by Staglin and Wessels, and Alan Armstrong as they use uni-directional formulation (1). But Vaccara and Simon average the bi-directional results by using formulations (1) and (2) by allowing the full play of both the technologies of the years in their estimate of the relative importance of technology and final demand in the total structural change.

In our methodological resume so far, we were considering the impact of technological change on gross output levels given the final demand. But as commented by Vaccara (1970, p. 238), "because of the procedures employed — application of the same set of final demands to different inverse matrics — it is generally to be expected that industries that sell primarily to final demand will show smaller percentage changes over time in total output requirements than industries that sell primarily to other producing industries." In view of this she considers that "a more meaningful way to summarise the impact on production of changes over time in the various input coefficients, is to concentrate on changes in *intermediate* rather than in total output requirements". In her paper she presents results based on this line of analysis for the changes in input-output coefficients for the United States during the period 1947-1961.

3.2 *Temporal Changes in the Pattern of Sectoral Interdependence*

The nature of interdependence exhibited in an economic system as built up in an input-output table throws a considerable amount of light on the way in which the primary factors of production are related to the final outputs of the economic system. Had there been no dependence of one production sector on others by way of absorbing inputs from and making deliveries to them there would have been merely a direct link between the primary factors and final consumers. Since in actual fact a good deal of inter-industrial transactions exist in the economic system as revealed by the input-output tables the link between the primary factors of production and the final consumers is not only direct but also to an extent indirect; so that one can speak about the deliveries among the productive sectors themselves as distinct from those made to and received from the categories of final demand and the primary factors.

Therefore an important standpoint from which sectoral interdependence in the production in the economy can be studied would be to find out to what extent production involves indirect use of the factors of production, that is, what proportion of the ultimate factors of production used to produce a given commodity is employed in the sector producing that commodity. Coupled with this is the extent of deliveries among the productive sectors themselves as distinct from those made to the final demand categories, constituting the indirect or intermediate demand.

Combining the above two aspects of indirectness or round-aboutness in the production system of the economy as captured in the input-output tables at different points of time one can study the production system from the point of view of economic development, on the basis of the degree of interdependence or indirectness. The process of development, simply stated, lies in further processing of the

primary products, so that their use value gets enhanced to the final consumer. A commodity, which satisfies a given type of wants of a consumer, goes through an increasing number of processes as the economy develops. This means, that the proportion of commodities that go into inter-industry use is expected to increase over time. How is this proportion changing in India?

3.2.1 *Changing Proportion of Interindustry Use*

The table below presents the proportion of inter-industry use of gross production for different time periods covered by the five input-output tables.

Table 3.2.1 : PROPORTION (%) OF INTERINDUSTRY USE TO GROSS PRODUCTION IN DIFFERENT TIME PERIODS

Year	*Total Economy*	*Total Economy excluding Agriculture*
1951-52	33.73	24.08
1953-54	34.71	25.93
1959	34.52	26.26
1960-61	N.A.	29.27
1963	34.76	36.91

Over the period 1951-63, the proportion of inter-industry use to the total output in the economy is around 34% and this proportion is almost stagnant or at best shows only marginal increase. If we exclude agriculture, which forms the major bulk of total output in the economy, both from the rows and the columns of the transaction matrices, a different picture emerges. The proportion of non-agriculture products, particularly the manufacturing products that goes into interindustry use increases from 24% to 37% from 1951 to 1963. This shows that the non-agriculture products are undergoing increasing processing over time. It may be noted that the above-mentioned proportion for non-agriculture subset of the economy is lower than that for total economy till the year 1963. This is because of the dominance of the agro-based industries in the manufacturing branch of the economy.

3.2.2 *Chenery-Watanabe Categories Based on U-W Statistics*

Now we will elaborate the changes that have taken place at the sectoral level of the economy and their contribution to the above phenomenon. The well known Chenery-Watanabe U-W method is followed in the following analysis for this purpose, though the method was first developed and used for intercountry comparison.

As narrated earlier, in this method the sectors of the economy are classified into 4 categories on the basis of U-W ratios. U_j is defined as the ratio of intermediate input of sector j to the total output of sector j whereas, W_i is

defined as the total intermediate demand for output of sector i to the total demand for sector i. U_is show the strength of the backward linkages and W_is, the strength of the forward linkages.[4] The categorisation of sectors is given below.

CHENERY-WATANABE TWO-WAY CLASSIFICATION OF PRODUCTIVE SECTORS OF THE ECONOMY BY TYPE

By output use	*Final*	*Intermediate*
By input type	*Low W*	*High W*
Manufacturing High U	III Final manufacture (High backward and low forward linkage)	II Intermediate manufacture (High backward and low forward linkage)
Primary production Low U	IV Final primary Production (Low backward and low forward linkage)	I Intermediate primary production (Low backward and high forward linkage)

A categorisation such as this is useful as it serves to focus on the quite different roles played by the various sectors in the economy. In this categorisation "final" describes the sectors whose output has a low proportion of intermediate demand, and hence low forward linkage, while "primary" describes those with a low proportion of intermediate input, hence high value added and low backward linkage. Thus for instance, sectors in category IV are relatively independent of other sectors in the economy and provide a link between the final users and owners of primary factors. On the other hand the sectors in category II are at the opposite extreme; the cost of their use of primary factors is less than the value of intermediate inputs they consume and a very large part of their output goes to meet the intermediate demand of other sectors. The categories I, II and III cater to intermediate demand which contain sectors either of high intermediate input consumption or high intermediate demand generation, roughly represent successive stages of a production cycle, with increasing processing at each stage. And category IV could be considered to embody all the three stages represented by other categories by using a high proportion for value added inputs and producing commodities for final demand.

From the point of view of level of development of the economy as judged by the degree of intermediate use, at low levels of development there would be a heavy concentration of sectors in categories I and III. As the economy develops many of the products which are used in their 'raw' form would be processed further and as such sectors would move from intermediate primary production (I) to the intermediate manufactures (II) category. To illustrate, in the initial stages much of the "iron and steel" used in the economy consists of pig iron and at later stages "iron and

steel" consists of more special types of iron and steel which need more processing than pig iron. The sectors which are initially in the final primary products category (IV) like agriculture are expected to move to intermediate primary (I) category and so on at higher stages of development.

3.2.3 *Results of Chenery Watanabe Categorisation*

In the table below we show the classification of the sectors falling in each of the four categories for different years. The sector numbers follow the sector classification index as given in Table 2.2.1. Tables 3.2.2A and 3.2.2B give detailed estimates of U-W statistics for the different years.

Table 3.2.2 : CLASSIFICATION OF 18 SECTORS IN CHENERY-WATANABE CATEGORIES FOR DIFFERENT YEARS

Category	*1951-52*	*1953-54*	*1959*	*1963*
I	2,3,8 to 11,13 & 15	2,3,8 to 10 & 15	2,3 & 15	2,3 & 15
II	12	11 to 13	8 to 12	8 to 12
III	4,5,7 & 17	4,5 & 17	4,5,6,7 13 & 17	4,5,7,13 & 17
IV	1,6,16	1,6,7,16	1,16	1,6,16

Note : Sector 14 : 'construction' is omitted as no data are available except for 1963. Sector 18 : 'other industries' being heterogeneous is also omitted.

The Table 3.2.2 shows that there is a significant shift of sectors from intermediate primary production to intermediate manufactures over time. Non-ferrous metals (12) was the only sector with high forward and backward linkages in the year 1951-52. By 1959 Non-metallic minerals (8), Chemicals and petroleum (9), Iron and steel (11), Metallic products and machinery (13) which includes both electrical and non-electrical machinery and transport equipment, have moved from category I to II showing that the outputs of these sectors have become more sophisticated, using increasingly larger number of processes and consuming larger quantities of intermediate inputs. The Metallic products and machinery (13) sector does not stop its shift up to intermediate manufacture, but it ultimately shifts to the final manufacture category. Thus the second Five Year Plan, 1956-61, which laid greater emphasis on industrialisation did have a significant impact on the character and quality of the industrial base of the economy. By 1960 the Indian economy developed a sound and sophisticated industrial base.

Table 3.2.2A : ESTIMATION OF U_J AND U FOR 1951-52, 1953-54, 1959 AND 1963

	Sector		1951-52		1953-54		1959		1963	
			U_J	IO_J	U_J	IO_J	U_J	IO_J	U_J	IO_J
1.	Agriculture	...	28.89	173485	28.49	206130	28.94	229045	22.47	204467
2.	Coke and Coal	...	20.06	1269	15.23	1065	19.94	1412	22.84	2983
3.	Other Mining	...	6.69	949	8.10	935	14.55	995	20.32	1973
4.	Food, Drinks and Beverages	...	57.51	68565	58.94	71675	47.22	58319	67.51	93724
5.	Textiles	...	46.67	34092	47.19	36920	50.75	50782	54.44	81863
6.	Paper and Printing	...	26.97	1849	24.74	2038	40.94	4611	37.47	7278
7.	Leather and Rubber	...	38.13	3641	36.16	4722	40.19	5653	48.99	18435
8.	Non-metallic Minerals	...	21.98	2907	22.37	3991	39.03	6089	47.56	21321
9.	Chemical and Petroleum	...	22.85	4791	37.85	7464	45.41	11605	45.81	23532
10.	Cement	...	35.47	913	36.96	1152	52.72	1812	56.27	3427
11.	Iron and Steel	...	32.55	3693	43.64	4464	60.42	9858	55.32	16919
12.	Non-ferrous Metals	...	56.93	1146	49.98	1595	60.69	917	47.89	3330
13.	Metallic Products and Machinery	...	31.42	7993	38.13	8164	33.70	20979	41.46	39244
14.	Construction	...	34.70	24449	39.63	30203	43.86	31786	40.96	20294
15.	Electricity	...	33.65	1447	31.21	1612	30.76	3368	39.43	6422
16.	Railway Transport	...	18.98	6923	21.39	6648	15.36	6198	15.16	2371
17.	Other Transport	...	45.07	15236	54.22	20567	44.60	21649	49.50	12007
18.	Other Industries	...	37.40	9982	45.40	14476	50.02	4361	38.97	30809
	Average U	...	37.15	363330	38.33	423821	37.09	469439	41.64	590399

$U_J = \frac{\text{Inputs consumed by sector j}}{\text{Domestic output of sector j}}$

IO_J = Total inputs consumed by sector j

Table 3.2.2B : ESTIMATES OF W_i AND W FOR 1951-52, 1953-54, 1959 AND 1963

	Sector		1951-52		1953-54		1959		1963	
			W_i	I_i	W_i	I_i	W_i	I_i	W_i	I_i
1.	Agriculture	...	38.48	231077	38.40	277843	36.21	291360	30.95	281734
2.	Coke and Coal	...	67.14	4248	76.38	5343	87.36	6187	86.96	11356
3.	Other Mining	...	74.57	10584	105.14	12130	68.52	4686	86.67	8415
4.	Food, Drinks and Beverages	...	13.58	16186	12.30	14962	18.09	22340	22.69	31494
5.	Textiles	...	25.49	18614	25.53	19974	19.34	19347	36.17	54385
6.	Paper and Printing	...	27.61	1893	28.81	2374	35.08	3951	40.53	7873
7.	Leather and Rubber	...	16.57	1582	19.43	2538	38.53	5420	32.54	12243
8.	Non-metallic Minerals	...	63.06	8339	64.50	11505	65.00	10139	48.36	21683
9.	Chemical and Petroleum	...	71.72	15036	93.91	18518	110.63	28277	70.34	36133
10.	Cement	...	121.29	3122	125.41	3909	101.34	3483	109.20	6650
11.	Iron and Steel	...	106.45	12078	106.12	10854	124.42	20302	80.92	24749
12.	Non-ferrous Metals	...	113.86	2292	119.27	3806	183.32	2770	246.05	17108
13.	Metallic Products and Machinery	...	58.34	14838	62.31	13341	31.93	19879	17.11	16195
14.	Construction	...	-	-	-	-	-	-	0.19	92
15.	Electricity	...	51.77	2226	45.61	2356	77.29	8463	69.91	11387
16.	Railway Transport	...	18.33	6687	24.51	7616	25.48	10283	51.32	8029
17.	Other Transport	...	13.40	4531	11.27	4278	12.14	5894	4.25	1031
18.	Other Industries	...	37.45	9997	39.12	12474	76.36	6658	50.40	39842
	Average W	...	43.51	363330	45.78	423821	46.53	469439	47.20	590399

$W_i = \frac{\text{Inter industry demand in sector i}}{\text{Domestic output of sector i}}$ I_i = Inter-industry demand for ith sector

3.2.4 *A Comparison of the Results with Developed Countries*

How does the Indian performance compare with developed countries? We now attempt a broad comparison of the developing Indian economy as it stood in 1963 with some of the developed countries in respect of sectoral interdependence. For this purpose we use the average results based on U-W statistics of Italy (1950), Japan (1951) and the United States (1947) as given by Chenery and Clark (1964, p.207).

In the table below we reproduce the sectoral classification in the 4 categories as given by Chenery and Clark for the developed countries and list side by side, the comparable sectors of the 1963 Table results for India, given earlier in Table 3.2.2. It may be noted that the sector classification used by Chenery and Clark for the developed countries is a bit more disaggregated than ours. (29 sectors against 18 of ours). Even in respect of the comparable sectors, we are not sure whether the product-mix of the sectors shows one-to-one correspondence in almost all the cases.

In spite of this limitation our broad comparison shows that, at least 10 out of the 18 sectors find placement in the same categories as for the developed countries. Of the remaining sectors, our highly aggregated sector of agriculture, (comprising crop production, animal husbandry, fisheries and forestry) is the only important one which differs in its placement and still continues to stay in the relatively isolated category of final primary production. Perhaps, a disaggregation may show that some activities have already shifted to intermediate primary production, but on the whole the Indian economy has not yet reached the stage, where agriculture falls into intermediate primary category.

We have not extended the above lines of analysis towards overall comparison of interdependence of production structure over time in terms of triangularisation of input-output matrices to examine the existence of one way interdependence etc. mainly because our sector classification is more aggregated so that further analysis may not adequately identify the appropriate hierarchy of sectors indicating one way interdependence and circularity.

3.3 *Intertemporal Changes in Technology*

Having noted the changing pattern of sectoral interdependence of the Indian economy for the period 1951-1963 we now attempt to figure out these changes quantitatively by studying the changes in the individual input-output coefficients.

A change in the structure of an economy is the resultant of changes in final demand and of changes in the input coefficients. The changes in input coefficients as measured from input-output tables may arise on account of many factors. It is necessary to distinguish technological change, i.e. change in the physical requirements for specific

Table 3.2.3 : A COMPARISON BETWEEN CHENERY RESULTS FOR DEVELOPED COUNTRIES* AND OURS FOR INDIA 1963

By type of input	*By use of output*	*Final (Low W)*			*Intermediate (High W)*		
	III	Final Manufacture:			II	Intermediate Manufacture:	
		*Developed Countries**		*India 1963*	*Developed Countries**		*India 1963*
Manufacturing (High U)	3*	Apparel	5	Textiles	13*	Iron and Steel	11 Iron and Steel
	4	Ship building			22	Paper and Paper Products	
	8	Leather and Products	7	Leather and Rubber	28	Petroleum Products	(9 Chemicals and Petroleum)
	1	Processed food					
	2	Grainmill Products	4	Food, Drinks and Beverages	19	Non-ferrous metals	12 Non-ferrous metals
	5	Transport equipment			16	Chemicals	9 Chemicals and Petroleum
	7	Machinery	13	Metallic Products and Machinery			
	15	Lumber wood products			23	Coal Products	
	14	Non-metallic mineral Products			11	Rubber Products	(7 Leather and Rubber)
					12	Textiles	
	10	Industry n.e.c.	17	Other transport	9	Printing and Publishing	
							8 Non-metallic minerals
							10 Cement
	IV	Final Primary Production:			I	Intermediate Primary Production	
		*Developed Countries**		*India 1963*	*Developed Countries**		*India 1963*
	A	Commodities			17*	Agriculture and Forestry	
Primary Production (Low U)	6*	Fishing	1	Agriculture	27	Coal mining	2 Coal and Coke
			6	Paper and Printing	20	Metal mining	3 Other mining
					29	Petroleum and natural gas	
	B	Services			18	Non-metallic minerals	
	25*	Transport	16	Rly. transport	24	Electric power	15 Electricity
	21	Trade					
	26	Services					

* H.N. Chenery and Paul G. Clerk, Interindustry Economics, John Wiley and Sons, New York, 1964, Table No. 8.2. The values of U and W on which the above classification for developed countries is based are the averages for Italy (1950), Japan (1951) and the U.S.A. (1947). The sectors of the developed countries are numbered in order of triangularity and the comparable sectors for India 1963 are placed side by side.

goods and services used in producing a given unit or basket of goods from non-technological changes which are in no way related to the technological requirements of production. These non-technological changes embedded in the input coefficients arise because of three circumstances namely, the economic reality, the theoretical requirements of input-output analysis and the empirical construction of the input-output model. For instance changes in input coefficients can be caused by vertical integration of industries overtime, often combined with changing product mix and shifts in industrial product composition. Further, the divergence of actual technical relationships from linear homogeneous function, and the strictly proportional relationship between changes in inputs and outputs that it assumes, could cause differences in input relationships between two periods of time. The conventional procedures relating to the treatment of secondary production and competitive imports have a considerable influence on the stability over time of the individual input coefficients. The temporal stability is also affected by the level of aggregation in the input-output model. Finally, some of the differences in the coefficients may be due to random factors such as differences between the different input-output tables in data sources and statistical methods for estimating the technical relationships etc.

A complete anlysis of changes in input coefficients, thus involves factoring out of the various causes of change and relating them to the underlying forces such as changes in consumer tastes, relative prices and technological innovation etc. But this is a claim of a very tall order for us to attempt here. For the purpose of this study, having eliminated the different price levels by deflation, we adopt the interpretation of coefficient change as technological change, as many researchers in the field have done. Obviously as noted by Reiner Staglin and Hans Wessels "there are numerous doubts in this interpretation as 'technology consists of a vast body of scientific, technical and social knowledge that dictates how goods and services are produced'. But in empirical input-output analysis it is not suitable to define technological change in a purely technical manner, i.e. as change in quantities of specific goods and services required to produce a given output unit (1912, p. 374).

3.3.1 *Changes in Individual Coefficients*

We define two types of coefficients from the input-output flow matrix, namely the column coefficient and the row coefficient or as Maria AUGUSTINOVICS prefers to call, coefficient based on "input approach" and that based on "output approach" respectively (1970, p. 251).

Let X_{ij} be the flow of the ith producing sector into jth absorbing sector, then, we define,

$$a^{C}_{ij} = x_{ij}/x_j$$

as the column coefficient and

$$a^{R}_{ij} = x_{ij}/x_i$$

as the row coefficient. In the input-output literature, the column coefficients or input coefficients, are considered as technical coefficients and each such coefficient defines the quantities of specific goods and services required to produce a given unit of output and the whole matrix of such coefficients comprising different producing sectors is termed as technology matrix of the economy. Evidently, these technical coefficients should change when the technology of production changes. The stability of these coefficients is a much researched topic in input-output literature. But the row coefficients are only the distributive coefficients that define the proportion of output of a given sector going to different industries and the final demand categories. As such, there is no apparent technical reason for their stability. However, column coefficients are affected by changes in price structure while row coefficients are invariant to them. In our analysis we use both types of coefficients and try to identify and interpret the changes in them. In Appendix Tables B3.3.1 (a), (b), (c), (d) and (e), we present the set of five column coefficient matrices and in Tables B3.3.2 (a), (b), (c), (d) and (e) the set of five row coefficient matrices based on the set of five input-output transaction matrices given in Tables A2.4.3 (a) to A2.4.3 (e). This forms the data for our analysis.

We seek to examine the change in each individual coefficient by calculating the coefficient of variation following the method of Tilanus noted earlier. Let $a_{ij}(t)$ be the (ij)th element in the coefficient matrix for the tth period for all i,j = 1,2,....18. Let t be represented in ordinal numbers as:

1 = 1951-52
2 = 1953-54
3 = 1959
4 = 1960-61
5 = 1963

The mean and variance of the observations in each cell of the matrices will be

$$\bar{a}_{ij} = 1/5 \sum_{t=1}^{5} a_{ij}(t) \qquad \text{and}$$

$$S^2_{ij} = 1/5 \sum_{t=1}^{5} (a_{ij}(t) - \bar{a}_{ij})^2$$

Dividing the standard deviation, $\sqrt{S^2_{ij}} = S_{ij}$ by the mean, $\bar{a}_{ij}$ we derive the classical coefficient of variation.

$$V_{ij} = S_{ij}\sqrt{a}_{ij}$$

We have calculated the coefficient of variation for all values of i, j = 1,2,....,18. The average coefficient matrix i.e. matrix with (ij)th cell as $\bar{a}_{ij}$, has 270 non-zero cells and hence we have only 270 values of V_{ij}'s. The computations are carried out for both column and row coefficients and the estimated coefficients of variance viz. V^C_{ij} and V^R_{ij} are given in two matrices of 18 x 18 in tables 3.3.3 (a) and 3.3.3 (b)

It is difficult to discuss the temporal change or variation as measured by us for each individual coefficient. To get an idea about the nature of the variation we have cross classified the estimates in different size groups of average value of coefficient by different size groups of coefficient of variation in a two way classification as given in Table No. 3.3.4 and Table No. 3.3.5.

It is observed that 81% column coefficients with size group less than 0.05 exhibit a coefficient of variation more than 100%. Exactly opposite picture is presented by coefficient with size group more than 0.05 and we find that 72% coefficients have less than 100% coefficient of variation. Thus it is seen that there exists a negative correlation between the size group of the coefficient and its temporal change as measured by the coefficient of variation i.e. the larger the size of the coefficient the smaller is its coefficient of variation over time. One of the reasons why the smaller coefficients have more variation is that the relative size of the absolute change gets magnified in those coefficients. Also for very small coefficients, say less than 0.00001 there is a chance of rounding error.

Similar is the picture presented by row-coefficient as shown in Table No. 3.3.5.

It is observed that 79% row coefficient with size group less than 0.05 show a coefficient of variation more than 100% and 72% of row coefficients with size group more than 0.05 show a coefficient of variation less than 100%. Thus in the case of row coefficients also there exists a negative correlation between the size of the coefficient and its temporal change. In general, therefore, the orders of magnitude of row and column coefficient variations are found to be similar.

3.3.2 *Changes in Sector Level Input and Interindustry Demand Coefficients*

We will now consider the changes in the sector level input coefficients (column) and interindustry demand co-

Table 3.3.3(a) : MATRIX OF COEFFICIENT OF VARIATION OF COLUMN COEFFICIENTS (V^c_{ij})

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	31.34	158.81	122.42	20.64	40.28	38.79	12.75	49.10	51.78	122.43	104.94	63.77	46.80	121.42	-	121.49	84.36	99.95
2.	-	58.60	-	47.80	22.90	21.44	83.02	75.69	53.35	38.24	45.84	35.79	43.77	100.11	22.65	17.71	122.58	75.84
3.	125.33	89.44	80.02	74.24	100.20	39.42	104.00	43.93	89.75	55.09	28.93	39.20	104.86	100.03	114.97	123.15	122.83	63.04
4.	15.25	131.02	-	40.51	84.13	58.84	49.25	-	38.93	-	-	-	80.11	-	-	124.43	145.60	87.20
5.	67.34	-	200.36	82.32	49.51	87.98	49.17	101.50	95.70	89.18	108.88	202.33	24.45	-	-	87.90	101.26	111.01
6.	-	123.97	-	80.24	32.00	28.01	48.41	68.96	48.04	102.40	104.17	127.06	74.23	101.80	-	101.72	95.25	163.42
7.	-	-	200.75	-	112.28	70.75	41.27	116.12	173.17	-	-	-	49.50	-	126.62	172.63	92.12	87.06
8.	110.69	-	57.11	56.04	118.75	73.88	129.86	107.47	53.59	177.29	172.39	199.61	43.58	45.89	137.42	52.87	106.00	130.70
9.	55.76	80.24	197.02	70.48	37.88	19.88	41.11	71.38	26.57	68.74	70.50	50.41	62.42	73.03	103.61	96.81	90.93	86.65
10.	-	-	-	-	-	-	-	94.68	-	122.52	-	-	122.69	55.17	-	89.33	-	200.00
11.	158.73	-	123.39	81.97	85.96	117.50	61.91	78.82	197.29	116.16	19.87	118.47	29.20	40.45	200.00	93.69	200.28	180.11
12.	-	-	-	99.72	189.19	127.29	151.63	66.61	67.60	-	58.50	22.75	40.87	-	126.75	106.46	-	173.75
13.	109.41	26.84	22.18	52.10	135.10	113.67	125.96	134.34	111.10	200.38	169.59	170.85	62.67	70.76	122.52	75.55	57.34	61.37
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	61.22	36.77	115.49	57.51	38.18	41.91	44.86	92.37	53.25	42.52	55.46	66.28	42.11	-	80.96	58.76	123.23	116.70
16.	81.27	133.99	172.73	70.78	73.18	69.43	79.18	101.44	80.21	55.16	75.30	91.80	80.82	103.58	121.97	73.27	122.89	64.32
17.	56.96	138.00	198.05	73.36	79.96	30.13	84.61	153.11	82.33	69.28	73.14	173.52	85.98	100.08	89.11	83.86	144.99	109.16
18.	38.04	129.55	172.32	122.12	137.59	88.30	20.69	56.65	105.89	94.52	119.81	163.84	118.40	100.64	141.26	189.27	193.92	129.39
Total (V^c_j)	28.83	12.53	44.84	15.21	6.79	18.92	11.60	30.37	23.61	20.22	20.10	8.65	12.01	8.33	14.17	17.79	12.01	11.66

* 14 - Based on 4 observations.

1. Agriculture
2. Coke and Coal
3. Other Mining
4. Food, Drinks and Beverages
5. Textiles
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals and petroleum
10. Cement
11. Iron and Steel
12. Non-ferrous Mtals
13. Metallic Products and Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table 3.3.3(b) : MATRIX OF COEFFICIENT OF VARIATION OF ROW COEFFICIENTS (v^R_{ij})

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	31.37	171.35	92.59	23.66	41.56	45.33	47.50	80.16	63.90	126.58	-	-	66.96	163.42	-	123.08	83.40	58.88
2.	151.40	58.73	-	24.37	17.19	33.81	61.37	90.84	56.63	42.21	51.94	40.96	61.67	122.60	9.96	42.25	122.81	94.12
3.	122.53	84.09	79.93	89.92	80.61	41.34	78.34	29.28	129.52	87.89	63.45	48.35	58.20	125.00	95.67	123.43	123.70	106.60
4.	18.46	-	-	40.60	88.92	77.71	94.93	-	58.00	-	-	-	-	-	-	128.00	148.73	118.89
5.	57.00	-	197.37	85.37	49.50	84.13	68.86	80.30	103.32	86.59	119.51	-	53.67	-	-	92.07	111.02	69.32
6.	89.32	125.85	-	52.37	21.81	28.88	59.76	68.22	47.07	105.69	101.39	144.17	90.55	123.29	-	118.65	116.09	99.86
7.	129.00	-	201.34	-	98.39	79.15	41.27	108.84	170.14	-	-	-	51.37	-	124.52	182.25	42.21	103.96
8.	115.11	-	84.50	52.40	96.36	95.08	135.62	107.47	67.26	181.69	172.25	204.17	82.13	44.12*	-	79.31	99.13	129.69
9.	43.62	71.26	190.23	46.50	39.62	24.07	42.17	75.23	26.56	67.35	64.53	61.92	94.69	100.08	91.24	88.35	80.68	104.16
10.	204.52	-	-	-	35.57	-	-	103.21	-	122.47	-	-	122.49	11.92*	-	109.29	-	199.98
11.	133.42	-	82.75	94.83	84.77	116.97	61.61	77.60	197.47	114.65	19.89	111.67	17.30	64.06*	200.07	117.68	200.00	195.24
12.	-	-	-	138.65	186.50	61.80	148.23	85.10	85.07	-	57.15	22.75	41.56	123.46	122.98	94.66	-	177.68
13.	115.75	23.61	63.63	36.19	135.89	183.40	106.15	139.23	111.29	-	166.42	110.94	62.67	102.92	125.85	109.48	75.96	91.50
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	47.90	20.70	69.07	26.25	27.79	43.43	58.20	78.94	66.64	31.47	41.38	79.10	54.54	-	80.84	37.12	122.76	155.51
16.*	70.55	102.70	114.00	29.65	21.75	14.93	30.54	88.99	92.53	100.40	106.67	36.77	67.87	108.78	147.00	47.89	106.56	55.85
17.*	27.70	100.74	168.84	43.30	50.44	54.03	84.48	101.60	41.96	20.47	39.92	119.94	85.60	100.38	121.36	60.96	121.63	56.56
18.*	105.83	103.33	100.62	16.99	140.44	49.28	64.59	55.50	132.31	85.26	166.37	57.72	158.10	100.09	173.21	126.99	100.78	52.87
Total (y^R_j)	13.87	10.57	27.86	31.09	43.44	14.02	30.00	35.58	16.76	48.77	37.12	32.37	58.80	-	22.60	42.33	34.63	30.60

1. Agriculture
2. Coke and Coal
3. Other Mining
4. Food Drinks and Beverages
5. Textiles
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals and Petroleum
10. Cement
11. Iron and Steel
12. Non-ferrous Metals
13. Metallic Products and Machinery
14. Construction
15. Electricity
16. Railway Transport*
17. Other Transport*
18. Other Industries*

Table 3.3.4 : TWO-WAY FREQUENCY DISTRIBUTION OF COLUMN COEFFICIENTS ACCORDING TO SIZE GROUP OF AVERAGE VALUE OF THE COEFFICIENT ($\bar{a}_{ij}$) AND COEFFICIENT OF VARIATION (VC_{ij})

Size group of average value of column coefficient ($\bar{a}_{ij}$)	*Size group of coefficient of variation* (V^C_{ij})				*Total*
	0-20%	*20-50%*	*50 to 100%*	*More than 100%*	
Less than 0.02	9	20	71	91	191
0.02 - 0.05	1	10	19	15	45
0.05 - 0.10	1	7	8	-	16
0.10 - 0.25	2	10	4	1	17
0.25 - 0.50	-	1	-	-	1
More than 0.50	-	-	-	-	-
Total	13	48	102	107	270

Table 3.3.5 : TWO-WAY FREQUENCY DISTRIBUTION OF ROW COEFFICIENTS ACCORDING TO SIZE GROUP OF AVERAGE VALUE OF THE COEFFICIENT ($\bar{a}_{ij}$) AND COEFFICIENT OF VARIATION (V^R_{ij})

Size group of average value of row coefficient ($\bar{a}_{ij}$)	*Size group of coefficient of variation* (V^R_{ij})				*Total*
	0-20%	*20-50%*	*50-100%*	*More than 100%*	*Total*
Less than 0.02	10	18	70	82	180
0.02 - 0.05	2	15	20	11	48
0.05 - 0.10	1	4	5	4	14
0.10 - 0.25	2	12	3	4	21
0.25 - 0.50	1	1	1	2	5
More than 0.50	1	1	-	-	2
Total	17	51	99	103	270

efficients (row) as we are interested in knowing the changes that have taken place in the total input consumption by a sector as well as in the share of its demand by industries.

Let $\bar{a}_j^C$ and s_j^C and $\bar{a}_i^R$ and S_i^R be the mean and standard deviation of column coefficient totals and row coefficient totals respectively. Then V_j^C and $V^R{}_i$ are the respective coefficient of variation for total coefficients of column and row. These coefficients of variation are presented in Table No. 3.3.6 as abstracted from Table Nos. 3.3.3(a) and 3.3.3(b).

Table 3.3.6 : SECTOR LEVEL COEFFICIENT OF VARIATION FOR TOTAL COLUMN AND ROW COEFFICIENTS

No.	*Name of the Sector*	*Coefficient of variation for total column coefficient* V_j^C	*Coefficient of variation for total row coefficient* V_i^R
1	Agriculture	28.83	13.87
2	Coke and Coal	12.53	10.57
3	Other Mining	44.84	27.86
4	Food, Drinks and Beverages	15.21	31.09
5	Textiles (All)	6.79	43.44
6	Paper and Printing	18.92	14.02
7	Leather and Rubber	11.60	30.00
8	Non-metallic Minerals	30.37	35.58
9	Chemicals and Petroleum	23.61	16.76
10	Cement	20.22	48.77
11	Iron and Steel	20.10	13.72
12	Non-ferrous Metals	8.65	32.37
13	Metallic Products and Machinery	12.01	58.80
14	Construction	8.33	-
15	Electricity	14.17	22.60
16	Railway Transport	17.79	42.33
17	Other Transport	12.01	34.63
18	Other Industries	11.66	30.60

Looking back to Tables 3.3.3(a) and 3.3.3(b) and comparing the magnitude of coefficient of variation of the total coefficient of the sector with that of the individual cell we find that for column as well as for row, the coefficients of variation for the sector level coefficients as noted in Table No. 3.3.6 are lower than those for the individual coefficients. This smaller magnitude of the coefficients of variation seems to show that there is no pronounced change of large magnitude in the sector level aggregate input consumption and interindustry demand generation over the years.

Comparing the magnitudes of the aggregate column and row coefficients of variation between themselves, sector by sector, the sectors can be bisected into two groups one showing the sectors whose row coefficient of variation is smaller than the column coefficient of variation (i.e. $V^R_i < V^C_j$) and the second showing the sectors whose column coefficient of variation is less than the row coefficient of variation (i.e. $V_j^C < V_i^R$). Considering the nature of the sectors falling in each of these groups it can be broadly inferred that the intermediate product manufacturing sectors show less variation rowwise than columnwise and the final product manufacturing sectors show less columnwise variation than rowwise.

The above results of the sector level analysis need a bit more deeper probing which will be attempted in Chapter IV.

3.3.3 *Estimates of Technological Change*

So far we have considered individual cellwise and sectorwise change in the input-output coefficients over the period 1951-52 to 1963 as indicated by the coefficient of variation. But the coefficient of variation does not give us an average measure of the technological change. For this purpose we use the following measure defined by Maria Augustinovics (1970, p. 261).

$$\alpha^{b,c}_{n,m} = \frac{1}{n,m} \sum_{i=1}^{n} \sum_{j=1}^{m} \frac{|a_{ij}^{(b)} - a_{ij}^{(c)}|}{\frac{1}{2}(a_{ij}^{(b)} + a_{ij}^{(c)})}$$

where $\alpha^{b,c}$ is a measure of the change (difference) in A matrix of size n x m between periods b and c. In this measure as noted earlier, the changes in the form of absolute differences in individual coefficients between two periods of time are compared to the average of the said coefficients and the unweighted arithmetic mean of these relative changes is computed. If there is no technological change at all, α will give the value zero and if the two technologies are entirely different, the maximum value α

takes will be 2. This means that the lower values of α show little change in the technologies of the two time periods and conversely.

A limitation of this measure is that it can be used to compare only two matrices at a time. Therefore for our 5 input-output tables we have $5C_2$ possible pairs of comparison. Since (i,J) and (J,i) give the same value of α, this reduces the number of possible pairs for comparison to 10. We have arranged the possible pairs of temporal comparisons such that a listing of them in terms of time gap, in years, in the values of α builds up a time sequence for gap years from 1 to 12. Unfortunately we have no estimate of α for the gap years 5 and 11. The α series in terms of gap years helps us to find out the overall change in technology over the years. We have built up the α series for the column coefficients and have presented them in Table 3.3.7(a). A similar series based on the row coefficients, termed as to series, is given in Table No. 3.3.7(b).

Table No. 3.3.7(a) : TECHNOLOGICAL CHANGE SERIES, α (COLUMN COEFFICIENT MATRICES)

Comparing years		*Time gap years*	*Technological change*
1	1959-60	1	0.6676
2	1951-53	2	0.3152
3	1960-63	3	0.7359
4	1959-63	4	0.8096
5	1953-59	6	0.9263
6	1953-60	7	0.9975
7	1951-59	8	0.7472
8	1951-60	9	1.0187
9	1953-63	10	1.0079
10	1951-63	12	1.0424

Table 3.3.7(b) : TECHNOLOGICAL CHANGE SERIES 1951-63, β (ROW COEFFICIENT MATRICES)

Comparing years		*Time gap years*	*Technological change*
1	1959-60	1	0.6650
2	1951-53	2	0.2799
3	1960-63	3	0.7319
4	1959-63	4	0.8488
5	1953-59	6	0.9481
6	1953-60	7	0.9742
7	1951-59	8	0.9717
8	1951-60	9	1.0062
9	1953-63	10	0.9928
10	1951-63	12	1.0037

As time gap between two input-output tables increases, α, the measure of technological change (in input coefficients) increases, except in two cases. These may be treated as aberrations, especially in view of the innumerable adjustments we had to make them to fit into a uniform pattern. Alternatively, one may be tempted to infer that the change between 1959 and 1960 involving a gap of 1 year is 0.6676 as against the change of only 0.3152 between 1951 and 1953 involving a gap of 2 years, is due to the fact that technology is changing more rapidly with the passage of time. But many more observations are required to make this type of inference with any confidence. The magnitude of α by itself indicates little. But the trend in the values of α helps us to infer that technology is changing with time.

The magnitude and trend of the values in β series is almost the same or similar to that of α over different gap years, indicating changing share of sectors in interindustry demand.

3.3.4 *The Direction of Structural Change due to Changes in Technical Coefficients*

In our exploration so far in the analysis of structural change in the Indian economy from 1951 to 1963, particularly technological change due to changes in technical coefficients we have used different measures which ensure change but do not indicate the direction in which the change takes place. Below we have attempted to get some idea about it following the well known method used by Leontief, noted earlier.

We have fitted a frequency distribution to the relative change index of input coefficients defined as

$$\bar{a}_{ij} = \frac{(a_{ij}^{(b)} - a_{ij}^{(c)})}{\frac{1}{2}(a_{ij}^{(b)} + a_{ij}^{(c)})}$$

where b and c refer to two time periods and a_{ij} are the respective input coefficients (column coefficients). On account of the absence of modulus in the numerator in the definition of the index it can be either positive or negative and the borders of it will also change from -2 to 2 instead of 0 to 2. By counting the number of input coefficients whose relative change indices fall within each prescribed range, the frequency distribution of relative change indices can be determined.

But it is important to note that given the total number of input coefficients, the industrial/sectoral classification used affects the frequency distribution

thus determined as it does not take into account the relative sizes of different sectors. In order to nullify the effects of sector classification on the frequency distribution, Leontief takes

$$\tfrac{1}{2} \left(x_{ij}^{(b)} + x_{ij}^{(c)}\right)$$

as weight of relative change in an input coefficient a_{ij}, where x_{ij} are the transaction values in periods (b) and (c) of sector j from sector i in constant prices. We have also used the same weighting scheme.

We have fitted two such distributions; one to compare the years 1951-52 and 1953-54 and the other to compare the years 1951-52 and 1963. The means and standard deviations of the two distributions are calculated by formulating 40 uniform class intervals of size 0.10 and the above weights as frequencies in each class interval. The relative change indices are presented in Table Nos. 3.3.8(a) and 3.3.8(b) for the two comparisons. Since the size of the frequencies is very large we have taken the average frequencies in each cell for plotting the distributions on the graph.

The means and the standard deviations, as obtained from the above frequency distributions and presented below, reflect the change in technology during the decade 1953-1963.

	1951-53 Distribution	1951-63 Distribution
Mean ...	-0.0319	-0.0605
Std. Deviation ...	0.1709	0.7383

Since both the distributions are nearly normal we can take their respective means as statistical measures of the magnitude of over-all change. It is seen that from 1951 to 1953 the input coefficients of all commodity for all industries were on the average increased by about 3%. But during the period 1951 to 1963 the average increase was of the order to 6%. This gives an idea of the rate of technical change during the period in the economy. While in a developed economy the inputs in the latter period are expected to be less than the former indicating increased productivity in the economy, in a developing economy, on the other hand, one expects a greater input usage indicating more and more round-about and refined processing. The above results thus corroborate our earlier finding in Section 3.2.1 and more so with respect to the mining and manufacturing branch of the economy as noted from Table 3.3.9.

GRAPH NO. : 3.3.1

Frequency Distribution of Mean Transaction values (weights) according to Relative changes in Technical Coefficients during 1951-53 & 1951-63.

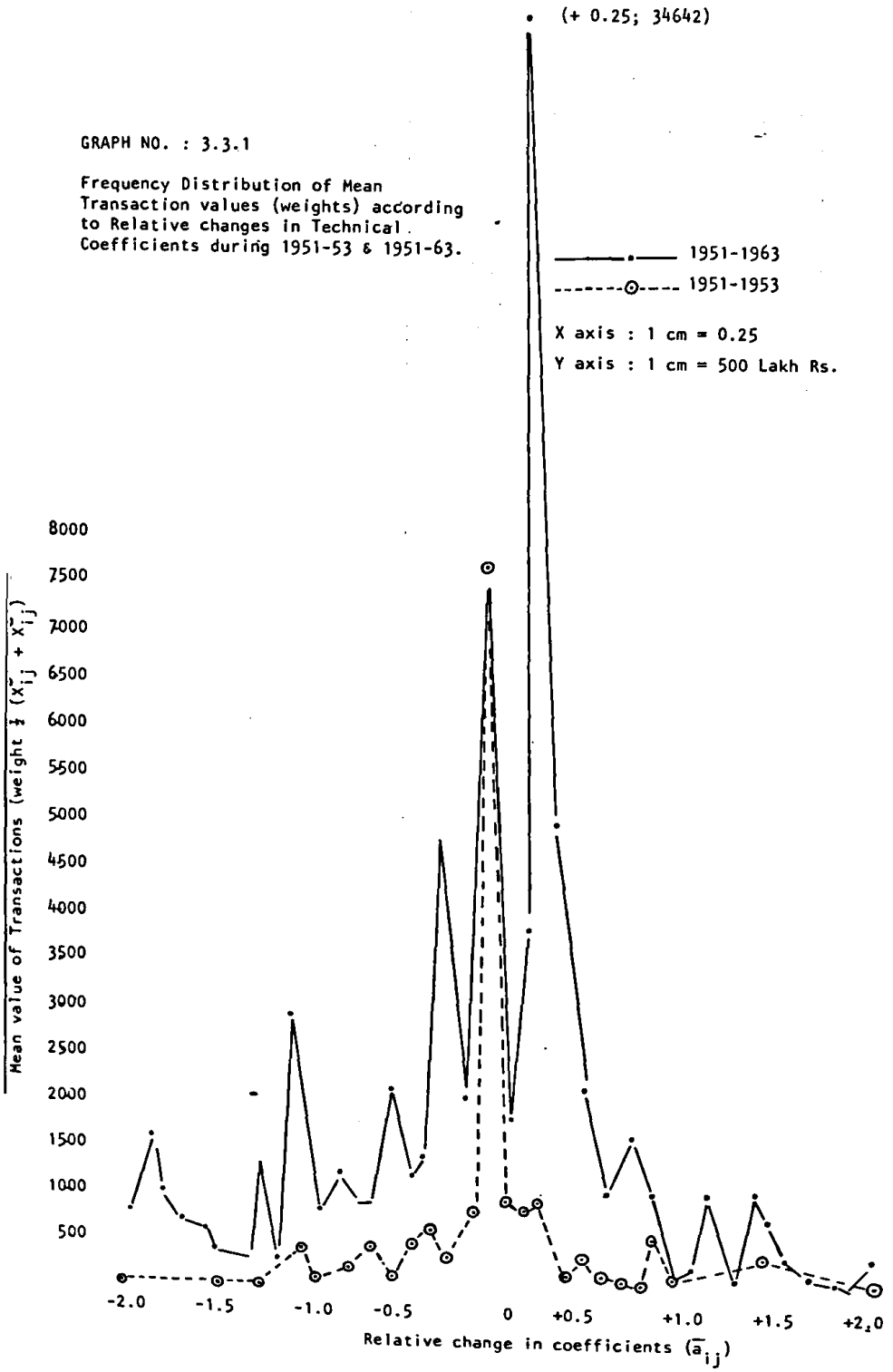


Table 3.3.8(a) : RELATIVE CHANGE INDICES* OF INPUT COEFFICIENTS OF 1953-54 OVER 1951-52

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	-0.0066	-0.0049	-0.4591	-0.0712	-0.0721	-0.1038	-0.0709	-0.4992	-0.6907	-0.0085	-0.6212	+0.0553	-0.8084	-0.3099	-	-0.0481	-0.3865	-0.6524
2.	+0.4084	+0.1891	-	+0.0116	-0.0135	+0.0905	+0.4563	+0.0099	-0.6897	+0.0860	-1.5101	+0.1799	-0.2839	-0.0928	-0.0031	-0.2590	-0.0965	-0.0821
3.	+0.3582	-0.0757	-0.2613	-0.1386	-0.1171	-0.1984	+0.2464	+0.0913	-0.8149	-0.2806	-0.6325	+0.0300	-0.4914	-0.0329	+0.1761	-0.1558	+0.1017	-0.0209
4.	+0.1688	+0.5387	-	+0.2006	-0.2021	+0.4522	+0.4691	-2.0000	-0.2274	-	-	-	-0.0180	-	-	+0.2621	-0.9940	-0.1793
5.	+0.9804	-	-	-0.2759	-0.0089	+0.0438	+0.2295	+2.2966	-	-	-	-	-0.0826	-	-	-0.5262	-0.4695	+0.1776
6.	+0.5316	+0.2657	-	-0.0199	-0.1978	-0.0017	-0.1199	-0.0961	-0.6464	-0.0961	-0.4527	-	-0.2875	-0.2833	-	+0.0458	-1.5267	-0.3203
7.	+0.3932	+2.0000	-	-	-	-0.3234	-0.0532	-0.6568	-	-	-	-	-0.6995	-	-0.4057	-0.4807	-0.4248	-0.4097
8.	-0.0038	-	-0.3974	+0.1025	-0.0420	+0.1834	+0.6895	-0.1490	-0.6229	-2.0000	-0.4984	-	-0.3379	-0.3482	-0.8550	+0.0855	-0.3120	-
9.	+0.2752	+0.3531	-0.5935	+0.1278	+0.1965	+0.2459	+0.2612	+0.1345	-0.4236	+0.1910	-0.2083	+0.4527	-0.1646	-0.1042	-	-0.0224	-0.2001	-0.1450
10.	+2.0000	-	-	-	-	-	-	+0.0756	-	+0.0004	-	-	-0.2502	-0.1449	-	-0.5828	-	-
11.	+0.9114	-	+0.1289	+0.1783	+0.5248	+0.4633	+0.7361	+0.4295	-2.0000	+0.3833	+0.0002	+0.6584	+0.0648	+0.0822	+2.0000	-0.3805	-2.0000	-2.0000
12.	-	-	-	-0.5243	-1.5659	-0.1018	+2.0000	-0.2877	-0.8367	-	-0.6584	+0.0003	-0.6534	+0.0741	-0.4087	-0.3848	-	-0.2011
13.	+0.4864	+0.5001	+0.0647	+0.8113	+2.0000	-	+0.3094	-0.3830	-0.3002	-	-	+2.0000	+0.0722	+0.0307	-0.0171	+0.0121	+0.0857	-0.0268
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	+0.1946	+0.1862	+0.0751	-0.1770	+0.1981	+0.1564	+0.0978	-0.3374	-0.5073	+0.0538	-0.3083	+0.3242	-0.1924	-	-0.2671	+0.1617	-0.1719	-0.0053
16.	-0.3113	+1.4072	+0.4762	+0.0656	+0.1574	+0.1660	+0.2168	+0.4001	-0.5954	+0.0068	+0.1665	+0.6565	-0.0853	-0.3995	+0.0923	-0.1640	-0.1854	-0.0215
17.	+0.4776	-0.0424	-2.0000	+0.1894	+0.2092	+0.1673	+0.2539	+0.5707	-0.5166	-0.3514	+0.3771	-1.2318	-0.0163	+0.1433	+0.6308	-0.2082	-0.0430	+0.0830
18.	+0.1231	+0.2960	-0.3784	-0.1708	-0.0681	+0.2532	-0.0558	+0.0938	-0.6956	+0.1909	+0.6791	-2.0000	-0.3218	+0.1601	-	-2.0000	-0.2558	-0.2980

$$*C_{ij} = \frac{a_{ij}^{(1)} - a_{ij}^{(2)}}{(a_{ij}^{(1)} + a_{ij}^{(2)})/2}$$

1. Agriculture
2. Coke and Coal
3. Other Mining
4. Food, Drinks and Beverages
5. Textiles
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals and Petroleum
10. Cement
11. Iron and Steel
12. Non-ferrous Metals
13. Metal Products and Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table 3.3.8(b) : RELATIVE CHANGE INDICES* OF INPUT COEFFICIENTS OF 1963 OVER 1951-52

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	+0.2345	-1.6327	-1.3460	-0.0068	+0.3099	-0.5193	+0.0887	-1.2611	-0.3390	+2.0000	-1.1410	+1.2870	+0.4716	+2.0000	-	+2.0000	+2.0000	+0.4665
2.	+2.0000	+2.0000	-	-0.8245	-0.0923	+0.0545	+1.4290	-1.2907	-1.0669	-0.8017	-1.5581	+1.1226	-0.8532	+2.0000	+0.4440	+0.2198	+2.0000	-0.4997
3.	+2.0000	+2.0000	+1.6304	+1.4692	+1.6811	+0.9568	+0.8150	+0.8330	-1.2345	-0.8662	-0.9315	+1.3391	+1.8252	+2.0000	+2.0000	+2.0000	+2.0000	-0.3764
4.	+0.1490	+2.0000	-	-0.5435	-0.9962	-0.2055	-0.5776	-2.0000	-0.6804	-	-	-	+1.3536	-	-	+2.0000	+2.0000	-0.5364
5.	-0.5906	-	-	-1.9778	-0.2714	-1.1237	-0.5024	-1.6806	-2.0000	-2.0000	-2.0000	-2.0000	+0.5950	-	-	-1.2695	+2.0000	-0.4294
6.	+2.0000	+2.0000	-	-1.1617	-0.6421	-0.6531	+0.0495	+1.0208	-1.3480	+1.8847	+1.7969	-2.0000	-0.8331	+2.0000	-	+1.3989	-1.6503	-0.5121
7.	+2.0000	+2.0000	-	-	-2.0000	+0.9595	-0.8590	+2.0000	-2.0000	-	-	-	-0.8920	-	+2.0000	-0.7519	-1.6840	+1.2558
8.	+2.0000	-	+2.0000	-0.6555	-0.9300	-1.4647	-0.9684	-1.8272	-1.0729	-	-1.8171	-2.0000	-0.9862	-1.0851	+2.0000	-0.2478	+2.0000	-2.0000
9.	-0.8229	-0.9277	-1.9825	-1.4910	-0.8245	+0.2123	-0.2052	-0.3805	-0.1608	-1.4471	-0.6299	-0.6476	-0.0863	+2.0000	-2.0000	-0.0411	-1.8193	+1.3766
10.	+2.0000	-	-	-	-2.0000	-	-	-1.9344	-	+2.0000	-	-	+2.0000	-0.9149	-	-0.0423	-	-2.0000
11.	+2.0000	-	-1.1686	+0.1473	+0.2231	+1.6756	+0.1643	+0.7037	-2.0000	+1.6679	+0.0663	+1.7890	+0.1931	-0.0679	+2.0000	+0.5253	-	-2.0000
12.	-	-	-	-0.1080	-1.9790	+0.1955	+1.1483	-0.7197	+0.2635	-	+0.9295	-0.4443	-0.4621	+2.0000	+2.0000	-1.7459	-	-1.9340
13.	+1.4110	-0.2853	-0.5184	-0.6898	-1.9582	-2.0000	-1.8655	-1.9786	-1.3766	-	-2.0000	+0.3869	-0.7611	+2.0000	+2.0000	+0.4900	-0.3947	+0.3964
14.	-2.0000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	-0.8997	-0.8174	-1.6014	-1.3924	-0.0235	-0.2576	-0.9506	-0.9767	-1.1979	-0.6427	-0.8462	-1.5096	-0.5600	-	-1.1994	-1.2550	+2.0000	-1.8282
16.	-0.8188	+1.8911	-0.1973	+1.3395	+1.4313	+1.2931	+1.5496	-0.2371	-0.8630	-0.4611	-0.7266	+1.8614	+1.9164	+1.9831	-1.7885	-0.7533	+1.9813	+1.0140
17.	+0.5966	+1.7228	-2.0000	+1.5321	+1.8549	+1.8469	+1.9406	+1.2198	+1.6454	+1.0595	+0.7329	+1.6475	+1.9531	+1.9846	-0.0228	+1.3376	+1.7740	+1.9454
18.	+1.1957	+2.0000	+2.0000	-1.1657	-1.7748	-0.4959	-0.0972	+0.5726	-1.7392	-1.0676	-1.9205	-2.0000	-1.8284	+2.0000	-2.0000	-2.0000	+2.0000	+0.4932

* $$C_{ij} = \frac{a_{ij}^{(1)} - a_{ij}^{(2)}}{(a_{ij}^{(1)} + a_{ij}^{(2)})/2}$$

1. Agriculture
2. Coke and Coal
3. Other Mining
4. Food, Drinks and Beverages
5. Textiles
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals and Petroleum
10. Cement
11. Iron and Steel
12. Non-ferrous Metals
13. Metal Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table 3.3.9 : FREQUENCY DISTRIBUTION OF MEAN TRANSACTION VALUES (WEIGHTS) ACCORDING TO RELATIVE CHANGES IN TECHNICAL INPUT COEFFICIENTS DURING 1951-53 AND 1951-63

Relative Changes in Technical Coefficients	*Weights 1/2 ($x^b_{ij} + x^c_{ij}$) of Changes in all Coefficients of*			
	All Sectors		*Mining and Manufacturing Sectors*	
	1951 ; 1953	*1951 ; 1963*	*1951 ; 1953*	*1951 ; 1963*
-2.10 to -2.00	66.99	3036.42	28.00	2984.00
-2.00 to -1.90	-	6287.94	-	6287.94
-1.90 to -1.80	-	9508.37	-	7811.38
-1.80 to -1.70	-	4833.01	-	4719.51
-1.70 to -1.60	-	3582.00	-	644.50
-1.60 to -1.50	42.50	1214.00	5.00	1214.00
-1.50 to -1.40	-	1230.96	-	1230.96
-1.40 to -1.30	-	1389.47	-	1389.47
-1.30 to -1.20	11.50	6466.49	11.50	6229.99
-1.20 to -1.10	369.50	5197.99	369.50	5197.99
-1.10 to -1.00	-	8710.50	-	577.50
-1.00 to -0.90	95.50	7278.01	-	2931.52
-0.90 to -0.80	920.50	16336.80	920.50	12118.47
-0.80 to -0.70	-	4649.01	-	4392.01
-0.70 to -0.60	4933.00	7279.50	4933.00	7279.50
-0.60 to -0.50	842.01	18965.50	748.01	18171.99
-0.50 to -0.40	5439.01	7146.00	4513.00	7146.00
-0.40 to -0.30	11747.80	5460.00	632.00	2006.50
-0.30 to -0.20	5607.51	33870.41	3347.52	33646.41
-0.20 to -0.10	17026.88	5056.96	9716.91	5056.96
-0.10 to 0.00	272778.01	65715.49	94805.58	61908.49
0.00 to +0.10	24841.47	6760.49	10979.49	6760.49
+0.10 to +0.20	20685.89	15076.97	7156.06	8512.51
+0.20 to +0.30	12446.00	173212.07	10944.49	787.52
+0.30 to +0.40	846.96	14750.00	198.50	14750.00
+0.40 to +0.50	3649.54	10471.51	510.00	8892.01
+0.50 to +0.60	741.41	1962.41	367.49	1610.41
+0.60 to +0.70	250.50	-	250.50	-
+0.70 to +0.80	32.01	325.00	31.00	325.00
+0.80 to +0.90	540.98	1042.49	540.98	1042.49
+0.90 to +1.00	128.03	362.50	28.00	362.50
+1.00 to +1.10	-	545.00	-	545.00
+1.10 to +1.20	-	2011.46	-	15.50
+1.20 to +1.30	-	363.49	-	363.49
+1.30 to +1.40	-	6212.49	-	6057.99
+1.40 to +1.50	31.00	2751.40	31.00	943.47
+1.50 to +1.60	-	628.46	-	628.46
+1.60 to +1.70	-	608.99	-	608.99
+1.70 to +1.80	-	121.51	-	85.00
+1.80 to +1.90	-	708.97	-	708.97
+1.90 to +2.00	87.94	15451.14	86.99	1639.49
Mean	-0.0319	-0.0605	-0.0634	-0.2856
Standard Deviation	0.1709	0.7383	0.2161	0.7444

It is noticed that the mean values of change are in the same direction and the value of the same for the period 1951-63 is higher than for the period 1951-53 indicating higher input consumption. The standard deviation also shows an increase indicating non-uniform increases in inter-industry input consumption during 1953-63. Alternatively this means that the growth of the sectors is not uniform.

3.3.5 *A Summary of the Results*

The preceding analysis has shown that the various measures used have uniformly indicated that the technology of the Indian economy is changing during the period 1951-63. But the Leontief measure of fitting a frequency distribution to the relative change index of input co-efficients has not only confirmed the fact but also has provided the direction of the change which clearly shows that interindustry consumption of input has increased during the decade 1953-63. This is in line with the result obtained earlier on the basis of Chenery-Watanabe categorization of U-W statistics which showed that some of sectors in the economy have undergone change by shifting from the intermediate primary products category to the intermediate manufacturing category, thus involving increased intermediate consumption.

In addition, the standard deviations of the frequency distributions have indicated that the nature of the above development is not uniform. In this respect also the Chenery-Watanabe U-W categorization has indicated that the basic industrial sectors, viz. Non-metallic Minerals (8), Chemicals and Petroleum (9), Iron and Steel (11), Metallic Products and Machinery (13) have developed much more than the others.

The above statistical evidence shows that during the period 1951-63 the Indian economy changed its technology in the direction of more industrialization and laid the foundation of a sophisticated industrial base for further development.

3.4 *Impact of Changing Technology on Production Levels*

So far we were considering changes in input coefficients, either at the individual cell level or at the sector level and attempted to find out and estimate technological change in the economy, by interpreting coefficient change as technological change and change in the entire technical coefficient matrix of the input-output table as structural change. We shall now consider the repercussions of the overall effects of the changes, not at the individual or sector level coefficients only but in all the coefficients on the gross production levels, by interpreting increases or decreases in input requirements represented by the changes in input and inverse coefficients as technological change. It may be noted that each element in the inverse

matrix depends on all of the input coefficients (i.e. direct coefficients).

As already noted, structural change in the economy is caused by a combination of changes in the final demand and changes in technology as represented by the technical coefficient matrix. Methodologically, therefore, in assessing the impact of technological change we will have to eliminate, isolate, or control the effect of final demand changes by holding them constant or fixed for the two periods. Similarly, the impact of final demand changes will have to be assessed by holding technology constant or fixed. Thus a factoring out of the causes of structural change in gross production amounts to a measurement of the relative importance of final demand and technology change. The details of the methodological procedure used is elaborated below in Section 3.4.1 and the results obtained for the Indian economy for the period 1951-63 are presented in Section 3.4.2.

3.4.1 *Details of Methodological Procedure to Factor out Technological Change and Final Demand Change in the Changes of Gross Production*

If G_b^b and G_c^c are gross production vectors of the economy valued at constant prices in the years b and c respectively then the change in the production levels between the years viz. $(G_c^c - G_b^b)$ is due to change in the technical coefficient matrices A_b and A_c and change in the final demand vectors f_b and f_c. In assessing the impact of technology and final demand change on the structural change in production levels we will have to factor out what part of the change is due to change in technology and what part is due to change in final demand.

Assuming that the technology remains unchanged between the period b and c and only the final demand changes from f_b to f_c then the estimated production vector for the period c with the technology of the period b will be

$$G_b^c - (1 - A_b)^{-1} f_c$$

Similarly

$$G_c^b = (1 - A_c)^{-1} f_b$$

represents the estimated production vector for the period b with technology of period c. The difference between the production vectors of the two periods can then be written as,

$$G_c^c - G_b^b = (1 - A_c)^{-1} f_c - (1 - A_b)^{-1} f_b$$

$$= [(1 - A_c)^{-1} f_c - (1 - A_b)^{-1} f_c]$$

$$+ [(1 - A_b)^{-1} f_c - (1 - A_b)^{-1} f_b]$$

The first term on the right hand side of the equation shows the change in the gross production levels due to change in the technology from A_b to A_c, with final demand f_c remaining the same in both the periods. The second term shows the change in the gross production levels due to change in final demand from f_b to f_c with technology Ab remaining the same in both the periods. Thus the total change in gross production levels is factored out into the two components or the 'main effects' which together exhaust the total change in the gross production levels.

In the above delineation we considered the operation of technology A_b in the period c. In a similar manner we can consider the backward operation of technology A_c in the period b. Then the change in gross production levels can be written as

$$G_c^c - G_b^b = (1 - A_c)^{-1} f_c - (1 - A_b)^{-1} f_b$$

$$= (1 - A_c)^{-1} f_c - (1 - A_c)^{-1} f_b$$

$$+ (1 - A_c)^{-1} f_b - (1 - A_b)^{-1} f_b$$

$$= (1 - A_c)^{-1} f_b - (1 - A_b)^{-1} f_b$$

$$+ (1 - A_c)^{-1} f_c - (1 - A_c)^{-1} f_b$$

In this equation also the first term represents the contribution of technological change and the second term represents the contribution of final demand change to the total structural change as represented by the difference in gross production levels in two time periods b and c.

The movement from period b to c and the reverse movement from c to b do not, in all likelihood, give identical results. The disagreement in the above results as noted already is on account of the 'interaction effect' Noting that "there is no single correct method of measuring the relative importance of the two factors — final demand and technical coefficients — which explain changes", Vaccara and Simon propose that "the best measure of the relative importance of the two factors would be an average of the answers that result from the two alternative procedures available ..., i.e. assuming fixed technical coefficients of the terminal year and the fixed technical coefficients of the initial year." (1968, pp. 25-26.) However, Gary Fromm

commenting on the above procedure of averaging, puts an additional heavy stress on the index number problem involved in it. He argues that the averaging of Paasche and Laspeyres indicators gives "a bastard measure" and the index number problem "should not be casually left in a grey area of implicit ignorance."(Vaccara, 1968, pp. 59-65.) However, in our subsequent empirical work, like Vaccara and Simon, we have adopted the arithmetic cross of the two indexes and have also presented the magnitudes of the interaction element.

The above method of factoring is useful only in a two period comparison. We have extended it for application to our five point data, which is explained below. We have five technical coefficients matrices representing technology A_1, A_2, A_3, A_4, A_5 for the periods 1951-52, 1953-54, 1959, 1961 and 1963 respectively. With one fixed final demand vector we can estimate five gross production levels, and with five final demand vectors, one for each period we can generate 25 estimates of gross production levels, viz.

$$. \quad (1 - A)^{-1} f_k - G_i^k$$

$$i = 1, 2, \ldots, 5$$

$$k = 1, 2, \ldots, 5$$

where G_i^k is the gross domestic product estimated with the k^{th} year's final demand and the ith years technology, presented in 5x5 matrix form as below:

	Changing Final Demand				
	G_1^1	G_1^2	G_1^3	G_1^4	G_1^5
	G_2^1	G_2^2	G_2^3	G_2^4	G_2^5
Changing Technology	G_3^1	G_3^2	G_3^3	G_3^4	G_3^5
	G_4^1	G_4^2	G_4^3	G_4^4	G_4^5
	G_5^1	G_5^2	G_5^3	G_5^4	G_5^5

The diagonal elements of the above matrix give the actual production levels with the actual technology and final demand observed in the respective years. The different columns give the expected gross production vectors under the assumption of fixed final demand and changing technology. The rows on the other hand, provide the gross production vectors under the assumption of fixed technology and changing final demand.

The effects of change in the gross production levels, namely, change due to technology and that due to change in final demand were factored with the help of non-diagonal

elements. For example,

$$(G_2^2 - G_1^1) = (G_2^2 - G_1^2) + (G_1^2 - G_1^1) \text{ and}$$
$$A \qquad\qquad T \qquad\qquad F$$

$$(G_2^2 - G_1^1) = (G_2^1 - G_1^1) + (G_2^2 - G_2^1)$$
$$A \qquad\qquad T \qquad\qquad F$$

The total change in gross production levels (A) is the same in both the equations. But the effects of technological change (T) and final demand change (F) are estimated as averages of the two equations given above, viz.,

$$T^* = \tfrac{1}{2}\left[(G_2^2 - G_1^2) + (G_2^1 - G_1^1)\right]$$

and $$F^* = \tfrac{1}{2}\left[(G_1^2 - G_1^1) + (G_2^2 - G_2^1)\right]$$

3.4.2 *Results*

Using the above methodology we have assessed the effect of changes in technology and final demand on gross production levels in the Indian economy for the period 1951-63. In assessing these effects we have not taken into consideration the sectors of Railway Transport (16), Other Transport (17) and Other Industries (18) as the final demand figures for these sectors could not be derived from the original input-output tables in a comparable manner. We have also excluded the Agriculture sector as the fluctuating nature of agricultural output and its very large and dominant size in the economy would swamp the effects in the other sectors.

The total change in gross production levels (A), the effect due to change in technology (T) and due to change in final demand (F) have all been reduced to percentage basis with the earlier of the two comparing years as the base. Our data give a time sequence of these magnitudes with a uniform gap of 2 years from 2 to 12. In Appendix Table B3.4.1 we present the five final demand vectors and in Table Nos. B.3.4.2(a), B.3.4.2(b), B3.4.2(c), B.3.4.2(d) and B.3.4.2(e) we present the Leontief inverses of the five technical coefficients matrices and finally in Table Nos. B.3.4.3(a), B3.4.3(b), B.3.4.3(c), B.3.4.3(d) and B.3.4.3(e) we present the various gross output levels obtained from the matrix multiplications of the Leontief inverses with the final demand vectors. The final results, viz. the percentage changes in gross production levels attributable to technology and to final demand for the mining and manufacturing branches of the economy, are presented in Table No. 3.4.4(a) below.

A similar table with Agriculture included is presented in Table No. 3.4.4(b).

Table 3.4.4(a) ; PERCENTAGE CHANGES IN TOTAL VALUE OF PRODUCTION DUE TO TECHNOLOGY AND DUE TO FINAL DEMAND IN THE MINING AND MANUFACTURING BRANCHES OF THE INDIAN ECONOMY, 1951-63

Comparing years	*Time gap in years*	*Total Change*	*Change due to technology*	*Change due to final demand*
1951, 1953	2	4.50	1.11	3.39
1959, 1963	4	44.63	14.35	30.27
1953, 1959	6	18.75	4.32	14.43
1951, 1959	8	24.08	5.52	18.56
1953, 1963	10	71.74	20.08	51.66
1951, 1963	12	79.47	22.76	56.71

Table 3.4.4(b) : PERCENTAGE CHANGES IN TOTAL VALUE OF PRODUCTION DUE TO TECHNOLOGY AND DUE TO FINAL DEMAND IN AGRICULTURE, MINING AND MANUFACTURING BRANCHES OF THE INDIAN ECONOMY, 1951-63

Comparing years	*Time gap in years*	*Total Change*	*Change due to technology*	*Change due to final demand*
1951, 1953	2	14.29	1.84	12.45
1951, 1963	4	26.03	-0.01	26.04
1953, 1959	6	12.69	0.45	12.24
1951, 1959	8	28.80	2.35	26.45
1953, 1963	10	42.04	0.69	41.35
1951, 1963	12	62.32	3.54	58.78

The results for mining and manufacturing branches presented in Table No. 3.4.4(a) are interpreted as follows. The first row of the table shows that the output of this branch of the economy in 1953 is 4.5 per cent more than that in 1951. Of this 3.4 per cent is due to the change in final demand and 1.1 per cent is due to change in technology, Similar is the interpretation for the other rows. If we ignore the second row, which apparently looks somewhat abnormal, we find that as the gap in the number of years increases, all the changes viz., total change, change due to technology and change due to final demand, increase. It is interesting to note that whenever we are comparing with the year 1963, the changes are much higher than those involving comparison with other years. This shows that by 1963 there is a major change in the role of the manufacturing branch in the Indian economy. The

second row of the table shows that the output has increased by 44.6 per cent from 1959 to 1963 and 14.4 per cent of it is due to technological change. This again points towards the fact of sharp emphasis on industrialization during the Second Five Year Plan (1956-61), which had a tremendous impact on the industrial structure of the country.

Comparing the changes due to technology and changes due to final demand as obtained in Table No. 3.4.4(a) we observe that final demand changes have a larger impact than technological changes for as large a gap as that of 8 years, when output changed by 24.1 per cent the technological change accounted for only 5.5 per cent. The rest of it, viz. 18.6 per cent is due to changes in final demand. This shows that the use of an 8 year old input-output table would result in an error of the magnitude of 5 per cent in the estimation of gross production. This finding is based on the data for 1951 and 1963. Whether a 5 per cent error for an 8 year period holds for future also depends on the rate of technological change. Similar trends are exhibited by the results as obtained in Table No. 3.4.4(b) for agriculture, mining and manufacturing branches of the economy as a whole, by and large.

So far we have assessed the changes in the gross production levels for the mining and manufacturing branches of the economy as a whole in Table No. 3.4.4(a) and for the agriculture, mining and manufacturing branches of the economy as a whole in Table No. 3.4.4(b); consequently the positive changes in one sector may be compensated by the negative changes in another sector. As a result the figures of technological change and final demand change presented in the tables above are underestimated to that extent. To correct for these compensatory changes we have calculated the absolute changes in values and presented results in Table Nos. 3.4.5(a) and 3.4.5(b), for the mining and manufacturing branches of the economy as a whole, and for the agriculture, mining and manufacturing branches of the economy as a whole, respectively.

It may be noted that since we are considering absolute values of the changes in individual sectors and adding them, the change in technology and the change in final demand do not together add up to the total change. The results based on the absolute values exhibit similar trends of the changes as discussed for tables 3.4.4. As the time gap increases changes in the gross production levels due to technology increase by and large. Again we find that the changes due to final demand are larger than the changes due to technology.

Earlier we observed that the use of 8 year old input-output table results in an error of the order of 5 per cent in estimating production levels. Considering the results based on absolute values we find that the error would increase to an order of 15 per cent if we use an input-

Table 3.4.5(a) ; PERCENTAGE CHANGES DUE TO TECHNOLOGY AND DUE TO FINAL DEMAND IN THE AGGREGATED ABSOLUTE VALUES OF SECTORAL PRODUCTION PERTAINING TO THE MINING AND MANUFACTURING BRANCHES OF THE INDIAN ECONOMY, 1951-63

Comparing years	*Time gap in years*	*Total change*	*Change due to technology*	*Change due to final demand*
1951, 1953	2	7.75	4.27	7.27
1959, 1963	4	49.50	19.14	36.70
1953, 1959	6	24.04	14.24	22.04
1951, 1959	8	27.70	14.16	21.80
1953, 1963	10	79.22	23.43	59.31
1951, 1963	12	87.17	26.75	63.39

Table 3.4.5(b) : PERCENTAGE CHANGE DUE TO TECHNOLOGY AND DUE TO FINAL DEMAND IN THE AGGREGATED ABSOLUTE VALUES OF SECTORAL PRODUCTION PERTAINING TO AGRICULTURE, MINING AND MANUFACTURING BRANCHES OF THE INDIAN ECONOMY, 1951-63

Comparing years	*Time gap in years*	*Total change*	*Change due to technology*	*Change due to final demand*
1951, 1953	2	15.55	3.06	13.95
1959, 1963	4	27.85	12.50	28.43
1953, 1959	6	14.57	6.12	14.93
1951, 1959	8	30.19	6.71	26.68
1953, 1963	10	44.69	14.72	44.06
1951, 1963	12	65.31	15.63	61.37

output table of 8 year old vintage. If we consider agriculture sector also, the error of using an 8 year old input-output table on the whole declines to around 7 per cent.

Let us now consider the computations of the interaction effect discussed earlier. In Tables 3.4.6(a) and 3.4.6(b) we present the computation of the interaction effect by use of base year and terminal year weights for the aggregate of the mining and manufacturing branches and for the aggregate of the agriculture, mining and manufacturing branches of the economy respectively and present the results as percentage to the gross output of the base year

Table 3.4.6(a) : COMPUTATION OF INTERACTION EFFECT, BY USE OF BASE YEAR AND TERMINAL YEAR WEIGHTS (EXPRESSED AS % TO BASE YEAR GROSS OUTPUT), FOR MINING AND MANUFACTURING BRANCHES OF THE ECONOMY

Years	*Gap in years*	*% Total Change*	*Base Year Weights*			*Terminal Year Weights*		
			% Change due to			*% Change due to*		
			Technology	*Final Demand*	*Interaction*	*Technology*	*Final Demand*	*Interaction*
1951, 1953	2	4.51	1.28	3.57	-0.35	0.93	3.21	+0.35
1959, 1963	4	44.63	13.32	29.24	+2.07	15.39	31.31	-2.07
1953, 1959	6	18.75	4.84	14.96	-1.05	3.79	13.90	+1.05
1951, 1959	8	24.08	6.02	19.06	-1.00	5.02	18.06	+1.00
1953, 1963	10	71.74	17.69	49.26	+4.79	22.48	54.05	-4.79
1951, 1963	12	79.47	18.50	52.44	+8.53	27.02	60.97	-8.53

Table 3.4.6(b) : COMPUTATION OF INTERACTION EFFECT BY USE OF BASE YEAR AND TERMINAL YEAR WEIGHTS (EXPRESSED AS % TO BASE YEAR GROSS OUTPUT) FOR AGRICULTURE, MINING AND MANUFACTURING BRANCHES OF THE ECONOMY

Years	*Gap in years*	*% Total Change*	*Base Year Weights*			*Terminal Year Weights*		
			% Change due to			*% Change due to*		
			Technology	*Final Demand*	*Interaction*	*Technology*	*Final Demand*	*Interaction*
1951, 1953	2	14.29	1.85	12.47	-0.03	1.82	12.43	+0.03
1959, 1963	4	26.04	0.14	26.19	-0.29	-0.16	25.89	+0.29
1953, 1959	6	12.69	0.61	12.39	-0.31	0.30	12.08	+0.31
1951, 1959	8	28.80	2.36	26.46	-0.02	2.34	26.43	+0.02
1953, 1963	10	42.04	0.65	41.31	+0.08	0.73	41.39	-0.08
1951, 1963	12	62.32	3.03	58.27	+1.02	4.05	59.29	-1.02

in six binary comparisons. All the main effects and the interaction are linearly additive.

It is observed that the interaction effect on the whole, is small in magnitude and ranges from 0.03 per cent to 1.03 per cent in the subeconomy including agriculture and from 0.35 per cent to 8.53 per cent in the subeconomy excluding agriculture. It is also observed that whenever comparisons are made with the 1963 technology, the magnitude of the interaction effect is somewhat large and the direction of it is also different. We have already noted this phenomenon earlier. We further note here that this also indicates that a larger change in the production levels either due to the main effect of technology or final demand or both entails a larger differential impact of the one on the other.

As an index number analogue the interaction element computed above represents the difference between the Laspeyres type base-year-weighted estimates of change due to technology or final demand and the corresponding Paasche type terminal-year-weighted estimates. It is well known that the Laspeyres type estimates show an upward bias and the Paasche type ones show a downward bias and the true estimate is usually taken as lying between these limiting values. The prescription in index number theory is : if the difference is not large, accept either Laspeyres or Paasche estimates or some sort of compromise between them such as an average as the best obtainable measurement of the main effects; on the other hand if Laspeyres and Paasche estimates differ widely, it may be necessary to reject both as measurements of change (Mudgett, 1951). It may be noted that our procedure follows this prescription However, the results in the above tables show that the difference between the base-year-weighted and the terminal-year-weighted estimates, though small in all the six binary comparisons of unequal time distance, the divergence increases with increase in the number of gap years in the comparison and in particular, the divergence is comparatively large in comparisons involving the terminal year 1963, in which three cases[5] the Paasche type estimates are larger than Laspeyres type ones. Such a situation, in index number theory, is explained in terms of "homogeneity error" (Mudgett, 1951, pp. 54-55) which arises on account of the fact that the "binary commodities" and the "unique commodities" in the base year basket are not the same as in the terminal year basket. In our context, this means that the composition of final demand in the above three comparisons is certainly different in the base year and in the terminal year. We would be reverting to this point in the subsequent chapter where we consider similar estimates at the sectoral level.

CHAPTER IV

SECTOR LEVEL CHANGES IN THE ECONOMY

In this chapter we analyse the changes in the economy at the individual sector level during the period under study. Since we are analysing an 18 sector model of the economy with individual sectors highly aggregated, it is necessary to take note of this limitation at the outset by spelling out the effect of aggregation on the changes we propose to study.

It is generally recognised (Per Seveldson, 1970, and Vaccara, 1970.) that aggregation in input-output tables entails tendencies both to make the flow coefficients more stable and to make them more instable. An important reason for increased stability is found in the fact that aggregation cancels out the impact of substitution among the related inputs. On the other hand an important reason for increased instability – and this is more relevant for our present context here – is the fact of changing product-mix; for when two or more sectors with different coefficients for the same input are combined, the aggregate coefficient will be an average of the coefficients of the individual sectors which will depend on the relative weight of the output in each sector so combined, and when weights vary the average coefficients will vary even if the individual coefficients remain constant.

The fact that every input-output sector must represent an implied product-mix does not raise any problem if the object is to purely present a chequer-board description of the economy at a point of time, in the input-output framework. Since the assumption of constant input coefficients plays a key role, the real problems emerge when such a table is employed as a tool for projection and impact studies. On account of the changing product-mix, it becomes less and less valid to use the input coefficients derived for a sector, for a base year, because that base year's product-mix no longer remains relevant. And this applies more severely to an aggregated model than to a disaggregated one.

The problems of coefficient change due to product-mix and input substitution are closely related to relative prices and cross-elasticities of demand. While the former problem is of course a problem which the Leontief model is particularly able to tackle through the specification of production sectors, the latter problem of substitution cannot be solved within the framework of simple Leontief model if prices are assumed to depend on the endogenous variables of the model. Substitutions brought about by price movements assumed to be exogenous to the model may of course be taken into account if price movements can be forecast (Per Seveldson, 1963).

The changing product-mix has the following implication for our analysis. It may be recalled that we have considered in Section 3.3 all coefficient difference to stand for technological change. But according to Vaccara (1968) changing technical relationships cannot be equated with technological change *per se*. Changing technology is only one of the many possible causes of change in the technical coefficients reflected in an input-output table between two time points. One of the factors that could cause a difference between any two time points in the technical coefficients for a given sector is the changing product-mix. And this factor has got subsumed in our evaluation of technological change, as we had no data readily available to allow for the changing product-mix of different sectors.

Even so, in such a highly aggregative picture of the Indian economy as is reflected in our 18 sector classification of the input-output tables, we are aware that an individual sector cannot represent a single or even a homogeneous set of commodities. In spite of this we venture to present below our sector level analysis which may throw some broad indications, if not accurate, sharp and clear-cut results about the changes during the period under study.

In this chapter after considering the relative position of the individual sectors in the economy with reference to gross output and final demand during the period render study, we present an analysis of the linkage structure of the sectors and then pass on to analyse the technological change based on direct coefficients and its impact on the sectoral production levels.

4.1 *Relative Position of the Sectors in the Economy with reference to Gross Output and Final Demand*

4.1.1 *Sectoral Shares in Gross Output Levels*

In Table 4.1.1(a) we present the percentage share of gross output of each sector to the gross output of the economy at 1952-53 prices for the five time points from 1951 to 1963. The sectors are ranked on the basis of the decreasing magnitude of the percentage share and are arranged on the basis of the average of the rank obtained by each sector for the individual year.

The Agriculture sector (1), including in itself the forestry and fisheries industries also, emerges as the most important first rank sector contributing more than half of the gross output of the economy throughout the period. The sectors next in importance are Food, Drinks and Beverages (4) and Textiles (5). Both the sectors retain their second and third rank up to 1961 and in 1963 they mutually exchange their ranks. The cumulative share of the above three sectors in the gross output of the economy is more than 70 per cent. The Construction (14) and Transport sectors (16 and 17) also contribute a mentionable share.

The Construction sector (14), despite its decreasing trend in the share over years retains its fourth rank up to 1961 and in 1963 it shows a sharp fall in the share by three ranks. The Transport sectors (16 and 17) which had the fifth and sixth rank in 1951-52 show a decreasing trend of their share in gross output of the economy and by 1963 their ranks fall down to 14 and 11 respectively. The above-named six sectors cumulatively contribute 75 to 87 per cent to the gross output of the economy and these are well known to cater primarily to the final demand rather than inter-industry demand of the economy. All the remaining sectors have comparatively lesser shares to contribute to the gross output of the economy.

As the manufacturing sectors have small shares in the total economy, to investigate their behaviour, we will restrict ourselves to the manufacturing branch of the economy only and consider the shares of the sectors in the gross output of that sub-economy. These are presented in Table 4.1.1(b) in the same format as that of Table 4.1.1(a). We have listed 11 out of 18 sectors; the 'Other Industries' sector (18) is omitted.

It is found that this branch contributes about 25 to 35 per cent to the gross output of the economy and over time it has increased by more than 200 per cent. The sectoral shares are also changing gradually over time. The first rank sector of Food, Drinks and Beverages (4) with a share of 41.32 per cent in 1951-52 shows a continuously decreasing trend in its share and is pushed down to the second rank in 1963 with its reduced share of 23.25 per cent. This decline may be due to the expansion of the other sectors during the period. The second rank sector of Textiles (5) with a constant share in gross output around 25 per cent retains its rank all through and is seen to improve it in 1963. These two sectors cumulatively contribute about a half to two-third to the gross output of the manufacturing branch. All the remaining sectors generally show an increasing trend in their shares, though not uniformly. The sector of Paper and Printing (6) however, shows a uniformly increasing trend with a gross output level in 1963 higher by 37 per cent than in 1951-52. The Electricity sector (15) also has a uniformly increasing trend with an increase of 83 per cent in its gross output level in 1963 over 1951-52. The Iron and Steel sector (11) shows a uniformly increasing trend in its share of gross output only from 1953-54 to 1963; with a 30 per cent increase in the gross output level in 1963 over 1951-52. The three sectors, namely, Leather and Rubber (7), Cement (10) and Non-ferrous Metals (12) show a uniformly increasing trend only from 1959 to 1963 with their gross output levels increased by 90 per cent, 15 per cent and 67 per cent respectively in 1963 over 1951-52. The remaining sectors, namely, Metallic Products and Machinery (13), Chemicals and Petroleum (9) and Non-metallic Minerals (8), do not show any trend but their gross output levels in 1963 show increases of 80 per cent, 18 per cent and 64 per cent respectively in 1963 over 1951-52.

Table 4.1.1(a) : SECTORAL SHARES OF GROSS OUTPUT AT 1952-53 PRICES IN THE INDIAN ECONOMY

Rank*	Sectors	1951-52		1953-54		1959		1960-61		1963	
		Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share
1.	Agriculture	55.76 (1)	55.76	59.25 (1)	59.25	59.19 (1)	58.19	50.04 (1)	50.04	53.59 (1)	53.59
2.	Food, Drinks and Beverages	11.07 (2)	66.83	9.96 (2)	69.21	9.08 (2)	67.27	8.47 (3)	58.51	8.17 (3)	61.76
3.	Textiles	6.78 (3)	73.61	6.41 (3)	75.62	7.36 (3)	74.63	6.69 (4)	65.20	8.85 (2)	70.61
4.	Construction	6.54 (4)	80.15	6.24 (4)	81.86	5.33 (4)	79.96	9.46 (2)	74.66	2.92 (7)	73.53
5.	Metallic Products and Machinery	2.36 (8)	82.51	1.75 (8)	83.61	4.58 (5)	84.54	4.76 (5)	79.42	5.57 (4)	79.10
6.	Other Transport	3.14 (6)	85.65	3.11 (5)	86.72	3.57 (6)	88.11	2.18(10)	81.60	1.43(11)	80.53
7.	Chemicals and Petroleum	1.95 (9)	87.50	1.62 (9)	88.34	1.88 (8)	89.99	3.12 (7)	84.72	3.02 (6)	83.55
8.	Railway Transport	3.39 (5)	90.99	2.55 (7)	90.89	2.97 (7)	92.96	3.22 (6)	87.94	0.92(14)	84.47
9.	Other Industries	2.47 (7)	93.46	2.62 (6)	93.51	0.64(14)	93.60	3.05 (8)	90.99	4.66 (5)	89.13
10.	Non-metallic Minerals	1.23(11)	94.69	1.46(10)	94.97	1.15(10)	94.75	2.47 (9)	93.46	2.64 (8)	91.77
11.	Leather and Rubber	0.89(13)	95.58	1.07(11)	96.04	1.03(11)	95.78	1.92(11)	95.38	2.22 (9)	93.99
12.	Iron and Steel	1.05(12)	96.63	0.84(13)	96.88	1.20 (9)	96.98	1.39(12)	96.77	1.80(10)	95.79
13.	Paper and Printing	0.64(14)	97.27	0.67(14)	97.55	0.83(12)	97.81	1.00(13)	97.77	1.14(12)	96.93
14.	Other Mining	1.31(10)	98.58	0.94(12)	98.49	0.50(16)	98.31	0.43(16)	98.20	0.57(16)	97.50
15.	Electricity	0.40(16)	98.98	0.42(16)	98.91	0.81(13)	99.12	0.68(14)	98.88	0.96(13)	98.46
16.	Coke and Coal	0.59(15)	99.57	0.57(15)	99.48	0.52(15)	99.64	0.61(15)	99.49	0.77(15)	99.23
17.	Cement	0.24(17)	99.81	0.26(17)	99.74	0.25(17)	99.89	0.31(17)	99.80	0.36(18)	99.59
18.	Non-ferrous Metals	0.19(18)	100.00	0.26(18)	100.00	0.11(18)	100.00	0.20(18)	100.00	0.41(17)	100.00
	All sectors, Rs.100 =	10,77,038		12,20,981		13,59,881		13,29,989		16,98,421	

* Average of the rank obtained by the sector in the individual year is shown in brackets.

Table 4.1.1(b) : SECTORAL SHARES OF GROSS OUTPUT AT 1952-53 PRICES OF THE MANUFACTURING BRANCH OF THE INDIAN ECONOMY

Rank*	Sectors	1951-52		1953-54		1959		1960-61		1963	
		Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share
1.	Food, Drinks and Beverages	41.32 (1)	41.32	40.29 (1)	40.29	32.12 (1)	32.12	27.31 (1)	27.31	23.25 (2)	23.25
2.	Textiles	25.31 (2)	66.63	25.92 (2)	66.21	26.02 (2)	58.14	21.57 (2)	48.88	25.18 (1)	48.43
3.	Metallic Products and Machinery	8.82 (3)	75.45	7.09 (3)	73.30	16.19 (3)	74.33	15.37 (3)	64.25	15.87 (3)	64.30
4.	Chemicals and Petroleum	7.27 (4)	82.72	6.53 (4)	79.83	6.65 (4)	80.98	10.06 (4)	74.31	8.60 (4)	72.90
5.	Non-metallic Minerals	4.58 (5)	87.30	5.91 (5)	85.74	4.06 (6)	85.04	7.97 (5)	82.28	7.51 (5)	80.41
6.	Iron and Steel	3.93 (6)	91.23	3.39 (7)	89.13	4.24 (5)	89.28	4.50 (7)	86.78	5.12 (7)	85.53
7.	Leather and Rubber	3.31 (7)	94.54	4.33 (6)	93.46	3.66 (7)	92.94	6.20 (6)	92.98	6.30 (6)	91.83
8.	Paper and Printing	2.38 (8)	96.92	2.73 (8)	96.19	2.93 (8)	95.87	3.21 (8)	96.19	3.25 (8)	95.08
9.	Electricity	1.49 (9)	98.41	1.72 (9)	97.91	2.85 (9)	98.72	2.19 (9)	98.38	2.73 (9)	97.81
10.	Cement	0.89(10)	99.30	1.03(11)	98.94	0.89(10)	99.61	0.99(10)	99.37	1.02(11)	98.83
11.	Non-ferrous Metals	0.70(11)	100.00	1.06(10)	100.00	0.39(11)	100.00	0.63(11)	100.00	1.17(10)	100.00
	Gross Output of Manufacturing Branch Rs. 100 =	2,88,515		3,01,823		3,84,511		4,12,264		5,97,005	

* Average of the rank obtained by the sector in the individual year is shown in brackets.

4.1.2 *Sectoral Shares in Final Demands*

We shall now consider the relative position of the sectors with reference to final demand. Table 4.1.2 presents the sectoral percentage shares of final demand for the five time points covering the period 1951 to 1963. In this Table also the sectors are ranked on the basis of the decreasing magnitude of the percentage share and are arranged on the basis of the average of the rank obtained by each sector in the individual year and the cumulative percentage shares over sectors are worked out.

The picture of the sectoral shares of final demand, as revealed by the table, does not show any radical change in the pattern over the years. During the period, Agriculture (1), Food, Drinks and Beverages (4), Construction (10) and Textiles (5) sectors which get the first four ranks respectively with reference to their shares in gross output as noticed earlier also obtain the same ranks with reference to their shares in final demand and stand out as the most important sectors cumulatively contributing more than 80 per cent to the final demand of the economy.

Since the behaviour of final demand and gross output is normally sympathetic in the sense that an increase in final demand is associated with an increase in gross output, we should consider the final demand shares with reference to the gross output shares. However, since our final demand data have been non-autonomously obtained as residual, after deducting interindustry demand from sectoral gross output, it would not be proper to dwell on the relationship between final demand and gross output over time at the sectoral level.

Considering the important sectors individually for their shares of final demand it is seen that the share of Agriculture (1) and Textile (5) sectors has increased while that of Food, Drink and Beverages sector (4) has gone down. A sharp increase in the trend of the final demand shares is observed in the case of the fifth ranking sector of Metallic Products and Machinery (13); on the contrary an equally sharp decline is noticed in the case of the third ranking sector of Construction (14). All the remaining sectors of the manufacturing branch of the economy show a little increase in their percentage shares of final demand except the two Mining sectors (2 and 3). But since the manufacturing activity has a small share in the final demand of the economy such increases or decreases are not expected to result in any significant change in the composition of final demand.

4.1.3 *Final Demand Shares in Gross Output Levels*

The sectoral compositions of gross output and final demand will not by themselves enlighten us much about the picture of sectoral changes in the economy. For this purpose we shall have to relate one to the other and see

Table 4.1.2 : SECTORAL SHARES OF FINAL DEMAND AT 1952-53 PRICES IN THE INDIAN ECONOMY

Rank*	Sectors	1951-52		1953-54		1959		1960-61		1963	
		Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share	Percentage Share	Cumulative % Share
1.	Agriculture	51.77 (1)	51.77	55.91 (1)	55.91	56.15 (1)	56.15	53.53 (1)	53.53	56.72 (1)	56.72
2.	Food, Drinks and Beverages	14.44 (2)	66.21	13.38 (2)	69.26	11.36 (2)	67.51	11.17 (3)	64.70	9.69 (2)	66.41
3.	Construction	9.87 (3)	76.08	9.56 (3)	78.85	8.14 (4)	75.65	13.74 (2)	78.44	4.46 (5)	70.87
4.	Textiles	7.63 (4)	83.71	7.31 (4)	86.16	9.06 (3)	84.71	9.11 (4)	87.55	8.66 (3)	79.53
5.	Metallic Products and Machinery	1.48 (8)	85.19	1.01 (9)	87.17	4.76 (6)	89.47	6.11 (5)	93.66	7.08 (4)	86.61
6.	Other Transport	4.10 (6)	89.29	4.22 (5)	91.39	4.79 (5)	94.26	1.56 (8)	95.22	2.10 (9)	88.71
7.	Railway Transport	4.17 (5)	93.46	2.94 (6)	94.33	3.38 (7)	97.64	1.82 (7)	97.04	0.69(12)	89.40
8.	Leather and Rubber	1.12 (9)	94.58	1.32 (8)	95.65	0.97 (8)	98.61	1.94 (6)	98.98	2.29 (7)	91.69
9.	Paper and Printing	0.70(11)	95.28	0.74(11)	96.39	0.82 (9)	99.43	0.96 (9)	99.94	1.04(11)	92.73
10.	Non-metallic Minerals	0.68(12)	95.96	0.79(10)	97.18	0.61(10)	100.04	0.47(11)	100.41	2.09 (8)	94.82
11.	Other Industries	2.34 (7)	98.30	2.44 (7)	99.62	0.23(13)	100.27	-	100.41	3.53 (6)	98.35
12.	Chemicals and Petroleum	0.83(12)	99.13	0.15(14)	99.77	-0.31(17)	99.96	0.88(10)	101.29	1.38(10)	99.73
13.	Electricity	0.29(15)	99.42	0.35(12)	100.12	0.28(11)	100.24	0.15(12)	101.44	0.44(14)	100.17
14.	Coke and Coal	0.29(13)	99.71	0.21(13)	100.33	0.10(14)	100.34	0.09(13)	101.53	0.15(15)	100.32
15.	Other Mining	0.51(13)	100.22	-0.07(15)	100.26	0.24(12)	100.58	-0.26(15)	101.27	0.12(16)	100.44
16.	Cement	-0.08(17)	100.14	-0.10(18)	100.16	-0.00(15)	100.58	-0.00(14)	101.27	-0.05(17)	100.39
17.	Non-ferrous Metals	-0.04(16)	100.10	-0.08(16)	100.08	-0.14(16)	100.44	-0.43(16)	100.84	-0.92(18)	99.47
18.	Iron and Steel	-0.10(18)	100.00	-0.08(17)	100.00	-0.44(18)	100.00	-0.84(17)	100.00	0.53(13)	100.00
	All Sectors, Rs.100 =	7,13,708		7,97,160		8,90,442		9,15,526		11,08,022	

* Average of the rank obtained by the sector in the individual year is shown in brackets.

whether the sector's twin usage of its gross output for final consumption and interindustry use is changing over time, as was considered for the whole economy in the earlier chapter. Table 4.1.3 presents sectorwise final demand shares in the gross output levels and their complement, the interindustry demand shares, for the five time points. The sectors are again ranked on the basis of the decreasing magnitude of the percentage share of final demand and are arranged on the basis of the average of the rank obtained by each sector for the individual year. The table does not include the Transport sectors (16 and 17) and the Other Industries sector (18) as their breakup use-wise is not available. Since final demand is nonautonomously derived by deducting interindustry demand from the sectors' gross output, negative final demand is indicated by asterisk in the table.

The bottom row of the table for total economy shows that the share of final demand in the gross output is of the order of 65 per cent and this share is almost stagnant or at best shows only a marginal change over the years. If we consider total economy excluding Agriculture (1), the change in the share of final demand shows a decrease over time indicating a larger interindustry use of the gross output in the non-agriculture sectors of the economy, particularly for the year 1963. We have already noted this total situation from the interindustry use-end in section 3.2. But our main interest here is the changing sectoral picture of the distribution of gross output between final demand and inter-industry demand over time.

Looking at the final demand shares in gross outputs of different sectors it is noticed that between 1951-52 and 1963 Agriculture (1), Non-Metallic Minerals (8) and Metallic Products and Machinery (13) sectors show substantial increases in their shares. Chemicals and Petroleum (9) is the only sector whose share remains almost the same. Construction (14) being a service sector has almost 100 per cent final demand share and hence the question of change in its share does not arise. All other sectors show a decline in their shares of final demand in gross output and these decreases are quite substantial. This clearly shows that in the manufacturing sectors the share of interindustry demand to gross output has increased indicating the growth of such industries during the period as revealed in the second part of the above table.

A further consideration of the bisection of the sectors' outputs into final demand use and interindustry use also helps to explain the apparent stagnancy in the share of interindustry use in gross output in the total economy. It has been noted that the Agriculture sector has more than 50 per cent share in the total final demand while the truly manufacturing sectors cover even less than 25 per cent of it. Any decline brought about in the final demand share in the gross output in the manufacturing sectors gets compensated by the increased share of

Table 4.1.3 : FINAL AND INTERINDUSTRY USE OF SECTORAL GROSS OUTPUTS (PERCENTAGES)

Rank@	Sector	Final Demand/Gross Output					Interindustry Demand/Gross Output				
		1951-52	1953-54	1959	1960-61	1963	1951-52	1953-54	1959	1960-61	1963
1.	Construction	100.00	100.00	100.00	100.00	99.81	0.00	0.00	0.00	0.00	0.19
2.	Food, Drinks and Beverages	86.42	87.70	81.91	90.79	77.31	13.58	12.30	18.09	9.21	22.69
3.	Textiles	74.51	74.47	80.66	93.77	63.83	25.49	25.53	19.34	6.23	36.17
4.	Leather and Rubber	83.43	80.56	61.47	69.60	67.46	16.57	19.44	38.53	30.40	32.54
5.	Metallic Products and Machinery	41.66	37.69	68.07	88.24	82.89	58.34	62.31	31.93	11.76	17.11
6.	Paper and Printing	72.39	71.19	64.92	66.37	59.47	27.61	28.81	35.08	33.63	40.53
7.	Agriculture	61.52	61.60	63.18	73.63	69.05	38.48	38.40	36.82	26.37	30.95
8.	Electricity	48.23	54.38	22.71	15.39	30.09	51.77	45.62	77.29	84.61	69.91
9.	Non-metallic Minerals	36.94	35.50	35.00	13.19	51.64	63.06	64.50	65.00	86.81	48.36
10.	Chemicals and Petroleum	28.28	6.09	*	19.50	29.66	71.72	93.91	110.63	80.50	70.34
11.	Coke and Coal	32.86	23.62	12.64	9.79	13.04	67.14	76.38	87.36	90.21	86.36
12.	Other Mining	25.43	*	31.48	*	13.32	74.57	105.14	68.52	142.40	86.68
13.	Iron and Steel	*	*	*	*	19.08	106.45	106.12	124.42	141.27	80.92
14.	Cement	*	*	*	*	*	121.28	125.41	101.34	100.02	109.20
15.	Non-ferrous Metals	*	*	*	*	*	113.86	119.27	183.32	251.42	246.05
	15 Sector Total	65.09	64.34	64.62	72.66	65.72	34.91	35.66	35.38	27.34	34.28
	Total Economy	66.27	65.29	65.48	N.A.	65.24	33.73	34.71	34.52	N.A.	34.76
	Total Economy excluding Agriculture	75.92	74.07	73.74	70.73	63.09	24.08	25.93	26.26	29.27	36.91

@ Average of the rank obtained by the sector in the individual year, on the basis of the decreasing magnitude of final demand share in gross output.

* Indicates negative final demand.

Agriculture sector from 61.52 to 69.05 per cent. Further since the weight of Agriculture sector being quite high, the above increase mops up all the change in the manufacturing sectors leading to an almost constant share of interindustry use in the gross output of the total economy.

To sum up, either from the point of view of the share in gross outputs or that in final demands, the economy continues to be dominated by Agriculture (1), and agrobased sectors of Food, Drinks and Beverages (4) and Textiles (5), Construction (14) and Transport (16 and 17). And most of these sectors show a declining trend in the shares, with the exception of Textiles (5) which shows an increasing trend in its shares both of gross output and final demand and Agriculture (1) which shows an increasing one in its share of final demand. Alongside these traditional, final demand oriented sectors which are getting modernised, there exists the modern industrial subeconomy which is growing over the years establishing linkages with the rest of the economy and enhancing intersectoral interdependence among the sectors. In the following section we shall consider the degree of the intersectoral interdependence and the interindustry linkage structures.

4.2 *Changing Pattern of Sectoral Interdependence and Interindustry Linkage Structures*

In Section 3.2 of the preceding chapter we considered the changing pattern of intersectoral interdependence and analysed the same by the well known Chenery-Watanabe tetrapartite classification based on U,W. statistics. We also referred to the identification of the four categories with reference to the concept of linkage developed by growth economists (Hirschman, 1958) as a criterion for selecting "key sectors" in the context of building a developmental strategy in general and investment decisions in particular, for economic development.

The economists specifically identify two "inducement mechanisms" that may encourage production activities in developing countries. As elucidated by Yotopoulos and Nugent (1973), firstly, a "non-primary" activity, i.e., the one that uses significant amounts of intermediate inputs from others, should be expected to induce attempts to supply these inputs by expanding domestic production. This has been termed as the backward linkage effect. On the other hand, an activity that is "non-final", i.e., the one that does not cater exclusively to final demand should be expected to induce attempts at the utilization of its ouputs as inputs in some other or new activities. This is termed as the forward linkage effect. These linkages are direct and are based on the direct flows of the input-output table. Besides these two, a third one which considers the higher order effects arising from the expansion of activities which provide inputs to "non-primary" activity that induced backward linkage has also been

defined. This is the "direct and indirect linkage" effect, which is often, inappropriately called as the "total linkage" effect.

The quantitative analysis of sectoral interdependence obtained from input-output tables by Chenery and Watanabe has provided the operational measures for backward and forward linkages which we note below:

$$BL_j = \frac{\sum_{i=1}^{n} x_{ij}}{X_j} = U_j$$

defines the backward linkage effect as the ratio of intermediate input of sector j to total input of the said sector.

$$FL_i = \frac{\sum_{j=1}^{n} x_{ij}}{X_i} = W_i$$

defines the forward linkage effect as the ratio of intermediate demand for output of sector i to the total demand for the said sector. The composite index of direct and indirect linkage effects is defined in terms of interdependence coefficients or Leontief inverse elements, derived from the input-output coefficient matrix as

$$TL_j = \sum_{i=1}^{n} a^*_{ij} \qquad \text{where } a^*_{ij} = (1 - a_{ij})^{-1}$$

It may be noted that "the direct plus indirect linkage effect as defined above captures not only the backward effects but also something in the way of forward effects as well. It is well known that the inverse of the Leontief matrix can be approximated by

$$(1 - A)^{-1} = I + A + A^2 + A^3 + \ldots$$

The multiplication of A matrices to obtain A^2 etc., in the above involves forward linkage to the extent that going backward *ad infinitum* in a closed system also captures forwards effects".(Yotopoulos, 1973, p. 162.)[7] Secondly, the above linkage effect is expressed in terms of per unit output and the sectoral composition of total production has not been taken account of by appropriate weighting diagram. The simplest method of weighting according to sectoral share in total output is due to Rasmussen (1956), who defines "power of dispersion" index as

$$Y_j = \frac{1/n \sum_{i=1}^{n} a^*_{ij}}{1/n^2 \sum_{i=1}^{n} \sum_{j=1}^{n} a^*_{ij}} = \frac{n \sum_{i=1} a^*_{ij}}{\sum_{i=1} \sum_{j=1} a^*_{ij}}$$

This index consists of "normalising" the direct and indirect linkage TL_j with respect to the number of sectors (n), the column sum of interdependence coefficients $(\sum_{i=1}^{n} a^*_{ij})$ and the average of all interdependence coefficients $(\sum_{j=1}^{n} a^*_{ij})$. In other words this index gives the ratio of the average direct and indirect input dependence of the specific sector j on every other sector i to the average direct and indirect input dependence of any sector on any other sector in the total economy. The measure Y_j is convenient in interpreting the linkage coefficients as it measures the effects of increased output of one sector relative to those of all sectors. If the value of Y_j for a sector is smaller than unity, the sector transmits only weak output inducements for the economy. On the other hand if the value is greater than unity, then the sector transmits above average inducements to other sectors.

The above direct and indirect linkage effect has been termed in literature as "direct and indirect backward linkage" effect and analogously "direct and indirect forward linkage" effect has been defined as the row sum of interdependence coefficients or the elements of Leontief inverse of input-output coefficient matrix i.e. $(\sum_{j=1}^{n} a^*_{ij})$ and further its normalised version has also been defined by Rasmussen, termed as "index of the sensitivity of dispersion" or "forward power of dispersion" (Wuu-Long Lin, 1975). However, defining direct and indirect forward linkage effect using the elements of A^* on the analogy of backward linkage, in our view, is logically unsound and is not really meaningful though a number of researchers have worked with this measure (Panchamukhi, 1976). While the inverse elements of a given column used in the backward linkage concept are additive, the elements of a given row are not so. The greater the number of sectors into which an economy is divided, the greater will be the sum of inverse coefficient elements in a given row, while the column sum is independent of the number of sectors. Even dividing the sum of row elements by the number of sectors is not of any help unless it is assumed that all the sectors are equally important, an assumption which is far from reality. Thus to divise direct and indirect forward linkages on the analogy of backward linkages is not logically correct. Rasmussen who devised these simple measures was careful in interpreting

the measure and clearly pointed out the limitations and suggested a weighted measure for working out the forward linkages. Nonetheless, in the literature the sum of the inverse elements of a row as the direct and indirect forward linkage is used by many workers because of its simplicity though it lacks rational basis.

The correct way, in our view, to evaluate the forward linkages is to use the direct flows of the transaction matrix and not the coefficients of A or A* matrix. If one desires to work with coefficients rather than transactions, a coefficient matrix constructed such that the row sum of coefficients, including final demands, is unity needs to be used. It must be pointed out that such a "row coefficient matrix", however, is not useful for evaluating the direct and indirect backward linkages, just as the familiar A coefficient matrix cannot be used for evaluating direct and indirect forward linkages. We have therefore not considered the forward linkage measure based on inverse elements of the familiar A matrix.

In the analysis of the linkages between the different sectors of the economy, as is clear from the above discussion, only the linkages of the current inputs (i.e. of A matrix) is considered. Naturally in such an analysis sectors which are of capital goods' nature do not figure in. For a total appreciation of the sectoral linkages it is necessary to integrate the capital inputs also. This requires the capital coefficient matrices (i.e. B matrices) which unfortunately are not available for our analysis in this study presented below. Hence this limitation of the non-inclusion of the linkages of the capital coefficients needs to be borne in mind.

4.2.1 *Direct Backward and Forward Linkage Structures in the Economy*

In Table 4.2.1(a) we present the backward and forward linkage coefficients based on direct flows together with their ranks ascribed on the basis of the decreasing order of the coefficient values for each sector, for the four time points. The sectors of Construction (14) and Other industries (18) are omitted. The table also presents for each sector the Chenery-Watanabe category to which it belongs in the tetrapartite classification.

Since by definition all primary production should exclude any substantial linkage effects, it is seen that Agriculture (1) and the two Mining sectors (2, 3) receive very poor ranking over all the points of time. On the other hand the agro-based sectors of Food, etc. (4) and Textiles (5) show substantial backward linkages with very high rankings. The sectors of Nonferrous Metals (12), Other Transport (17), Iron and Steel (11) and Cement (10) also fall in the first quartile of direct backward linkage ranks. Of the above sectors in the first quartile of ranks, Food (4), Textiles (5) and Other transport (17) show

very poor forward linkage effects and occupy places in the last quartile of direct forward linkage ranks as they mostly cater to final consumption demand. The sectors of Railway Transport (16), Leather and Rubber (7), and Metal Products and Machinery (13) which also occupy places in the last quartile of forward linkage ranks are also known to cater to final demand. The basic industrial sectors of Nonferrous Metals (12), Iron and Steel (11) and Cement (10) occupy ranks in the first quartile of direct backward linkage ranks are found to occupy ranks in the first quartile of direct forward linkage ranks also. These sectors as we know belong to Chenery-Watanabe category of Intermediate Manufacture and constitute the top ranking sectors in the Hirschman's ranking scheme for development strategy.[8]

The above cross comparison of the sectors falling in the first quartile of the backward and last quartile of the forward linkage ranks showed that a good many of the sectors in both the sets cater to final demand requirements. This is statistically substantiated by the rank correlation coefficients between direct backward and forward linkages presented in table 4.2.1(b). The forward and backward linkages are poorly correlated indicating that the sectors that have large input dependence are not large input suppliers.

It is also observed from Tables 4.2.1(a) and (b) that there is very little change in the overall rank order of the sectors over the years and the production structures seem to have maintained more or less uniform linkage structures as revealed by the high, positive intertemporal rank correlation coefficients. Between the two linkage types, the said correlation coefficients are of a higher order for forward linkage ranks, indicating that forward linkage structure has remained more rigid than the backward for any change. It is further observed that with the growth in the economy and increasing interdependence of the sectors over time noted earlier, the level of linkage coefficients of both types is seen to be increasing for most of the sectors.

The above general observations do not preclude the differential behaviour in respect of a set of important sectors with reference to their linkage effects. It will be observed from the Table 4.2.1(a) again that in respect of Nonmetallic Minerals (8), Chemicals and Petroleum (9), Cement (10), Iron and Steel (11) and Metallic Products and Machinery (13) sectors, their increasing trend of backward linkages is associated with decreasing trend of forward linkages. In this context it may be noted that it is these sectors which have shifted their position in the tetrapartite Chenery-Watanabe classification from 1959 time point onwards from Intermediate primary production category to Intermediate Manufacture, with the exception of the last named sector of Metallic Products and Machinery (13) which moves through all the successive stages of the

Table 4.2.1(a) : DIRECT BACKWARD (BL_j) AND FORWARD (FL_i) LINKAGE COEFFICIENTS TOGETHER WITH THEIR RANK ORDER THE CHENERY-WATANABE CLASS FOR EACH SECTOR

Sector	1951-52			1953-54			1959			1963		
	Chenery Class	100 BL_j	100 FL_i	Chenery Class	100 BL_j	100 FL_i	Chenery Class	100 BL_j	100 FL_i	Chenery Class	100 BL_j	100 FL_i
1. Agriculture	IV	28.89(10)	38.48(10)	IV	28.49(11)	38.40(10)	IV	28.94(13)	36.21(10)	IV	22.47(14)	30.95(13)
2. Coke and Coal	I	20.06(14)	67.14 (6)	I	15.23(15)	76.38 (6)	I	19.94(14)	87.36 (5)	I	22.84(13)	86.96 (3)
3. Other Mining	I	6.69(16)	74.54 (4)	I	8.10(16)	105.14 (4)	I	14.55(16)	68.52 (7)	I	20.32(15)	86.67 (4)
4. Food, Drinks and Beverages	III	57.51 (1)	13.58(15)	III	58.94 (1)	12.30(15)	III	47.22 (5)	18.09(15)	III	67.51 (1)	22.69(14)
5. Textiles	III	46.67 (3)	25.49(12)	III	47.19 (4)	25.53(12)	III	50.75 (4)	19.34(14)	III	54.44 (4)	36.17(11)
6. Paper and Printing	IV	26.97(11)	27.61(11)	IV	24.74(12)	28.81(11)	III	40.94 (8)	35.08(11)	IV	37.47(12)	40.53(10)
7. Leather and Rubber	III	38.13 (5)	16.57(14)	IV	36.16 (9)	19.43(14)	III	40.19 (9)	38.53 (9)	III	48.99 (6)	32.54(12)
8. Non-metallic Minerals	I	21.98(13)	63.06 (7)	I	22.37(13)	64.50 (7)	II	39.03(10)	65.00 (8)	II	47.56 (8)	48.36 (9)
9. Chemicals and Petroleum	I	22.85(12)	71.72 (5)	I	37.85 (7)	93.91 (5)	II	45.41 (6)	110.63 (3)	II	45.81 (9)	70.34 (6)
10. Cement	I	35.47 (6)	121.29 (1)	I	36.96 (8)	125.41 (1)	II	52.72 (3)	101.34 (4)	II	56.27 (2)	109.20 (2)
11. Iron and Steel	I	32.55 (8)	106.45 (3)	II	43.64 (5)	106.12 (3)	II	60.42 (2)	124.42 (2)	II	55.32 (3)	80.92 (5)
12. Non-ferrous Metals	II	56.93 (2)	113.86 (2)	II	49.98 (3)	119.27 (2)	II	60.69 (1)	183.32 (1)	II	47.89 (7)	246.05 (1)
13. Metallic Products and Machinery	I	31.42 (9)	58.34 (8)	II	38.13 (6)	62.31 (8)	III	33.70(11)	31.93(12)	III	41.46(10)	17.11(15)
15. Electricity	I	33.65 (7)	51.77 (9)	I	31.21(10)	45.61 (9)	I	30.76(12)	77.29 (6)	I	39.45(11)	69.91 (7)
16. Railway Transport	IV	18.98(15)	18.33(13)	IV	21.39(14)	24.51(13)	IV	15.36(15)	25.48(13)	IV	15.16(16)	51.32 (8)
17. Other Transport	III	45.07 (4)	13.40(16)	III	54.22 (2)	11.27(16)	III	44.60 (7)	12.14(16)	III	49.50 (5)	4.25(16)

Rank order of sectors is indicated in brackets.

Table 4.2.1(b) ; RANK CORRELATION COEFFICIENTS OF DIRECT BACKWARD AND FORWARD LINKAGES

Year	*Rank correlation coefficient between forward and backward linkages*	*Intertemporal Rank Correlation Coefficients of Backward Linkages*			*on Forward Linkages*		
		1953-54	*1959*	*1963*	*1953-54*	*1959*	*1963*
1951-52	-0.25588	0.87352	0.74118	0.79412	1.00000	0.88235	0.83235
1953-54	-0.20588		0.76765	0.78529		0.88235	0.83235
1959	+0.25882			0.84706			0.85294
1963	-0.14118						

production cycle during the period, starting from Intermediate Primary Production to Final Manufacture *via* Intermediate Manufacture. This shift may indicate a contraction in the forward linkage effect on account of greater processing of the output within the sector into intermediate manufactures rather than supplying the same to other sectors.

4.2.2 *Direct and Indirect Linkage Structures*

We shall now consider the direct and indirect linkage structures based on interdependence coefficients derived from the Leontief inverse of the input-output coefficient matrix. Table 4.2.2(a) presents the direct and indirect linkage coefficients (TL_j) together with their ranks ascribed on the basis of the decreasing order of the coefficient value for each sector for the four time points. The table also presents Rasmussen's "power of dispersion" Index (Y_j) which has been defined in 4.2 earlier. Table 4.2.2(b) presents rank correlation coefficients of direct and indirect linkage coefficient (TL_j) with direct backward linkage coefficient (BL_j) presented in table 4.2.1(a) for different time points. It also presents the intertemporal rank correlation coefficients of direct and indirect linkage coefficient (TL_j).

Considering the sectors that figure in the first and last quartile of the direct and indirect linkage ranks we find the same set of sectors that figured earlier in connection with the direct backward linkage ranks. In fact the rank correlation coefficients between the direct and indirect linkage (TL_j) and the direct backward linkage (BL_j) for different time points are very large and positive indicating that the former very much reflects the latter.

As in the case of direct linkages, the level of direct and indirect linkage coefficients is also increasing for almost all the sectors and sectoral ordering of the linkage ranks does not show any significant changes over the years. The very high and positive intertemporal rank correlation of direct and indirect linkages between time points indicates that the technological and production structures have maintained more or less a uniform linkage structure over the period. A comparison of the set of intertemporal rank correlation coefficients of direct and indirect linkages with that of direct backward linkages shows that linkage structures based on direct and indirect flows are more similar than those based on direct flows, except for the year 1959.[9] The rank correlation coefficients for the year 1959 with any other year are relatively smaller in magnitude within the two sets. But between the sets the said correlations for 1959 based on direct and indirect linkages are smaller than those based on direct backward linkages. In this context it may be noted that intertemporal similarity of linkage structures is the resultant of several factors such as changes in relative prices, product-mix and technology. Though, on the whole these factors

Table 4.2.2(a) ; DIRECT AND INDIRECT LINKAGE COEFFICIENTS (TL_j) AND RASMUSSEN'S POWER OF DISPERSION INDEX(Y_j)

		Direct and Indirect Linkage Coefficients(TL_j)				*Power of Dispersion Index (Y_j)*			
		1951-52	*1953-54*	*1959*	*1963*	*1951-52*	*1953-54*	*1959*	*1963*
1.	Agriculture	141.22(10)	140.62(11)	141.76(13)	130.34(15)	96.05	92.32	87.54	77.38
2.	Coke and Coal	127.10(14)	121.04(15)	129.21(14)	130.61(14)	86.45	79.47	79.79	77.54
3.	Other Mining	108.58(16)	110.69(16)	121.24(16)	133.74(13)	73.85	72.67	74.87	79.70
4.	Food, Drinks and Beverages	184.44 (1)	185.98 (1)	170.46 (6)	200.98 (1)	125.45	122.11	105.27	119.32
5.	Textiles	173.25 (3)	175.02 (3)	179.97 (4)	196.35 (2)	117.84	114.91	111.14	116.57
6.	Paper and Printing	137.32(11)	135.46(12)	165.52 (8)	159.91(11)	93.40	88.94	102.21	94.94
7.	Leather and Rubber	157.39 (5)	156.22 (8)	164.58 (9)	184.45 (6)	107.05	102.57	101.63	109.51
8.	Nonmetallic Minerals	128.97(13)	131.18(13)	157.23(10)	172.57(10)	87.72	86.12	97.10	102.39
9.	Chemicals and Petroleum	132.25(12)	158.30 (7)	174.16 (5)	176.21 (8)	89.95	103.93	107.55	104.61
10.	Cement	147.54 (6)	149.88 (9)	182.52 (3)	185.97 (5)	100.35	98.40	112.71	110.41
11.	Iron and Steel	146.80 (8)	165.18 (5)	191.00 (2)	189.29 (3)	123.76	108.45	117.95	112.38
12.	Non-ferrous Metals	181.96 (2)	172.00 (4)	191.01 (1)	184.40 (7)	100.00	112.93	117.96	109.48
13.	Metallic Products and Machinery	174.02 (7)	160.99 (6)	155.08(11)	173.88 (9)	100.00	105.70	95.77	103.23
15.	Electricity	145.33 (9)	142.04(10)	142.21(12)	158.14(12)	98.85	93.26	87.82	93.89
16.	Railway Transport	126.54(15)	131.02(14)	123.27(15)	124.45(16)	86.07	86.02	76.12	73.88
17.	Other Transport	160.59 (4)	175.69 (2)	168.76 (7)	188.60(10)	109.23	115.35	104.22	111.97

Rank order of sectors is indicated in brackets.

Table 4.2.2(b) : BANK CORRELATION COEFFICIENTS OF DIRECT AND INDIRECT LINKAGES

Year	*Rank correlation coefficient between direct and indirect linkage (TL_j) with direct backward linkage (BL_j)*	*Intertemporal Rank Correlation Coefficient of direct and indirect linkage (TL_j)*		
		1953-54	*1959*	*1963*
1951-52	0.98824	0.90294	0.70882	0.81471
1953-54	0.99118		0.75000	0.86471
1959	0.99412			0.81765
1963	0.95588			

seem to have operated in a mutually counterbalancing manner so that sectoral ordering by linkages has not changed over time significantly, the above results for the year 1959 seem to indicate that perhaps it was a sort of a watershed receiving old trends and transmitting new departures. The trends in the shares of gross outputs and those of shares in final demand given in Table 4.1.1(a) and Table 5.1.2 also support the above finding about the year 1959.

4.3 *Sector Level Changes in Technology*

Earlier in Section 3.3.2 we strayed into a consideration of changes in the sector level aggregate input coefficients by using Tilanus method of coefficient of variation and tried to gauge the changes that have taken place over the period in the aggregate input coefficient of each of the sectors. The analysis revealed that there is no pronounced change in the sector level aggregate input coefficient over time. However, in view of the crudity of approach, which possibly might have confounded the individual input changes because the coefficient of variation as an indicator of change, for individual inputs within a sector is not only large for almost all of them but very large for many of them when compared with that for the aggregate input coefficient as revealed by Table 3.3.3(a), we felt that an in-depth probing is necessary. We attempt to do it here.

It is necessary at the outset to distinguish two aspects of change in the flows of input-output table over time. On the production side change means a variation in the methods of production and therefore a change in the quantities and qualities of goods which may be produced out of a given amount of them. This is technological change and is analysed by the "input approach". On the distribution side, change means a variation in the share of interindustry demand over time of goods so produced. This latter is not strictly technological change but is the

opposite side of the same coin and is analysed by the "output approach". In this section we study the production side of change at the sector level with the help of technical coefficient matrices by using the following three measures. The other aspect of changing shares of inter-industry demand in sectoral outputs will be dealt with in the subsequent section as a parallel analysis on both approaches helps a deeper and more general insight into the nature of change in the economy.

Before we consider the measures to evaluate the differential patterns of technological change between sectors of the economy in terms of coefficient differences it is important to bear in mind the following besides others. Firstly the base year technological vintage of the different sectors and the different industries comprising them is not the same and they are not exposed during our period to technological changes uniformly and receive a uniform quantum of it. In fact there is planning activity going on during the period, providing differential targets of growth for different industries. Besides the technological change in individual industries or sectors there are forces that affect technological change across a broad industrial front. Most industries benefit from the growth of the whole economy. Progress in certain strategic industries benefits all. Certain types of new products developed by producer industries, say machinery manufacturing, have broad applications across industry lines. Such pervasive and linked changes in technology probably spread with a time lag. In view of these therefore, it is necessary to realise that the picture of technological change that emerges is a highly complex one. We do not venture here to disentangle the same and explain the causes of technological change, but modestly attempt to evaluate and describe as far as we can the sectoral patterns of technological change with the help of the measures available in literature which are considered below.

4.3.1 *The Three Measures of Technological Change*

We have already referred in Section 3.3.1 to the "absolute column measure" developed by Chenery and Watanabe to study the type of production, sector by sector. This index measures the degree of similarity or change in the input structures. If two input structures are identical the index will be zero and if the inputs are completely uncorrelated it will have an upper limit of 2.0. Table 4.3.1 presents for each of the 14 sectors the values of the Chenery Index γ_j for the six time point comparisons. We have omitted the consideration of sectors on Construction (14), Transport (16, 17) and Other Industries (18) because of their lack of comparability over time on account of differential coverage, etc.

In Section 3.3.3 we estimated technological change in production for the economy as a whole by using Maria

Table 4.3.1 : SECTORAL VALUES OF TECHNOLOGICAL CHANGE ON Y_j INDEX

	Comparison Years	*1951;1953*	*1959;1963*	*1953;1959*	*1951;1959*	*1953;1963*	*1951;1963*
	Gap Years	*2*	*4*	*6*	*8*	*10*	*12*
	Sector						
1.	Agriculture	0.0268*	0.2689*	0.0702*	0.0779*	0.2828*	0.2886*
2.	Coke and Coal	0.2943	0.8569@	0.8055@	0.5943*	1.2975@	1.1078@
3.	Other Mining	0.2455	1.6688@	0.9541@	1.0224@	1.5079@	1.5055@
4.	Food, Drinks and Beverages	0.0964*	0.4209*	0.4487*	0.3583*	0.2919*	0.2268@
5.	Textiles	0.0553*	0.6613*	0.4325*	0.4342*	0.4390*	0.4180*
6.	Paper and Printing	0.1169*	0.5035*	0.6321*	0.6001*	0.5897*	0.5911*
7.	Leather and Rubber	0.1377*	0.5180*	0.3336*	0.3935*	0.5326*	0.4927*
8.	Non-metallic Minerals	0.2142	0.7623	0.7285	0.8034	1.0580@	1.1631@
9.	Chemicals and Petroleum	0.4942	0.6886*	0.5306*	0.7933	0.5699*	0.7314*
10.	Cement	0.1071*	0.7240*	1.2564@	1.2284@	1.1047@	1.1236@
11.	Iron and Steel	0.3268	0.7991	0.8555	1.0705	0.4881*	0.6687*
12.	Non-ferrous Metals	0.1571*	1.0748	0.4534*	0.4316*	0.8751	0.9367
13.	Metal Products and Machinery	0.2624	0.9744@	0.9002@	0.9175@	0.5616*	0.6347*
15.	Electricity	0.1910*	0.3616*@	1.0994@	1.2087@	1.1606@	1.2602@
	14 Sector Mean	0.1947	0.7345	0.6786	0.7096	0.7685	0.7964
	18 Sector Mean	0.1952	0.8067	0.7239	0.7619	0.8565	0.8756

* Below 14 sector mean value. @ Value shows $Y_j > \alpha_1$

Augustinovics measure α which, as has been noted there, combines all the cell level Leontief relative change indices (with modulus) in a single measure for the economy as a whole. In Table 4.3.2 are presented the segregated sector level values of technological change in production obtained on Maria Augustinovics formula after deleting summation and averaging over sectors/columns, viz.

$$\alpha_j^{b,c} = \frac{1}{n} \sum_{i=1}^{n} \frac{|a_{ij}^b - a_{ij}^c|}{1/2\ (a_{ij}^b + a_{ij}^c)}$$

where a_{ij} are the individual input coefficients and n is their number, and b and c are the two time points of comparison. The values of $\alpha_j^{b,c}$ indicate the average change (absolute) in the input requirement of the sector during the comparison period.

The above formulation gives an unweighted average of the ratios of all the input coefficient differences in a sector in the two time points. Comparing this with Chenery's "absolute column measure", viz.

$$\gamma_j^{b,c} = \frac{\sum_{i=1}^{n} |a_{ij}^b - a_{ij}^c|}{1/2 \sum_{i=1}^{n} (a_{ij}^b + a_{ij}^c)}$$ or in terms of

the transaction values of the flow table

$$\gamma_j^{b,c} = \frac{\sum_{i=1}^{n} \left| \frac{x_{ij}^b}{x_j^b} - \frac{x_{ij}^c}{x_j^c} \right|}{1/2 \sum_{i=1}^{n} \left(\frac{x_{ij}^b}{x_j^b} + \frac{x_{ij}^c}{x_j^c}\right)}$$ or

$$= \frac{\frac{1}{x_j^b} \sum_{i=1}^{n} x_{ij}^b - \frac{1}{x_j^c} \sum_{i=1}^{n} x_{ij}^c}{\frac{1}{2x_j^b} \sum_{i=1}^{n} x_{ij}^b + \frac{1}{2x_j^c} \sum_{i=1}^{n} x_{ij}^c}$$

Table 4.3.2 : SECTORAL VALUES OF TECHNOLOGICAL CHANGE ON α_j INDEX

	Comparison Years	*1951;1953*	*1959;1963*	*1953;1959*	*1951;1959*	*1953;1963*	*1951;1963*
	Gap Years	*2*	*4*	*6*	*8*	*10*	*12*
	Sector						
1.	Agriculture	0.4317	0.7145	0.9907	1.1347	1.1293	1.2622
2.	Coke and Coal	0.3255	0.6185*@	0.7910*@	0.8084*	0.9844@	1.0709@
3.	Other Mining	0.2686*	0.9856@	0.9481@	0.9353@	0.7614*@	0.8025*@
4.	Food, Drinks & Tobacco	0.1702*	0.7277*	0.7001*	0,6695*	0.8572*	0.8058*
5.	Textiles	0.3096*	0.9317	1.1124	1.1534	1.0503	1.0551
6.	Paper and Printing	0.1640*	0.8556	0.8395*	0.8087*	0.8166*	0.7730*
7.	Leather and Rubber	0.3970	0.7786*	0.5974*	0.7724*	0.9211*	0.7896*
8.	Non-metallic Minerals	0.3617	0.9533	1.1251	1.0670	1.0374@	1.1465@
9.	Chemicals and Petroleum	0.5315	0.8502	0.9814	0.9202	0.8986*	1.0549
10.	Cement	0.2027*	0.7741*	1.0777@	1.0522@	0.9859@	0.8829*@
11.	Iron and Steel	0.3396	0.8059*	1.0228	1.0976	0.7965*	0.9498*
12.	Non-ferrous Metals	0.4216	1.1015	0.6277*	0.5146*	1.2027	1.1131
13.	Metal Products and Machinery	0.3096*	0.9166@	0.7746*@	0.8464*@	0.9481*	0.9596*
15.	Electricity	0.2968*	0.3114@	0.9380@	1.0598@	0.9954@	1.0808@
	14 Sector Mean	0.3216	0.8089	0.8947	0.9172	0.9561	0.9819
	18 Sector Mean	0.3152	0.8096	0.9263	0.9697	1.0079	1.0424

* Below 14 sector mean value. @ Value shows $\gamma_j > \alpha_j$

it is important to note that the Chenery formulation is a ratio of the sum of individual coefficient differences in a sector to the average of the sum of the individual coefficients of the said sector, with an implicit weighting pattern reflecting the importance of each individual input difference. In fact Chenery and Watanabe explicitly state that they have "compared direct coefficients, weighted by production levels. ... The weighting procedure is not necessary when we are interested in differences by column, however, because each coefficient would have the same production level as weight."(1958, p. 498.) In the Augustinovics formulation, however, each input change in a sector is implicitly weighted equally. From this significant desideratum of the formulations we can advantageously infer that if

$$\gamma_j^{b,c} > \alpha_j^{b,c}$$

the more important or major inputs have undergone greater change, relatively though not exclusively. On the other hand, if

$$\alpha_j^{b,c} > \gamma_j^{b,c}$$

one can infer that new items of input have been introduced in the production process and/or minor inputs have gained prominance in the change.[10] This relationship gives us a criterion for defining a typology for technological change for different sectors.

Let us now consider the third measure which we are going to use. The two measures dealt with above indicate the absolute magnitude of technological change in the input coefficients of a sector and do not specify the direction of it. A consideration of the direction of technological change for a sector cannot avoid the 'netting' of positive and negative deviations of the different individual inputs comprising a sector. The measure we propose to consider here for studying the direction of technological change is based on Leontief's relative change index of coefficient differences without modulus.

In the earlier chapter, following Leontief we have fitted weighted frequency distributions to the relative change indices of coefficient differences with the average of the flow table transaction value of the individual input in the binary comparison as the weight of the relative change in the said input coefficient. We also noted there Leontief's rationale of weighting the relative change by its binary average size to nullify the effects of change in industrial classification between comparisons. Based on these desiderata Domar (1961) has formulated "Leontief's Index of Structural Change" by weighting the relative change index by the ratio of binary mean individual input transaction to the corresponding total. The weighted index for sector j can be written as -

$$-I_j = \sum_{i=1}^{n} \frac{a_{ij}^b - a_{ij}^c}{1/2\,(a_{ij}^b + a_{ij}^c)} \cdot \frac{1/2\,(x_{ij}^b + x_{ij}^c)}{1/2\,(\sum_{i=1}^{n} x_{ij}^b + \sum_{i=1}^{n} x_{ij}^c)}$$

where a_{ij} are the input coefficients, x_{ij}, the input values of the flow tables for the two time points b and c and n, the number of inputs in the sector. Obviously the first term on the right hand side is the Leontief measure of relative increase or reduction in inputs per unit of output, where change is taken relative to the mean input requirements between the two points of time. The second term weights these relative changes in individual inputs by the share of the mean individual to the mean total input requirements of the sector in the corresponding two time points.[11] It may be noted here that the $-I_j$ Index for any sector is nothing but weighted average of relative change indices for the sector obtained by sectorwise segregation of the Leontief frequency distribution fitted to the total economy (Leontief, 1953, p.31). The differences if any in the actual calculations will be due to the estimation of the one from the ungrouped and the other from the grouped data.

The values of $-I_j$ indicate increase or reduction in inputs per unit of output of the j^{th} sector between two time points b and c. If I_j is negative (i.e. if $-I_j$ is positive) then there has been a saving on inputs. "A negative change, i.e. a reduction in the input requirements per unit of output" according to Leontief (1953, p.28) "can be loosely described as an increase in productivity" indicating "technical progress", due to fuller use of materials and higher degree of processing etc. "The fact of technical progress" notes Tinbergen (1950, p. 27) "can easily be established if there is a reduction in the use of *each* of the factors of production". One such that we are considering here is the material inputs used in the process of production and not all the inputs or factors of production. And such "Partial productivity" changes, while useful for measuring the saving in particular inputs achieved over time, do not measure overall changes in production efficiency, since they are affected by changes in the composition of input, i.e., by factor substitution.

A positive I_j (i.e. negative of $-I_j$) on the other hand may be taken to indicate that new inputs or a new combination of them are being used in the production process so that the total input requirements of a sector per unit of output is increasing over the period. Also the product-mix might be changing over the period. As has been already pointed out, though in the context of a developed economy increasing input usage may indicate declining productivity, in a developing economy one expects a greater input usage indicating more and more round about and refined processing. This can be taken to indicate a second type of progress or technological advance viz. the modernization of final

products. However, a large positive value of I_j, even in the context of a developed economy need not be viewed as a catastrophic decline in productivity but as reflection of a change in the definition of the activity of the sector over the period.

Thus, based on the sign of the Index I_j we can define another typology of technological change, namely that due to reduction in input requirements per unit of output or "technical progress" and that due to increase in input requirements per unit of output due to round about and refined processing leading to "modernisation" of the final product.

Earlier we pointed out that the discrepancy in the values of technological change indices α_j and γ_j as due to the difference in their weighting diagram and considered the Leontief weighting system as reflecting the appropriate importance of the individual inputs for aggregating the relative change indices comprising a sector. We also noted that in the Chenery measure γ_j the individual input changes are implicitly weighted by the magnitude of such change ascribing a larger weight to an input showing a higher magnitude of change. The extent of concordance between these two weighting patterns will determine the extent to which the Chenery Index and the Domar-Leontief Index I_j i.e. Leontief weighted α_j will give the same values of technological change. In other words, if the percentage share of the individual input change to total change in a sector on the γ_j and I_j turn out to be similar, if not the same, we may conclude that the Leontief weighting system acts as a correcting factor to the discrepancy between γ_j and α_j. In view of this, under circumstances where only the technical coefficient matrices are available and not the transaction tables, one can use the Chenery formula for γ_j without modulus as a proxy for the Domar-Leontief Index I_j. Table 4.3.3 gives the values of I_j for the 6 comparison periods based on Domar-Leontief formulation.

4.3.2 *Pattern of Technological Change of Different Sectors in the Economy*

Let us now consider the results based on the three measures elaborated above and try to identify the patterns of technological change exhibited by different sectors of the economy.

4.3.2(a) *Typographies of Technological Change*

In our attempt to describe technological changes that accompany economic growth of the developing country on the assumption of the existence of a set of underlying processes that may interact in different ways in different sectors, we considered the measurement of technological change on the basis of three measures and also indicated two typologies in order to discover uniformities in their behaviour

Table 4.3.3 : SECTORAL VALUES OF TECHNOLOGICAL CHANGE ON I_j INDEX

Comparison years	*1951;1953*	*1959;1963*	*1953;1959*	*1951;1959*	*1953;1963*	*1951;1963*
Gap years	*2*	*4*	*6*	*8*	*10*	*12*
Sectors						
1. Agriculture	- .0138	- .2507	+ .0176	+ .0084	- .2318	- .2412
2. Coke and Coal	- .2721	+ .3358	+ .2704	+ .0096	+ .6483	+ .4072
3. Other Mining	+ .1893	+ .5917	+ .3949	+ .3758	+ .7792	+ .3710
4. Food, Drinks and Beverages	+ .0253	+ .3435	- .2800	- .1946	+ .1609	+ .1671
5. Textiles	+ .0110	+ .3084	+ .0882	+ .1403	+ .1916	+ .2040
6. Paper and Printing	- .0855	- .0276	+ .5185	+ .4393	+ .4646	+ .4032
7. Leather and Rubber	+ .0559	+ .2809	+ .1105	+ .0821	+ .3874	+ .3583
8. Non-metallic Minerals	+ .0235	+ .3612	+ .3023	+ .5863	+ .8771	+ .9753
9. Chemicals and Petroleum	+ .4937	+ .1343	+ .1886	+ .6749	+ .3075	+ .7656
10. Cement	+ .0428	+ .1705	+ .3993	+ .5276	+ .6016	+ .7123
11. Iron and Steel	+ .2851	+ .0665	+ .4324	+ .6909	+ .3647	+ .6445
12. Non-ferrous Metals	- .1196	+ .2517	+ .1114	+ .0280	+ .1494	+ .3469
13. Metal Products and Machinery	+ .1943	+ .3445	+ .1448	+ .2660	+ .2732	+ .4568
15. Electricity	- .0646	+ .2800	+ .2495	+ .2575	+ .6448	+ .6986
Total						
14. Sector segment of the economy	+ .7653	+3.1907	+2.9484	+3.9321	+5.6185	+6.2696
18. Sector economy	+1.3973	+2.2295	+2.3871	+3.9468	+4.2805	+5.7894

of the technological change indices of sectors at a different level of development. This will help us to separate the general from the characteristics specific to sectors which may throw light on the development process.

A further and rather elementary typology will also be considered, namely that based on the comparison of the average technological change for the economy as a whole or a segment of it with that of the individual sector, focussing attention on the extent of individual deviations from the average. Such an examination will be more instructive than the analysis of the average change for the economy as a whole. Further such a comparative analysis of the levels of change also leads to the identification of the characteristic features of the development process in the economy which may be viewed as a set of interrelated changes in the structure of the economy passing through the transitional phase from traditional to modern forms of production with industry growing more rapidly than agriculture.

Comparing the values of the indices of technological change γ_j and α_j for different individual sectors presented in tables 4.3.1 and 4.3.2 against the respective mean change index for the 14 sector segment of the economy it is noticed that the sectors which show values below mean are the traditional sectors of agro-based industries of Food (4), Textiles (5), Paper and Printing (6) and Leather and Rubber (7) where technological change is small and slow, despite their lion's share collectively and individually at least in respect of Food (4) and Textiles (5), in the gross output and final demand of the economy. It is well known that when the economy sets out for technological transformation towards industrial growth and development, it is expected, as a consequence of planned industrial investment strategy that the relative importance of these traditional agro-based industries would be less than those of the modern ones. It is also expected that the consumer goods industries catering to final demand get less importance than the ones producing intermediate and investment goods, during the process of such transformation.

However, though traditional the mining sectors (2 and 3), whose share in the gross output and final demand is of lower order, surprisingly present a picture of sizable, i.e., above average technological change, more clearly on the Chenery index γ_j than α_j. This result perhaps, seems to indicate the phenomenon of decreasing returns, that is the increasing depth of mining necessitated over the years, might have increased the input costs, particularly of the major ones. But this increase in input costs does not imply any technological change as such. Even so, one cannot deny some technological change in these sectors also when the whole economy, under the regime of different five year plans was undergoing technological change towards growth and development with emphasis on the production of intermediate and investment goods. These sectors, it may

be recalled, have been found to present a picture of increasing share of intermediate demand in their gross output over the period.

The "modern" sectors of Chemicals and Petroleum (9) and Nonferrous Metals (12) on the Chenery index γ_j and the sector of Metal Products and Machinery (13) on α_j index are noticed to occupy borderline positions with respect to the level of technological change. This is despite the expectation noted above and also the fact that the sectors of Metal Products and Machinery (13) and Chemicals and Petroleum (9) are the very high ranking sectors in the manufacturing branch of the economy in terms of their relative share in the gross output, standing in rank only next to Food (4) and Textile (5). In fact Chemical industry has been acknowledged as one of the most dynamic industries all over the world. Also, it may be recalled that these sectors have recorded sizable growth during the period; particularly the Metal Products and Machinery (13) sector, we have seen, has almost doubled its share in the gross output around 1959 onwards.

It may be pertinent to note here that the chemical, metallurgical and engineering industries comprising these sectors which form the bulk of "modern" industries of our economy, are not subjected to the constraint as the traditional agro-industries, considered a little while ago, which depend on agriculture for their basic raw materials. A demand for the products of these sectors is mainly a demand for the modernization, with an almost infinite scope for our developing economy lagging so far behind the rest of the world. So it is natural therefore to expect a larger than average technological change for these sectors.

In the case of the two sectors viz. Metal Products and Machinery (13) and Chemicals and Petroleum (9) besides their growing relative share in the gross output, which alone need not imply any technological change, we have earlier seen that structurally the pattern of their sectoral interdependence was also changing over the years from the Chenery category of intermediate primary production to intermediate manufacture. In respect of the Metal Products and Machinery (13) sector we have further noticed that the shift continues to the further category of final manufacture with increasing backward linkage at every stage. Coupled with this is the fact that the industries of machinery manufacture and petroleum refining are relatively of recent time vintage than metallurgical and chemical. Hence, in the context of our observed border-line behaviour of these two sectors it is likely that the changing pattern of the relative proportions in which the above industries are combined in the composition of our two sectors over the comparisons has possibly concealed the effect of technological change in these composite sectors which an appropriate decomposition might have revealed.

In the case of the low ranking sector of Non-ferrous Metals (12), all the below average index values of technological change are confined to comparisons involving earlier years up to 1959 and not involving the year 1963, indicating larger than average technological change from the middle of the Second Five Year Plan period and thereafter.

4.3.2(b) : *Some Evidence on the Nature of Technological Change*

Let us now consider the typology based on the relationship between the magnitude of the two indices of technological change for each of the sectors on the basis of Tables 4.3.1 and 4.3.2 and consider whether the relation changes over the comparisons, as the two indices measure technological change with a differential emphasis on the nature of it, as has been explained earlier. It is noticed that in most of the sectors for most of the comparisons the α_j index values are higher than those of γ_j indicating that the technological change for such sectors and for such comparisons is characterised by the introduction of new inputs in the production process and/or minor inputs have gained prominence in the measurement of technological change. This covers a large part of the economy. However, the sectors on Mining (2 and 3) show the reverse relation with γ_j values larger than α_j ones in almost all binary comparisons except the one involving 1951 and 1953 which were the initial years of the First Five Year Plan. Hence in respect of these two traditional primary production sectors comprising the mining segment of the economy, the technological change indices reveal that it is not only the increasing material costs necessitated by increasing depth of mining over the years, but also that the use of more important or major inputs has undergone greater change relative to other inputs over the years.

The above behaviour of the mining sectors towards technological change seems to have percolated to the sectors on Electricity (15), Cement (10), Metal Products and Machinery (13) and Non-metallic Minerals (8) all of which are mining-based sectors in whose case also we observe the reverse relation for the indices viz. $\gamma_j > \alpha_j$. In the particular case of Electricity (15) sector the reverse relation is as frequent over the binary comparisons as the mining sectors. Also in respect of decadal and post-decadal comparisons all the sectors listed above except Metal Products and Machinery (13) sector exhibit the said relation in the magnitude of the indices. In the case of the Metal Products and Machinery sector (13) about which we discussed a little while ago, the pertinent relation, however, is observed only in the three intervening comparisons. It may be recalled again that a large part of this 'modern' sector, especially the machinery industry was the creation of the planning activity, particularly the Second Five Year Plan.

Now considering the direction of technological change or progress during the period as revealed by the typology based on the Domar-Leontief Index I_j discussed earlier and the index values presented in Table 4.3.3, it is found that a majority of the sectors give positive I_j index values for all binary comparisons, indicating thereby the introduction of new inputs or a new combination of them in the production process and/or the alteration of the prevalent product-mix of the sector so that the total input requirement per unit of output is increasing. The increased usage of inputs, as we have noted, implies more round about and refined processing. The type of technological change over time or technological progress leading to "modernization" of the final products seems to be the dominant ethos of the technological climate of the economy during the period.

Coke and Coal (2), Non-ferrous Metals (12) and Electricity (15), all mining and mining-based sectors, however show a negative I_j in the initial binary comparison involving the years 1951 and 1953. This seems to suggest that these sectors joined the stream of the above noted type of technological change a bit late. But the same cannot be said in respect of the composite sector on Paper and Printing (6) which besides having a negative I_j in the initial comparison also gives a similar I_j for the comparison involving the later years viz. 1959 and 1963.

In respect of the sector on Agriculture (1) and the agro-based sector on Food, Drinks and Beverages (4) the run of positive and negative values of I_j index over the binary comparisons, however, tempts us to notice the interesting association of negative I_j in Agriculture sector (1) with the positive I_j in the Food sector (4) implying that an increase in the productivity of the material inputs of one sector leads to technological change of the "modernization" type in the other. Though this association logically fits into the development process of the economy a larger number of observations are necessary to establish it. Also since these sectors are highly aggregative and dominant sectors in the economy it is necessary that the complex phenomenon of technological change for these sectors be probed at a disaggregated level.

4.3.3 *Time Pattern of Technological Change for Different Sectors*

So far we were considering the sector level indices of technological change using the evidence rather synchronically to appraise the nature of change on the basis of six binary comparisons. These comparisons, however, constitute a uniform sequence in the time domain in terms of gap years which we may use to study the time pattern of technological change for different sectors during the period 1951 to 1963. But it may be noted that the time patterns in technological change indices that we propose to study in the following will not be in terms of chronological calendar years, like most time series, as technological change has been measured in terms of technical coefficient

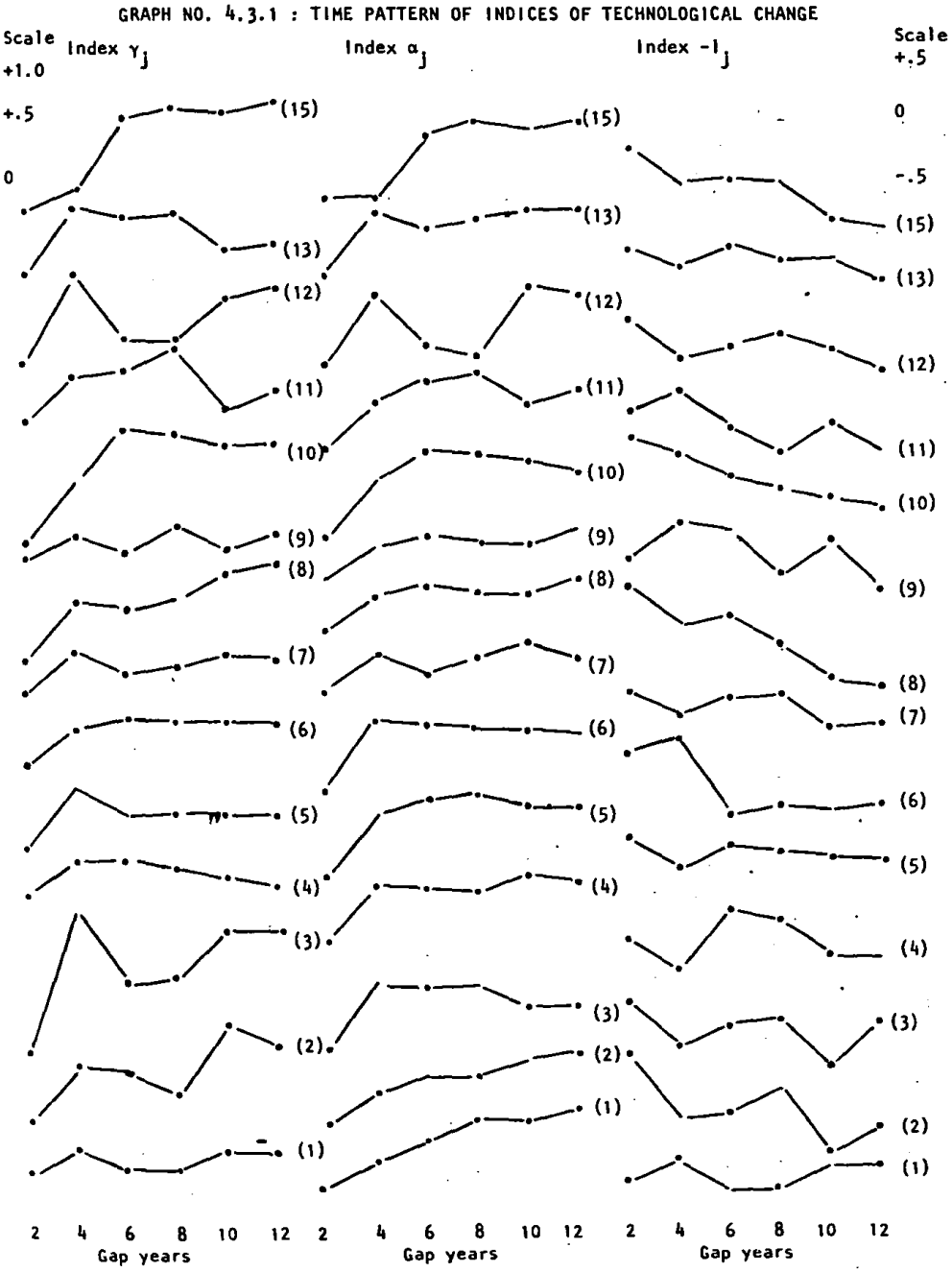
differences of the Input-output tables between two specific calendar years. Relating the time gap involved in the co-efficient difference with the changing magnitude of indices of technological change for a sector will give us the short term time trend of the same. However, this unavoidable procedure suffers from a lacuna in that though our time reckoning becomes delinked from the calendar year, the technical coefficients from which the indices of technological change are estimated remain embedded in the calendar year context and are not delinked from the calendar year effect. This results in a logical hiatus of lack of one to one correspondence in the temporal relationship between the gap year and the related index of technological change. This limitation will be taken into consideration during the analysis that follows.

Any sophisticated time series analysis with as few as 6 time points, we are afraid, is an extremely risky business. However, any attempt to find the internal structure of a time series by what is termed in sophisticated literature as "interocular test" i.e. visual observation by plotting the points on a graph against time axis is also risky indeed, as even the eye cannot be relied upon. But between the two we have chosen the latter and have presented in the following Graph 4.3.1 the plots of γ_j and α_j indices against the time axis of gap years for the different sectors. In the said graph we have plotted the Index $-I_j$ instead of I_j for purposes of consistency of comparison.

Further in the nature of it our study of the time pattern and the intertemporal fluctuations will be "formal" as substantive analysis and interpretation based on examination of individual fluctuations demands particular detailed information from the "technological annals" of the individual industries comprising each sector. This is beyond the scope of our present study.

A perusal of the graph reveals that none of the 14 sectors plotted shows a continuously declining trend in the values of the indices of technological change with increasing gap years. This indicates that each of the sectors was exposed to technological change towards progressive development of the economy though differently at different points of time during the period 1951 to 1963. Broadly speaking the actual movements that the economy experiences in any period reflect the balancing of all opposing forces and what happens depends on how the diverse forces enter at any given time. Further, these are not likely to be fixed relationships or sequences because what is happening in any sector is influenced by all other sectors. Even if the movements of a part of the economy have some regularity they are more often altered by the relationship between the total economy and the particular part in the dynamic context of time. Our attempt here is not to disentangle all this complex web of temporal movement of sectors and the economy with regard to technological

GRAPH NO. 4.3.1 : TIME PATTERN OF INDICES OF TECHNOLOGICAL CHANGE



change. But we notice here from the graph that for both the indices α_j and γ_j, the mean technological change for the 14 sector segment of the economy on α_j index shows, as one expects, a continuously increasing trend with increasing gap years. The same for the 18 sector economy as a whole also shows a continuously increasing trend on the said index which we have already noted in the last chapter. The Chenery index γ_j also shows the same trend for the said 14 sector segment and 18 sector economy except for the gap year 4 involving technological change between 1959 and 1963.

With reference to gap year 4 it is pertinent to note here that since our indices of technological change for the gap year 4 are estimated on the comparison years which belong to faster growth period of the economy, the indices show an abrupt change in the level in most of the sectors of the economy. This is due to the methodological lacuna noted earlier. Even with this proviso for the gap year 4, one expects that technological change should increase with increasing gap years for the individual sectors also. However, if we examine the changes in the individual sectors, most of them do not show such a behaviour. There are differences in the rise and fall for each sector and since they are caused by the basic structural differences, the intersectoral dissimilarity in trend holds from period to period. Further every trend, whether simple or complex has implicit within it a certain basic causal relationship embodied in its intertemporal structure, and each such trend describes a particular type, consequently our study can note and classify the types and possibly attempt to explain.

Table 4.3.4 presents the typography of sectoral trend patterns in technological change indices α_j, γ_j and $-I_j$. It lists up 4 broad types deleneated on "formal" basis and not strict categories, as scanned from the statistics in Tables 4.3.1, 4.3.2 and 4.3.3 and the Graph 4.3.1. It needs to be pointed out that when we are talking about technological changes we should consider only broad changes and ignore small differences. In other words the figures are not to be interpreted in strict arithmetical magnitudes, as small fluctuations arise due to a number of reasons which may have no bearing on changes in technology. However, the order of smallness to be ignored, is again a matter of judgement made by the researcher based on his knowledge of the situation or even his lack of it.

While classifying the trend patterns we have ignored the "intervention effect" of abrupt change in level followed by abrupt change in direction at the gap year point 4 on any of the indices for reasons already noted. In the case of sectors on Coke and Coal (2) and Non-ferrous Metals (12) which are classified in erratic or irregular class on α_j and/or γ_j indices, the trend pattern seems to cover the time segment which encloses parts of two cycles of technological change. The same seems to be the situation

Table 4.3.4 : SECTORAL TREND TYPOGRAPHY OF TECHNOLOGICAL CHANGE WITH RESPECT TO GAP YEAR

On Index γ_j / *On Index* α_j	*Continuously rising trend*	*Rising for some time but more or less constant later*	*Rising for some time but declining later*	*Erratic or irregular trend more or less*
1. Continuously rising trend	Agriculture* (1) (D) Electricity (15) (A)		Metal products and Machinery (13) (A)	Coke and Coal (2) (D)
2. Rising trend for some time but more or less constant later	Non-metallic Minerals (8) (A)			
3. Rising trend for some time but declining later	Other Mining* (3) (D)	Textiles (5) (B)* Chemicals and Petroleum (9) (D)	Paper and Printing (6) (C) Leather and Rubber (7) (D) Cement (10) (A) Iron and Steel (11) (D)	
4. Erratic trend more or less			Food, Drinks and Beverages (4) (D)	Non-ferrous Metals (12) (D)

* Ignoring the intervention effect of abrupt change in the level followed by abrupt change in direction at the gap year 4.

Note : Trend typography on $-I_j$ index is shown in bracket below the sector name in alphabetic code which means (A) Continuously declining trend (B) Declining for some time but more or less constant later (C) Declining for some time but rising later (D) Erratic or irregular

in the case of Food, Drinks and Beverages (4) on α_j index. However, the above-noted situation is less pronounced and also the trend pattern on γ_j index clearly shows a rising trend for some time but declining later.

This introcularly observed phenomenon of cyclicity of technological change noted above, seems to show itself in a heightened way when we consider as many as 8 sectors belonging to the erratic or irregular type on $-I_j$ index. Three of them, namely, Coke and Coal (2) again, Chemicals and Petroleum (9) and Iron and Steel (11) seem to cover a six year cycle of technological change from the gap year 2 to 8. All these are mining and mining-based sectors. In the case of another 4 sectors, viz., Agriculture (1), Other Mining (3), Food, Drinks and Beverages (4) and Leather and Rubber (7) the 6 year cycle which they seem to cover is from the gap year 4 to 10. Barring the sector on Other Mining (3) all these sectors belong to Agriculture and agro-based manufacturing industries. The last sector of Non-ferrous Metals (12) seems to cover an 8 year cycle of technological change from the gap year 4 to 12. In any case the whole phenomenon of cyclicity in technological change needs to be studied in depth and confirmed on the basis of further gap year observations even at this level of aggregation. The above is just an introcular observation.

The classification of the trend pattern for Chemicals and Petroleum (9) on α_j and γ_j indices also needs to be explained. On γ_j index, which emphasizes technological change in major and more important inputs relative to the others, the intrinsic trend line charts a rising one for some time but more or less constant later with alternately rising and falling fluctuations indicating change in variability. On the α_j index the trend charted is a rising one for some time but declining later. Our classification has ignored the change in the direction at the gap year point 10 followed by a slight rise in the level at the gap year 12, as a proper consideration of the last point datum requires further observations. The same is the case in respect of Iron and Steel sector (11) in the matter of the last gap year point.

The above enumeration is enough to show how subjective considerations enter the classification and how rough and tentative is the classification based on trend pattern determined on the basis of 'introcular test'. Bearing this in mind, we consider, below the apparent differential trend typographies between indices based on the classification presented in Table 4.3.4.

It is noticed that as many as 5, 6 and 7 sectors out of 14 are seen to show different trends on α_j and $-I_j$, γ_j and $-I_j$ and α_j and γ_j indices respectively. As we have already discussed in section 4.3.1, though these indices measure technological change as such, between themselves they do so with a differential emphasis, in-built in their

formulation on account of differences in the method of aggregating the individual coefficient changes viz. in gross or net terms and also the weighting system for aggregation at the sector level. The changing pattern of individual inputs coupled with the changing pattern of weights indicating the changing position of the individual input in the totality of inputs or in the totality of technological change of a sector seems to be largely responsible for the apparent divergent trend patterns on different indices. And in the case of sectors which show similar trend patterns, a scan of the data at the individual input level indicates a concordance in the changing pattern of the weights, etc., between indices so as to render the sectors apparently insensitive to the differential emphasis between them.

The implications of different trend types in the above table in terms of the behaviour of technological change in different sectors are obvious and do not need any elaboration. However, considering the frequency of sectors between different trend types, the type which attracts the largest number of sectors (9 out of 14) on either of the indices α_j and γ_j and needs comment, is the one that charts the trend as rising initially up to some time and then falling as the gap years increase. This behaviour type on α_j and γ_j indices is surprising. If true, one possible explanation of the later decline might be due to the changes in vertical integration of processes that have taken place in these manufacturing sectors. In the initial stages, it may be noted, the import components to manufacture more modern and sophisticated items in these sectors might increase the input coefficients. And later on, because of the efforts towards import substitution the gradual manufacture of these components domestically results in the decrease in the magnitude of the said input flow coefficients (as the value added part would go out of reckoning in our measure).

However, in contrast to the large number of sectors affected by the above trend type on α_j and γ_j indices, the index $-I_j$ attracts only one sector namely that of Paper and Printing (6) to the trend type under discussion. In particular barring this sector and that on Food (4) all other sectors in the said set of 9 that showed later decline after initial rise in their trend pattern fail to show any such trend on $-I_j$ index. They get classified in other types and belong to the technological change typology on $-I_j$ which we have earlier described as modernisation characterized by the introduction of new inputs or a new combination of them in the production process and/or the alteration of the product-mix, leading to increased input usage, more round about and refined processing. The apparent contrast vanishes because of the Leontief weighting diagram of $-I_j$ index as explained earlier and also the netting of individual input changes.

In the case of the above 9 sectors belonging to the trend type under discussion, assuming, on the strength of the evidence of α_j and γ_j indices, the later decline in technological change is true despite their modernization and the explanation ascribed by us holds good, it is interesting to note the light they throw on the nature and the time since when the impact of import substitution is being felt. The relative decline in the introduction of new items of input or in the technological change of the minor input components is indicated by the index α_j in respect of Other Mining (3), Textiles (5) and Chemical and Petroleum (9) while the technological change in respect of major inputs was either increasing or constant. On the other hand, relative decline in respect of major and more important input items is indicated by γ_j index in respect of sectors on Metal Products and Machinery (13) and Food, Drinks and Beverages (4). The sectors on Paper and Printing (6), Leather and Rubber (7), Cement (10) and Iron and Steel (11) seem to experience the said relative decline in respect of both the major and minor input items. This broad indication of the nature of impact of import substitution on input components in respect of these sectors however needs verification on the basis of detailed studies on import substitution.

We may further note that the abrupt change in the direction leading to decline in technological change in the case of the above 9 sectors takes place at the gap year point 8 or 6 involving the calendar year 1959. Obviously the year 1959 seems to be the time point since when the impact of import substitution on technological change is being felt. Besides if we consider the time point of change in the direction from increase to near constancy in respect of the other trend type, which also takes place at the gap year point 6 which also involves the calendar year 1959. Thus in respect of a majority of sectors the year 1959 seems to figure as a sort of watershed point in the context of technological change also.

The above exercise in the empirical analysis of the difficult and intriguing concept of technological change leads us unfortunately to the trite observation that there is no unique measure of technological change and different measures of it have different shades of meaning and though they give consistent results, between them they give different, though not contradictory ones, and as such they are not strictly comparable. Secondly as we leave the analysis of technological change for the economy as a whole and examine the same, for different sectors, even at our level of aggregation, we are struck by the considerable diversity of the movement of technological change over time, and our short term context seems to have hightened it.

4.4 *Sector Level Changes in the Share of Interindustry Demand*

In this section we will study the distributional aspect of changes at the sector level by using the row coefficient matrices presented in Tables B 3.3.2. We have earlier found at the economy level, that the changes in row coefficients, as judged by Tilanus' method of coefficient of variation and also by the application of Maria Augustinovics' formula to the coefficient differences of the said row matrices are of the same or similar order as compared to the said differences of the column coefficient matrices. In other words, the variation in the share of interindustry demand to gross output is of the same or similar order as compared to technological change. But the story of distributional change at the sector level may not be the same as that at the level of economy as a whole as was observed in the case of technological change at the sector level earlier. In fact as noticed earlier, the intertemporal coefficient of variation of the row coefficients within each row is not only large for almost all of them but very large for many of them in comparison with the coefficient of variation for the sector's aggregate interindustry demand coefficient as revealed by Table 3.3.3(b). Let us therefore analyse the sector level patterns of change in the share of interindustry demand in the sectoral output over our six binary comparisons.

For this analysis we adopt the same methodology and use the same three measures detailed in the last section. Table 4.4.1 presents the sector level changes in the share of interindustry demand in the output on the Chenery index γ_i defined for the row-coefficient matrices as:

$$\gamma_i^{b,c} = \frac{\sum_{j=1}^{n} |a_{ij}^b - a_{ij}^c|}{1/2 \sum_{j=1}^{n} (a_{ij}^b + a_{ij}^c)}$$

Table 4.4.2 presents the same changes as segregated values at the sector level on Maria Augustinovics formula defined for the row coefficient matrices as:

$$\bar{\beta}_i^{b,c} = \frac{1}{n} \sum_{j=1}^{n} \frac{|a_{ij}^b - a_{ij}^c|}{\frac{1}{2}(a_{ij}^b + a_{ij}^c)}$$

Table 4.4.3 presents the said sector level changes on the Domar-Leontief formula defined for the row coefficient matrices as

Table 4.4.1 : SECTORAL VALUES OF CHANGES IN THE SHARE OF INTERINDUSTRY DEMAND ON Y_i INDEX

	Comparison years	*1951;1953*	*1959;1963*	*1953;1959*	*1951;1959*	*1953;1963*	*1951;1963*
	Gap years	*2*	*4*	*6*	*8*	*10*	*12*
	Sectors						
1.	Agriculture	.0458*	.3506*	.1505*	.1797*	.2763*	.2847*
2.	Coke and Coal	.1829	.7612	.3896*	.5236*	.8931	1.0955
3.	Other Mining	.3402	.8071	1.0487	1.2661	1.4061	1.5555
4.	Food, Drinks and Beverages	.1341*	.3860*	.4352*	.3263*	.6166*	.5204*
5.	Textiles	.0206*	.6969	.4859*	.4883*	.3527*	.3514*
6.	Paper and Printing	.1572	.6170*	.8506	.9808	.7143*	.7417*
7.	Leather and Rubber	.1805	.5351*	.8655	.9765	.7406*	.8547
8.	Nonmetallic Minerals	.1528*	.6709	.5278*	.6067*	.9066	.9005
9.	Chemicals and Petroleum	.2905	.6290	1.0572	1.0893	.9145	.8098
10.	Cement	.0355*	.1509*	.2813*	.2496*	.4012*	.3727*
11.	Iron and Steel	.1318*	1.1020	.6713	.7408	.6290*	.5316*
12.	Nonferrous metals	.0716*	.8192	.5715*	.5791*	.9005	.9093
13.	Metal products and Machinery	.1805	.8114	1.3414	1.2552	1.4309	1.3732
15.	Electricity	.2353	.4505*	.6702	.6730*	.6808*	.7452*
	14. Sector Mean	.1542	.6277	.6676	.7096	.7759	.7890
	18. Sector Mean	.1572	.8072	.6756	.7106	.9321	.9451

* Below 14 sector mean value.

Table 4.4.2 : SECTORAL VALUES OF CHANGES IN THE SHARE OF INTERINDUSTRY DEMAND ON β_i INDEX

Comparison years	*1951;1953*	*1959;1963*	*1953;1959*	*1951;1959*	*1053;1963*	*1951;1963*
Gap years	*2*	*4*	*6*	*8*	*10*	*12*
Sectors						
1. Agriculture	0.2291*	1.0502	0.9511*	1.0161	0.9422*	1.0080*
2. Coke and Coal	0.2029*	0.7267*	0.6804*	0.7366*	0.9789*	1.0762
3. Other mining	0.4156	0.8756	0.8502*	0.9909*	1.4240	1.4204
4. Food, Drinks and Beverages	0.3085	0.5539*	0.8293*	0.6955*	0.8295*	0.8580*
5. Textiles	0.1035*	0.8754	1.0548	1.0961	1.0231	0.9886*
6. Paper and Printing	0.2612*	0.7773*	1.1505	1.2678	1.0761	1.1112
7. Leather and Rubber	0.2477*	0.5397*	0.8262*	0.9946*	0.8913*	1.0140*
8. Non-metallic Minerals	0.3265	1.1706	1.2573	1.2264	1.3641	1.2560
9. Chemicals and Petroleum	0.1554*	0.8764	1.0762	1.0850	0.9890*	1.0049*
10. Cement	0.1346*	0.3107*	0.5586*	0.6682*	0.6497*	0.7523*
11. Iron and Steel	0.5922	1.1870	1.3909	1.3052	1.0239	1.0123*
12. Non-ferrous Metals	0.2904	0.8046*	0.8520*	0.9487*	0.8469*	0.7827*
13. Metal Products and Machinery	0.4301	1.0642	1.5149	1.4494	1.3498	1.2830
15. Electricity	0.1833*	0.6161*	0.7021*	0.7025*	0.6999*	0.6716*
14. Sector Mean	0.2772	0.8163	0.9782	1.0131	1.0063	1.0171
18. Sector Mean	0.2799	0.8488	0.9481	0.9717	0.9928	1.0037

* Below 14 sector mean value.

Table 4.4.3 : SECTORAL VALUES OF CHANGES IN THE SHARE OF INTERINDUSTRY DEMAND ON I_i INDEX

	Comparison years	*1951;1953*	*1959;1963*	*1953;1959*	*1951;1959*	*1953;1963*	*1951;1963*
	Gap years	*2*	*4*	*6*	*8*	*10*	*12*
	Sectors						
1.	Agriculture	-0.0015	-0.1660	-0.0400	+0.0452	-0.2075	-0.2040
2.	Coke and Coal	+0.1326	+0.1789	+0.1349	+0.2759	-0.1209	+0.5075
3.	Other Mining	+0.3383	+0.3600	-0.5983	-0.5646	-0.2877	-0.1005
4.	Food, Drinks and Beverages	-0.0984	+0.2305	+0.3811	+0.2856	+0.5989	+0.5079
5.	Textiles	+0.0018	+0.6240	-0.2587	-0.2534	+0.3071	+0.3610
6.	Paper and Printing	+0.0459	-0.1567	+0.2692	+0.6686	+0.4454	+0.5094
7.	Leather and Rubber	+0.1609	-0.0615	+0.6693	+0.8464	+0.5883	+0.7403
8.	Non-metallic Minerals	+0.0259	-0.2192	+0.0242	+0.1082	-0.0107	+0.1080
9.	Chemicals and Petroleum	-0.2687	-0.3783	+0.2566	+0.2643	-0.0342	+0.1720
10.	Cement	+0.0335	-0.1119	-0.2088	-0.1689	-0.0782	-0.0304
11.	Iron and Steel	-0.0048	+1.0307	+0.2212	-0.7320	-0.0884	-0.1326
12.	Non-ferrous Metals	+0.0489	+0.5961	+0.3318	+0.4352	+0.8049	+0.8760
13.	Metal Products and Machinery	+0.0638	-0.5242	-0.1817	-0.2175	-0.6328	-0.6810
15.	Electricity	-0.1238	-0.0637	+0.5838	+0.5051	+0.5405	+0.4748
	Total						
14.	Sector segment of Economy	+0.3544	+1.3387	+1.5846	+1.4981	+1.8237	+3.1084

$$-I_i = \sum_{j=1}^{n} \frac{(a^b_{ij} - a^c_{ij})}{\frac{1}{2}(a^b_{ij} + a^c_{ij})} \quad \frac{\frac{1}{2}(x^b_{ij} + x^c_{ij})}{\frac{1}{2}(\sum_{j=1}^{n} x^b_{ij} + \sum_{j=1}^{n} x^c_{ij})}$$

The notations in the above formulations have the usual meanings[12] and a_{ij} stands for the ij^{th} element in the row coefficients matrix and measures interindustry demand per unit of output. In other words it can be taken to measure the strength of the sector's 'direct forward linkage effect in each absorbing industry/sector,[13] if we recall the Chenery definition of it, viz.

$$w_i = \sum_{j=1}^{n} w_{ij} = \frac{\sum_{i=1}^{n} x_{ij}}{X_j} = \sum_{j=1}^{n} a_{ij}$$

And the above indices measure the relative changes in the sectors' forward linkage effect per unit of output, where change is taken relative to the mean share of interindustry demand or the mean strength of the forward linkage between two points of time. Analogously we can consider the technological change of the earlier section in terms of changes in the backward linkage effect of the sector per unit output.

All the three indices have different weighting systems for aggregating the sectors' change over the different absorbing sectors about which we have dwelt at length in the previous section. While the first two indices measure gross change in the interindustry demand of the sectors' output or in its direct forward linkage effect, the net change index $-I_i$ indicates the direction of it, i.e. increase or decline in the interindustry demand per unit of the sectors' output between two points of time. A positive value of I_i (i.e. negative value on $-I_i$) may indicate that more of this sector's share in output is used by other industries of the economy and hence its forward linkages have increased or expanded. One may be tempted, on the other hand, to interpret a shrinkage in the direct forward linkage effect as indicated by a negative value of I_i (i.e. positive value on $-I_i$) as an increase in the efficiency of the sectors' output use by the consuming industries. But a little reflection would show that the above inferences would be valid only if the technology remains constant between the two time points and more importantly the structure of outputs in the two time points also remains the same. However, in reality, even if technological changes are noted to be minimal, the relative growths of different sectors differ. The differential growth of sectors in different periods would give rise to differences in row coefficients even if technology were to remain same. Thus no valid inferences can be made on the basis of our third measure about the efficiency of

the interindustry use of sectoral output. It is, however, possible to conclude that a positive value of I_i would mean that more of sectors output is used for interindustry consumption because the production structure demands it in the developing context of the economy.

It is necessary to add that the analysis based on the above indices is 'partial' as only flow coefficients are considered and thereby the outputs of investment goods' sectors like machinery, construction, etc., which have a major role to play in the capital matrix, do not figure fully in the computation of interindustry demand. Besides capital formation, the import and export vectors being in the final demand categories an increase in the inter-industry demand does not necessarily mean that the nature of the sector's output has changed in the sense that it is increasingly becoming an intermediate product as the difference could be accounted for by the imports and exports.

4.4.1 *Differential Pattern of Changes in Interindustry Demand Between Sectors*

In the light of the above discussion let us look at the results presented in the Tables 4.4.1, 4.4.2 and 4.4.3 with a view to discern the differential patterns of change in the share of interindustry demand in the sectoral output.

(A) *Level of Change*

It is noticed that the mean change Index on β_i and γ_i formulations for the economy as a whole as also for the 14 sector segment of it, shows increasing magnitude of change between the six binary comparisons ordered as a sequence of gap years. However, a comparison of the deviations of the individual sectors from the 14 sector mean change index shows that the sectors on Metal Products and Machinery (13) and Other Mining (3) fall in the typological category of above mean level change on both γ_i and β_i indices, in all the binary comparisons for the former and in most of the comparisons for the latter sector indicating highly changing nature of the direct forward linkage of the above sectors' output. On the evidence of I_i index, which reveals the direction of change, the above sectors show a shrinkage in the said linkage effect indicating that more of these sectors' output is being passed on to the final demand categories rather than to intermediate use. We have earlier noted that between the two sectors which have substantial forward linkages, the Other Mining sector (3) is an intermediate primary production sector with a high rank in respect of interindustry demand, while the modern sector on Metal Products and Machinery (13) has been known to shift its Chenery-Watanabe category from Intermediate Primary to Final Manufacture via Intermediate Manufacture, catering largely to the final demand categories. Thus the observed narrowing in the forward linkage effect in respect

of Metal Products and Machinery (13) is understandable, but the same in respect of Other Mining (3) looks a bit surprising. However the apparent surprise may vanish if we consider the export trade in Other Mining, particularly, Iron Ore.

Besides sectors on Agriculture (1) and Food etc. (4) the sectors on Cement (10) and Electricity (15) are also found to belong to the typological category of change below mean level on either of the indices γ_i and β_i, in almost all the binary comparisons. This position in respect of Agriculture (1) and the agro-based Food (4), both of which are known to have poor forward linkages, stands explained as they largely cater to final consumption demand. But in spite of this low level of change, the direction of it as judged by the evidence of I_i index, shows that for the Food (4) sector the forward linkages though poor are increasing in almost all the binary comparisons. In a surprising contrast to this, the contraction in the already poor forward linkage effect of the Agriculture sector (1) as indicated by the I_i index in almost all the binary comparisons, seems to reflect on the relative stagnancy, if not decline in the outputs of the major absorbing sectors viz., Food (4) and Textiles (5) as also the hold of final consumption demand which is still the first charge on the sectors' output.

The lower level change position of the very high ranking intermediate sector of Cement (10) which has substantial forward linkage effect for its output needs explanation in the context of our developing economy. In the first place it is important to note that our estimation of interindustry demand coefficients are not based on the full coverage of the Construction sector (14). Further the existence of a sizeable import component in the interindustry demand for Cement might have possibly kept the changes at the lower level. The evidence on I_i index about the shrinkage in the forward linkage effect also seems to indicate that explanation of it needs to be found in the final demand categories.

The same lower level of change in the case of the Electricity sector (15) which still remains a middle ranking sector with respect to interindustry demand seems to reflect on the energy basis of industrialization of the economy which is still dominated by coal and petroleum. It is interesting to note in this context the typological position of the sector of Coke and Coal (2) which shows higher level of change in the share of interindustry demand in its output on the evidence of γ_i index and indicates that the forward linkage effect of it is increasing as noted on the I_i index also. Even at its lower level position with respect to mean change, the Electricity sector (15) also seems to be improving its substantial forward linkage effect as indicated by the I_i index.

In respect of the other sectors not singled out above, particularly the important ones of high rank in inter-industry demand, the evidence regarding the level of change tendered by indices γ_i and β_i, between themselves is different, due to differences in the weighting systems adopted in their formulation.

(B) *Direction of Change*

A typological categorization of the sectors on the basis of the sign of the I_i index values in Table 4.4.3 in respect of all or most of the binary comparisons shows that 8 sectors out of 14 show increase in the share of inter-industry demand in their outputs indicating increase or expansion of their forward linkages. These sectors are:

(1) The mining and mining-based sectors of Non-ferrous Metals (12), Coke and Coal (2), Non-metallic Minerals (8) and Electricity (15). Of these the first two are the high rank sectors and the other two are the middle rank sectors with respect to interindustry demand.

(2) The agro-based sectors of Food, Drinks and Beverages (4), Textiles (5) Paper and Printing (6) and Leather and Rubber (7) all of which are low rank sectors with respect to interindustry demand.

Of the remaining sectors, barring the sector of Chemicals and Petroleum (9) which shows borderline behaviour in regard to typological categorization, the following 5 sectors show decline in the share of interindustry demand in their output indicating decrease or contraction of their forward linkages.

(1) Mining and mining-based sectors of high rank with respect to interindustry demand, namely, Other Mining (3), Iron and Steel (11) and Cement (10).

(2) The middle rank sector of Agriculture (1).

(3) The low rank sector of Metal Products and Machinery (13).

We have already offered indicative comments on the behaviour of most of the sectors. In respect of the borderline behaviour of the middle rank sector of Chemicals and petroleum (9), the only comment we can offer apparently is about the composite nature of the sector which we have already noted in detail elsewhere.

(C) *Time Pattern of Change*

With the same analytical limitations which we have noted in section 4.3.3 while analysing the time pattern of changes in technology, we present in Table 4.4.4 the sectoral trend typologies of the changes in the share of interindustry demand with reference to the gap years for

Table 4.4.4 : SECTORAL TREND TYPOGRAPHY OF CHANGES IN THE SHARE OF INTERINDUSTRY DEMAND IN OUTPUT WITH REFERENCE TO GAP YEARS

Trend on γ_i / *Trend on* β_i	*Continuously rising trend*	*Rising trend for some time but more or less constant later*	*Rising trend for some time but declining later*	*Erratic trend more or less*
	1	*2*	*3*	*4*
1. Continuously rising trend	Coke and Coal* (2) Other mining (3) Cement (10)			
2. Rising trend for some time but more or less constant later	Food, Drinks and Beverages (4) Non-metallic minerals* (8) Electricity (15)	AGriculture (1)	Leather & Rubber (7) Chemicals & Petroleum (9)	
3. Rising trend for some time but declining later	Non-ferrous metals* (12)	Metal Products and Machinery (13)	Textiles (5) Paper and Printing (6) Iron and Steel (11)	
4. Erratic trend more or less				

* Ignoring the intervention effect of abrupt change in the level followed by abrupt change in direction at the gap year 4 on γ_i index.

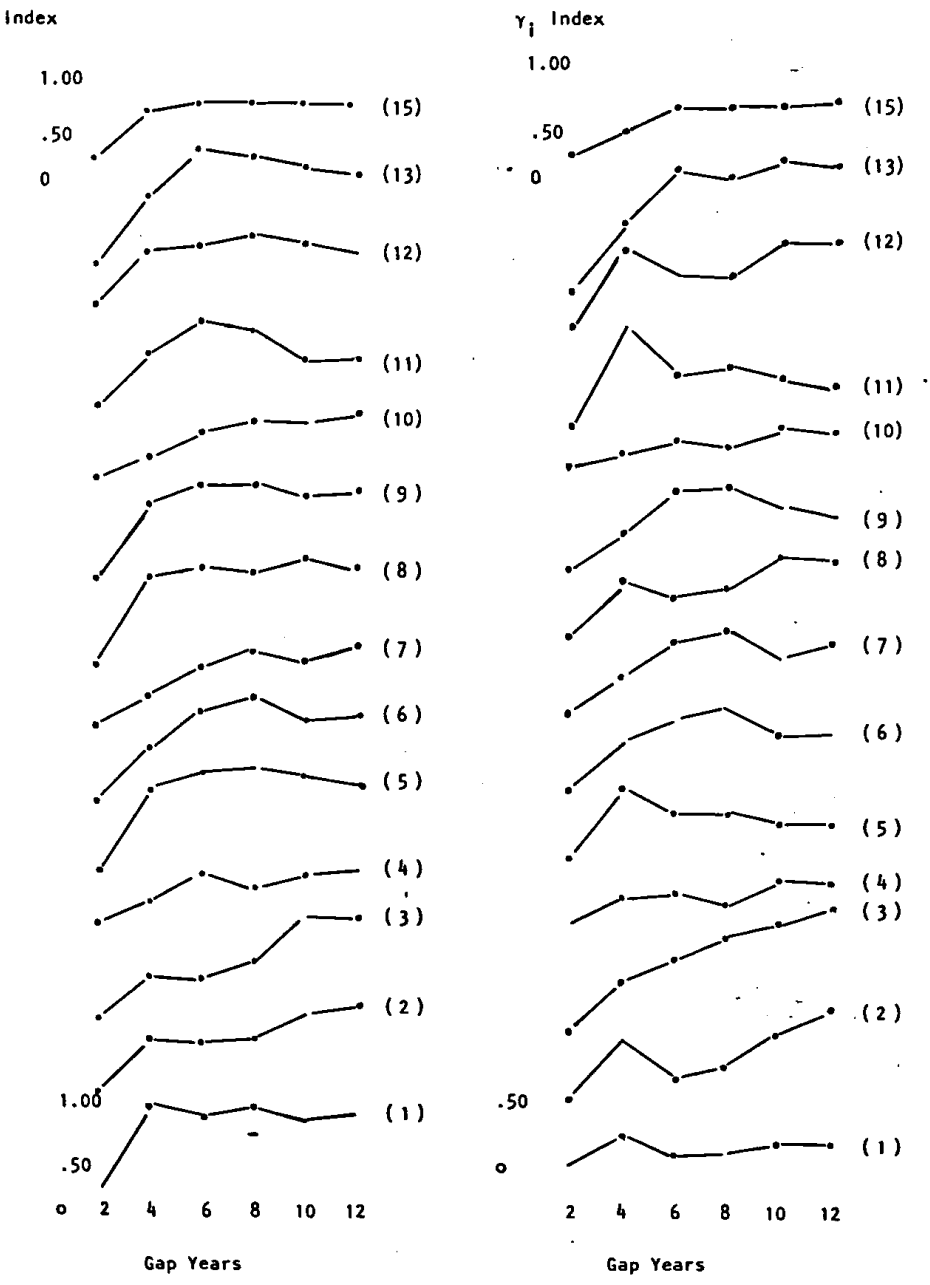
the six binary comparisons cross-classified on the basis of the two indices β_i and γ_i which we interpreted as indicators of gross changes in the direct forward linkage effect of a sector. Trends with reference to the gap years for the individual sectors on both β_i and γ_i indices are presented on the Graph 4.4.1. The third index I_i is not included in this analysis on account of its limitations noted a little while ago.

We have already noted that the differential trend typology arises because of the differential weighting pattern between the indices β_i and γ_i while aggregating the row table flow coefficient differences over the different absorbing sectors. And in respect of sectors which belong to similar trend typologies between indices, there seems to be a concordance in the changing pattern of weights, that is to say, the relative importance of the individual absorbing sectors and the relative importance of the direct forward linkage change in them seem to be moving in the same direction sympathetically. The above table shows that as many as seven sectors belong to similar trend typology between indices for direct forward linkage change. The remaining seven sectors which show differential trend pattern seem to be sensitive to the differential emphasis between the indices, because of the discordance in the changing pattern of weights i.e. the relative importance of the absorbing sector and the relative importance of the direct forward linkage change in it not moving in sympathy.

According to the above table, while the γ_i index attracts the largest number of sectors to the typological category of continuously rising trend of changes in direct forward linkage effect and these are mostly high ranking intermediate sectors, the β_i index is shown to attract the lowest number of sectors to the same category. On the other hand while β_i index attracts the largest number of sectors to the typological category of rising trend for some time but more or less constant later, and these are a set of low ranking intermediate sectors and high ranking final demand sectors equally mixed, the γ_i index of change in the direct forward linkage effect is seen to attract the lowest number of sectors to the same category. However the frequency of sectors attracted to the typological category of rising trend for some time but declining later, on either of the indices β_i and γ_i, are about the same in number and these are again a set of low ranking intermediate sectors and high ranking final demand sectors almost equally mixed.

On the whole the fact that about 1/2 to 3/4th of the sectors are found to belong to the typology of rising trend for some time but more or less constant or declining later on either of the indices seems to indicate that absolute coefficient differences are found to remain constant or taper off at the higher gap years and hence reflects on the nature of intertemporal stability of the row coefficient matrix. However, the continuously rising trend

GRAPH NO. 4.4.1 : TIME PATTERN OF β_i & γ_i INDICES FOR DIFFERENT SECTORS



typology on the joint evidence of β_i and γ_i indices belongs to the minor segment of the economy consisting of the very high ranking intermediate sectors of mining (2 and 3) and the mining-based sector of Cement (10).

4.5 *Impact of Changes in Technology on Sectoral Production Levels*

Earlier we discussed changes in intermediate demand at the sectoral level based on direct coefficient changes. We have also noted that the output levels are affected not only by changes in final demand but also by changes in intermediate demand. The changes in intermediate demand have two possible causes, namely, they may occur in response to changes in final demand or as a result of changes in the techniques of production. These two causes of change evidently show different effects : a change in the demand for a particular sector generates a uniform proportional change in the vector of direct inputs into that sector, with no change in the direct coefficients, whereas a change in the technology used in the sector's production alters the structure of the direct input vector and consequently changes the input coefficients. Both types of change have repercussions on the level and the indirect inputs. Hence a study of the full extent of the changes in the intermediate demand between any two years it is necessary to study the "interdependence coefficients" i.e. the elements of the Leontief inverse. This, in other words, leads to a study of the impact of changes in technology and final demand on the sectoral output levels.

The details of the methodology etc. of such a study have been discussed in section 3.4.1 when we were dealing with the said impact on the economy as a whole. In the following we discuss the results obtained from the calculations as per the above referred methodology and presented in table 4.5.1 below for the six binary comparisons.

An examination of table 4.5.1 reveals a wide range of changes in the total output levels between sectors and between the six binary comparisons and the range increases with the increasing gap years. Vaccara (1968) and Alan Armstrong (1974) who have noticed similar wide diversity of performance in the case of United States (1947-58) and United Kingdom (1948-1968) respectively pose the following two questions in this context, viz., : "do changes in final demand and changes in technology complement or offset each other in influencing output levels; and what are their relative impacts on the total output level of each (sector)?" (Armstrong, 1974, p. 28). Below we follow their line of analysis[14] and try to see what answers our data give to the above questions. Let us consider the influence of final demand changes first.

Table 4.5.1 : PERCENTAGE CHANGES IN THE SECTORAL OUTPUTS LEVELS DUE TO CHANGES IN TECHNOLOGY AND FINAL DEMAND IN THE INDIAN ECONOMY, 1951-63

	Year	*1951;1953*			*1959;1963*			*1953;1959*		
	Gap Years		*2*			*4*			*6*	
	Sectors	*T*	*F*	*Total*	*T*	*F*	*Total*	*T*	*F*	*Total*
1.	Agriculture	2.30	18.17	20.47	-2.55	23.52	14.97	- 1.66	11.04	9.38
2.	Coke and Coal	19.42	- 8.88	10.54	43.94	40.24	84.18	1.66	- 0.40	1.26
3.	Other Mining	6.19	-24.91	-18.72	20.69	25.99	46.68	-72.46	31.73	-40.73
4.	Food, Drinks and Beverages	-2.04	4.05	2.01	2.83	9.48	12.31	5.98	- 4.42	1.56
5.	Textiles	-0.17	7.30	7.13	27.73	22.46	50.19	- 8.08	35.96	27.88
6.	Paper and Printing	4.67	15.49	20.16	1.60	71.35	72.95	22.62	14.08	36.70
7.	Leather and Rubber	6.56	30.18	36.74	49.63	117.74	167.37	18.21	-10.50	7.71
8.	Non-metallic Minerals	17.61	17.28	34.89	74.84	111.89	186.73	- 6.60	- 5.95	-12.55
9.	Chemicals and Petroleum	11.84	-17.79	- 5.95	-18.31	118.57	100.26	56.87	-27.26	29.61
10.	Cement	20.64	0.47	21.11	138.10	-61.41	76.69	- 8.60	18.87	10.27
11.	Iron and Steel	-10.75	0.90	- 9.85	3.03	82.64	85.67	54.58	4.95	59.53
12.	Non-ferrous Metals	88.22	-29.67	58.55	1257.55	-100.27	1157.28	-111.03	58.37	-52.66
13.	Metallic Products and Machinery	- 8.72	- 7.10	-15.82	-10.10	62.07	51.97	13.64	177.09	190.73
15.	Electricity	0.67	19.45	20.12	- 3.20	53.88	50.68	105.36	6.64	112.00
	All 14 sectors	1.84	12.45	14.29	- 0.01	26.04	26.03	0.45	12.24	12.69
	Range	98.97	59.85	77.26	1275.85	218.84	1144.98	216.40	204.35	243.40

(Contd..)

Table 1.5.1 (Contd..)

Year	1951;1959			1953;1963			1951;1963		
Gap Years	8			10			12		
Sectors	T	F	Total	T	F	Total	T	F	Total
1. Atriculture	2.01	29.76	31.77	- 9.94	35.70	25.76	- 8.60	60.10	51.50
2. Coke and Coal	22.65	-10.72	11.19	41.08	45.42	86.50	72.89	33.27	106.16
3. Other Mining	49.18	- 2.64	-51.82	-57.82	44.76	-13.06	-30.87	1.54	-29.33
4. Food, Drinks and Beverages	3.83	- 0.23	3.60	9.79	4.26	14.05	7.74	8.61	16.35
5. Textiles	-8.41	45.40	36.99	22.45	69.61	92.06	22.98	82.77	105.75
6. Paper and Printing	29.27	34.98	64.25	41.78	94.64	136.42	55.02	129.05	184.07
7. Leather and Rubber	31.97	15.32	47.29	63.64	124.35	187.99	88.96	204.85	293.81
8. Non-metallic Minerals	9.59	8.37	17.96	67.32	83.43	150.75	103.33	134.89	238.22
9. Chemicals and Petroleum	61.53	-39.63	21.90	22.25	137.32	159.57	38.97	105.16	144.13
10. Cement	9.75	23.79	33.54	153.02	-58.18	94.84	193.70	-57.75	135.95
11. Iron and Steel	30.80	13.01	43.81	3.68	192.54	196.22	-12.27	179.30	167.03
12. Non-ferrous Metals	-38.37	13.42	-24.95	430.31	64.83	495.14	878.88	-35.29	843.59
13. Metallic Products and Machinery	2.38	142.37	144.75	2.18	339.66	341.84	-7.24	279.19	271.95
15. Electricity	122.63	32.03	154.66	124.11	95.35	219.46	151.57	132.17	283.74
All 14 sectors	2.35	26.45	28.80	0.69	41.35	42.04	3.54	58.78	62.32
Range	171.81	181.99	206.48	488.19	457.85	508.20	909.74	336.95	872.98

T = % change in output levels due to changes in Technology.

F = % change in output levels due to changes in Final Demand.

(Concluded)

4.5.1 *Impact of Changes in Final Demand on Sectoral Output Levels*

From table 4.5.1 it is seen that the greatest positive impact of final demand change on output levels occurred in the Metal Products and Machinery sector (13) in the later four of the six binary comparisons, with increases in output levels ranging from 142 per cent to 339 per cent. In the case of the earlier two comparisons with gap years 2 and 4, the strong positive influence of final demand change is noticed for the sectors of Leather and Rubber (7) and Chemicals and Petroleum (9) which recorded output increases of the order of 30 per cent and 118 per cent. On the other hand, the largest negative impact on sectoral output levels due to final demand change occurred in the Non-ferrous Metals sector (12) in the first two binary comparisons with gap years 2 and 4 recording output decreases ranging from 29 per cent to 1057 per cent. In the case of the middle two comparisons with gap years 6 and 8, the said strong negative impact was shown by the Chemicals and Petroleum sector (9) recording output reductions ranging from 2 per cent to 62 per cent. It is the Cement sector (10) which also showed a strong negative impact in the last two comparisons with gap years 10 and 12 recording output reductions due to final demand change ranging from 37 per cent to 78 per cent. In connection with these three sectors showing the largest negative impact it may be recalled that they had negative elements in the vectors of final demand, and in the case of Cement (10) the coverage is also not total in the basic input-output tables we have used.

The above table further reveals that in as many as 8 sectors we find a pronounced impact of final demand change on the sectoral output levels wherever comparisons are instituted with the 1963 final demand. This means that the structure and composition of final demand in the sixties was of a significantly different order. In particular we notice that the sectors on Paper and Printing (6), Leather and Rubber (7), Non-metallic Minerals (8), Chemicals and Petroleum (9), Iron and Steel (11), Metal Products and Machinery (13) and Electricity (15) have recorded more than 100 per cent increases in output levels because of changes in final demand alone. Most of these are modern manufacturing sectors whose final demand base was at a lower level prior to the sixties.

We have earlier considered broadly the changes in the composition of the aggregate final demand over the years in section 4.1.2. While changes in the composition of final demand did not look large in view of the dominant position of the Agriculture sector (1) their impact on sectoral output levels, under conditions of constant technology may be quite significant as found above. While considering the relative performance of the sectors over the years with reference to final demand changes it is necessary to note that the latter incorporates not only

changes in the sectoral composition of the said demand which may affect different sectors differentially, but also the structural changes, that is to say, the different categories of final demand - private and public consumption, investment, foreign trade, etc., - which may change at different rates, thus changing the relative importance of the categories as purchasers; and since the sectoral composition of demand differs for each category any change in structure will affect different sectors differentially. Since our final demand vectors are aggregate and cannot be broken down into different categories any further analysis to interpret the above noted behaviour of the sectors is not possible. In fact it is more important to recall here that our aggregate final demand vectors have been non-autonomously estimated as residuals. Perhaps this latter data limitation might lend a tinge of colour to our results which otherwise might have been clean and clear.

4.5.2 *The Complementary Behaviour of Final Demand Change and Technological Change in Influencing Sectoral Output Levels*

Let us now consider Vaccara's line of analysis and see whether our results in table 4.5.1 show the complementary behaviour of final demand change and technological change in influencing sectoral output levels as observed by her.

A perusal of changes in output levels due to final demand changes shows a wide range between the sectors and between the binary comparisons the range goes on increasing with increasing gap years, though not systematically. This range, shown in table 4.5.1, as in the case of Vaccara and Armstrong, is however considerably smaller than that for total change in sectoral output levels. This means that the sectoral output changes due to final demand change, under conditions of constant technology or nil technological change diverge less than the mean and the mean absolute deviation is smaller as compared to that for the actual total change in the sectoral output levels. This "narrowing" of the difference between sectoral output changes and the average change, if one considers output changes based on final demand changes only rather than actual total changes is "almost universal" according to Vaccara. Out table below also shows that in a majority of the sectors the divergence associated with final demand change is smaller than that of actual total output change. Table 4.5.2 shows the divergence of changes in the sectoral output levels from the mean of the 14 sector segment of the economy for the six binary comparisons and also the variation as measured by mean absolute deviation.

The above noted narrowing of the range and the average variation in the sectoral output changes due solely to final demand changes indicates that the influence of technological changes is to increase the variability in the total output changes. And according to Vaccara (1968, pp. 33-35), this further implies that, "in general, those

Table 4.5.2 : DIVERGENCE OF CHANGES IN SECTORAL OUTPUTS FROM THE MEAN (SIMPLE) FOR 14 SECTORS SEGMENT OF THE ECONOMY, 1951-1963

	Year	*1951;1953*			*1959;1963*			*1953;1959*		
	Gap Years	*2*			*4*			*6*		
	Sectors	*T*	*F*	*Total*	*T*	*F*	*Total*	*T*	*F*	*Total*
1.	Agriculture	-8.87	16.39	7.52	-121.39	-17.77	-139.16	-6.70	-11.12	-17.82
2.	Coke and Coal	8.25	-10.66	-2.41	-68.90	- 1.05	- 69.95	-3.38	-22.56	-25.94
3.	Other Mining	-4.98	-26.69	-31.67	-92.15	-15.31	-107.46	-77.50	9.57	-67.93
4.	Food, Drinks and Beverages	-13.22	2.27	-10.94	-110.02	-31.82	-141.84	0.94	-26.58	-25.64
5.	Textiles	-11.34	5.52	-5.82	-85.11	-18.84	-103.95	-13.12	13.81	0.69
6.	Paper and Printing	-6.51	13.71	7.20	-111.24	30.05	-81.19	17.58	-8.08	9.50
7.	Leather and Rubber	-4.62	28.40	23.79	-63.21	76.45	13.23	13.18	-32.66	-19.48
8.	Non-metallic Minerals	6.43	15.50	21.93	-38.00	70.59	32.59	-11.63	-28.11	-39.74
9.	Chemicals and Petroleum	0.67	19.57	-18.90	-131.15	77.27	-53.88	51.84	-49.42	2.42
10.	Cement	9.46	-1.31	8.15	25.25	-102.71	-77.46	-13.63	- 3.29	-16.92
11.	Iron and Steel	-21.93	-0.88	-22.81	-109.81	41.34	-68.47	49.55	-17.21	32.34
12.	Non-ferrous Metals	77.05	-31.45	45.59	1144.71	-141.56	1003.15	-116.07	36.21	-79.86
13.	Metallic Products and Machinery	-19.89	-8.88	-28.77	-122.94	20.78	-102.16	8.61	154.93	163.54
15.	Electricity	-10.50	17.66	7.16	-116.04	12.58	-103.46	100.33	-15.52	84.81
	Mean divergence (ignoring sign)	14.55	14.21	17.33	167.14	47.01	149.85	34.57	30.65	41.90

(Contd..)

Table 4.5.2 (Contd..)

	Year	*1951;1959*			*1953;1963*			*1951;1963*		
	Gap Years	*8*			*10*			*12*		
	Sectors	*T*	*F*	*Total*	*T*	*F*	*Total*	*T*	*F*	*Total*
1.	Agriculture	-14.45	7.96	-6.49	-75.21	-55.28	-130.49	-119.67	-29.75	-149.42
2.	Coke and Coal	6.19	-32.52	-26.33	-24.20	-45.55	-69.75	-38.18	-56.57	-94.75
3.	Other Mining	-65.64	-24.44	-90.08	-123.10	-46.22	-169.31	-141.94	-88.31	-230.25
4.	Food, Drinks and Beverages	-12.63	-22.03	-34.67	-55.48	-86.71	-142.20	-103.34	-81.24	-184.58
5.	Textiles	-24.87	23.60	-1.27	-42.82	-21.37	-64.19	-88.10	-7.02	-95.12
6.	Paper and Printing	12.81	13.17	25.98	-23.49	3.66	-19.83	-56.06	39.21	-16.85
7.	Leather and Rubber	15.51	-6.48	9.03	-1.63	33.37	31.74	-22.11	115.00	92.89
8.	Non-metallic Minerals	-6.87	-13.43	-20.30	2.04	-7.55	-5.51	-7.74	45.04	37.30
9.	Chemicals and Petroleum	45.07	-61.43	-16.36	-43.03	46.34	3.31	-72.11	15.32	-56.79
10.	Cement	-6.71	1.98	-4.73	87.74	-149.16	-61.42	82.63	-147.60	-64.97
11.	Iron and Steel	14.34	-8.79	5.55	-61.60	101.56	39.96	-123.34	89.45	-33.89
12.	Non-ferrous Metals	-54.83	-8.38	-63.21	365.04	-26.15	338.89	767.80	-125.13	642.67
13.	Metallic Products and Machinery	-14.08	120.57	106.49	-63.10	248.68	185.58	-118.32	189.35	71.03
15.	Electricity	106.17	10.23	116.40	58.83	4.37	63.20	40.49	42.32	82.81
		28.58	25.36	37.63	73.38	62.55	94.67	127.27	76.53	132.38

T = Change in output due to technological change.

F = Change in output due to changes in final demand.

(Concluded)

industries which had above average increases in final demand (direct and indirect) were also faced with increasing demand for their product because of changing technical requirements, while those industries which experienced below average increases, or actual decreases, in final demand were also industries whose output was in lessened demand because of changes in the technical requirements of production." "There is thus an indication that, in general, the two elements of change ... reinforced rather than offset one another" as she puts it.

Following Vaccara further, to study the above noted complementary nature of changes in final demand and technology in contributing to the differences in sectoral output changes we present in table 4.5.3 a frequency classification of the 14 sectors on the basis of total output change cross-classified according to output changes due to changes in final demand and technology. For purposes of comparison we have also presented therein Vaccara's U.S. and Armstrong's U.K. data appropriately classified. In view of the smaller number of our sectors we have not resorted to the five point frequency classification as done by Vaccara. Also, in view of the smaller number of frequencies in different classes no further statistical examination of the hypothesis of complementarity of the two factors of change has been carried out.

It is noticed that our data also show the above discussed complementary behaviour generally for the sectors and compare fairly well with the U.S. and U.K. data. In the category of above-average total output change, the above-average technological increases followed the above-average final demand increase in 60 per cent to 100 per cent of the cases, between the six binary comparisons. At the other end, in the category of below-average total output change the below-average total increases or actual decreases in technology followed the below-average increases or actual decreases in final demand in 33 per cent to 75 per cent of the cases between the said comparisons.

Interpreting the above Vaccara notes: "the fact that the two factors, technical coefficient change and final demand change tended to reinforce one another makes it seem likely that there are some basic underlying trends which influenced both these movements in the same direction", (1968, p.40), and considers that a sector which shows above-average increases for both final demand and technology reflects its "growing importance in all aspects of our modern day life" and similarly a sector which shows below-average increases in final demand and technology gives indications of the declining importance of it. In this light it is interesting to find that during the 12 year period 1951-63 the sectors on Textiles (5), Paper and Printing (6), Leather and Rubber (7), Non-metallic Minerals (8), Chemicals and Petroleum (9), and Electricity (15) show the said "growing importance in all aspects of modern

Table 4.5.3 : FREQUENCY CLASSIFICATION OF TOTAL SECTORAL OUTPUT CHANGES CROSS-CLASSIFIED ACCORDING TO OUTPUT CHANGES DUE TO CHANGES IN FINAL DEMAND AND TECHNOLOGY

		India : Comparison years with gap years						*U.S.A.*	*U.K.*
Classification Categories		*1951; 1953*	*1959; 1963*	*1953; 1959*	*1951; 1959*	*1953; 1963*	*1951; 1963*	*1947; 1958*	*1948; 1968*
		2	*4*	*6*	*8*	*10*	*12*		
100	*Total Output Change, above average*	7	12	6	8	11	11	18	20
110	*Final Demand Change, above average*	5	9	3	5	10	8	16	16
111	Technological Change, above average	4	6	2	3	10	6	13	7
112	Technological Change, below average	1	3	1	2	-	2	3	9
120	*Final Demand Change, below average*	2	3	3	3	1	3	2	4
121	Technological Change, above average	2	3	3	3	1	3	2	4
122	Technological Change, below average	-	-	-	-	-	-	-	-
200	*Total Output Change, below average*	7	2	8	6	3	3	24	18
210	*Final Demand Change, above average*	-	-	3	-	1	-	3	-
211	Technological Change, above average	-	-	-	-	-	-	-	-
212	Technological Change, below average	-	-	3	-	1	-	3	-
220	*Final Demand Change, below average*	7	2	5	6	2	3	21	18
221	Technological Change, above average	3	1	3	4	1	1	6	3
222	Technological Change, below average	4	1	2	2	1	2	15	15
	Total No. of Sectors	14	14	14	14	14	14	42	38

Source : Table No. 4.5.1(a), U.S.A. : Vaccara (1968, pp. 29-32); U.K. : Armstrong (1974, p. 27).

life". Three of the above sectors namely, Paper and Printing (6), Leather and Rubber (7) and Non-metallic Minerals (8) also show the said growing importance in most of the other binary comparisons also. In respect of these sectors therefore, one logically expects the above noted strong tendency to continue beyond 1963. At the other end the sectors of Agriculture (1) and Other Mining (3) are found to show "declining importance" in the 1951-1963 comparison. In 3 other binary comparisons also, Agriculture (1) is found to show the said declining importance. This obviously indicates that Agriculture had to wait for technological break-through which took place during the green revolution after 1965.

4.5.3 *Impact of Changing Technology on Sectoral Output Levels*

A look again at the Table 4.5.1 shows that the greatest positive impact of technological change on output levels occurred in the lowest ranking sector in the economy both with reference to gross output and final demand namely the Non-ferrous Metals sector (12) in all the binary comparisons, except the two involving 1959 as the terminal year and with gap years 6 and 8 and increases in output levels ranged from 83 per cent to the fantastic 1257 per cent. In the case of the said two binary comparisons, it is the Electricity sector (15) which shows a strong positive influence of technological change on output levels recording more than 100 per cent increases. At the other extreme, the largest negative impact on sectoral output level due to technological change occurred in the Other Mining sector (3) in the later 3 binary comparisons which were based on input-output tables of 8 or more years apart and the output reductions recorded ranged from 31 per cent to 58 per cent. The largest negative impacts of changes in technology were also recorded in the Iron and Steel sector (11) (1951-53 comparison), Chemicals and Petroleum (9) (1959-63 comparison), and Non-ferrous Metals (12) (1953-59 comparison) where output decreases were of the order of 11 per cent, 18 per cent and 111 per cent respectively.

The impact of technological changes on the output levels of the sectors of Agriculture (1), Food, Drinks and Beverages (4) and Metal Products and Machinery (13) is within 10 per cent limits. For the Textiles sector (5) also it is within 10 per cent limits except when it is compared with the 1963 technology. These being final demand goods' sectors changes in technology have, obviously, only minor impact on their output levels. The sectors on Coke and Coal (2), Non-metallic Minerals (8) and Cement (10), show more pronounced impact of technological change on their output levels whenever comparisons are made with the 1963 technology. This indicates that in the sixties the use of these inputs in other industries has increased. In the case of Paper and Printing (6), Leather and Rubber (7) and Electricity (15) the use of their sectoral outputs as inputs shows an increasing trend from 1951 to 1963. It

might be possible to forecast these inputs by fitting an appropriate trend function. In the case of Chemicals and Petroleum (9), Iron and Steel (11) and Non-ferrous Metals (12) no uniform pattern of impact is observable. Estimation of output levels based on input-output tables of earlier vintage for these sectors results in large errors. The output flows of these sectors into different absorbing sectors of the economy needs serious attention while using an input-output table for forecasting purposes.

4.5.4 *Relative Importance of Changes in Final Demand and Technology on the Changes in Sectoral Output Levels*

Table 4.5.2 presented earlier shows that the average divergence of output for a sector due to technological change ranges from 14 points to 167 points, which is almost twice as large as the corresponding average divergence range for output due to final demand change viz., 14 to 76 points between the six binary comparisons. And within each of the comparisons the average divergence of output due to technological change is greater than that due to final demand change, except in the earliest period comparison of 1951 and 1953 where output divergence due to final demand change is observed to be marginally larger than that due to technological change. This result, which is contrary to that observed both by Vaccara and Armstrong for U.S.A. (1947-58) and U.K. (1948-68) respectively, who find mean divergence of output due to final demand change greater than that due to technological change, together with our higher levels of mean divergencies for the total as also for the two factors than those obtained by the above scholars, may perhaps be typical of a developing economy recently set on the path of technological transformation, contrasting with the large-established developed industrial economies with stable relative position of sectors and with limited scope for further technological change. Unfortunately we could not lay our hands on any analogous study for any other developing economy to check our results. It should also be borne in mind that the above results pertain to the 14 sector segment of the 18 sector economy. Perhaps the mean divergencies might get reduced if calculations are made at a disaggregated level but not to the extent of altering the basic result.

However, from Table 4.5.1, it is seen that for the economy as a whole the absolute magnitude of the impact on output change due to final demand change exceeded that due to technological change universally in all the six binary comparisons indicating final demand changes as a dominant factor in explaining the changes in output, which we have seen in the previous chapter. At the individual sector level also it is seen from the same table that a smaller number of sectors (4 to 6 out of 14) show that the absolute magnitude of the impact on output change due to technological change exceeded that due to final demand change, in all the binary comparisons except the two in the

time frame 1953-59 and 1951-59 involving gap years of 6 and 8. In these two comparisons a greater number of sectors (9 to 10 out of 14)[15] have shown larger changes in output levels due to technological change than due to final demand change. Barring the sectors on Agriculture (1), Textiles (5), Cement (10) and Metal Products and Machinery (13) all other sectors are observed to show the impact of technological change on output levels exceeding that of final demand change. This means that for these two comparisons involving the year 1959, the changing technology seems to be somewhat more important factor than changes in final demand in explaining the changes in the output levels of a larger number of sectors of the economy than found in the case of the other comparisons. This result is also in consonance with our averment in the earlier chapter that up to a period of 8 years the changes in technology are not of so significant an order as to vitiate output projections by using an input-output table of an 8 year vintage.[16] In the light of the above result it is again tempting to consider the period around 1959 as a watershed regarding changes in technology (direct and indirect). It may be recalled that we have similarly inferred about 1959 as a sort of a watershed while considering the time pattern of technological change on the basis of direct coefficient changes.

However, one expects that if there is a major technological change in most of the sectors around 1959, this change should get itself preserved in the post-1959 period, giving similar results for 1953-63 and 1951-63 comparisons to those observed in the case of 1959 comparisons under discussion. But we do not find the dominance of technological change over final demand change in influencing the sectoral output changes in the said post-1959 comparisons. This is somewhat puzzling. Perhaps, the inherent difficulties in making all the input-output tables strictly comparable may have some bearing on this. In spite of the above discordance, the evidence strongly seems to suggest that a major technological change took place around the middle year of the Second Five Year Plan (1956-61) which pioneered technological transformation in the economy.

In respect of all other binary comparisons, particularly the one that covers the entire time period under study (1951-63), the changing level and pattern of final demand seems to be a somewhat more important factor than changes in technology in explaining the sectoral changes in output levels. Across the binary comparisons, the most common set of sectors which consistently shows the absolute magnitude of the impact of final demand change exceeding that due to technological change contained the following sectors which are mostly final demand goods' sectors: Agriculture (1), Textiles (5), Paper and Printing (6), Leather and Rubber (7), Chemicals and Petroleum (9) and Metal Products and Machinery (13). On the other hand the corresponding common set showing the absolute magnitude of

the impact on output change due to technological change exceeding that due to final demand change consisted of the two Mining sectors (2 and 3) and mostly mining-based sectors of Cement (10), Non-ferrous Metals (12) and Electricity (15).

4.5.5 *The Interaction Effect at the Sectoral Level*

In Sections 3.1 and 3.4.1 of the previous chapter we have discussed in detail about the existence and significance of the interaction effect and considered its magnitude and behaviour for the economy as a whole. We now consider its segregate at the sector level with respect to its magnitude and behaviour. In Tables 4.5.4(a) and 4.5.4(b) we present the computation of the interaction effect by use of the base year and terminal year weights respectively, for the 14 individual sectors and present the results as percentage to gross output of the base year in the six binary comparisons. All the main effects and the interaction are linearly additive.

It is observed that for the 14 sector segment of the economy the average interaction effect is small in magnitude indicating the large degree of similarity between the Laspeyres type base-year-weighted estimates of output change due to changes in technology and final demand and the corresponding Paasche type terminal-year-weighted estimates of the same for the different binary comparisons. But between the sectors the range of it, as shown in the tables, is found to exceed 100 percentage points in almost all comparisons except the initial one of 1951 and 1953. And excluding the minor sector of Non-ferrous Metals (12) which throws extreme results, the said range between sectors is found to exceed 65 percentage points in almost all comparisons with the above noted exception. It is further observed that these ranges between sectors, of the interaction effect are smaller than those for the corresponding main effects in almost all comparisons, except for 1959-63 when the above noted sector of Non-ferrous Metals (12) is included. It is not only the range but the variation as measured by the mean absolute deviation is also smaller than that of the corresponding main effects in all comparisons, again with the above noted exception of 1959-63 comparison with the inclusion of the said Non-ferrous Metals sector (12). This indicates that though the differential impact of technological change and final demand change on the change in the sectoral output levels is small in magnitude, it shows a differential pattern between sectors.

A scan of the above tables for the relative magnitude of the interaction effect sector by sector shows that the said effect is smaller in magnitude than either of the main effects in a majority of sectors in every binary comparison indicating the large degree of similarity between the Laspeyres and Paasche type estimates of sectoral output change due to the main effects. However for some

Table 4.5.4(a) : COMPUTATION OF INTERACTION EFFECT BY USE OF BASE YEAR WEIGHTS, EXPRESSED AS PERCENTAGE TO BASE YEAR SECTORAL GROSS OUTPUTS IN THE INDIAN ECONOMY, 1951-1963

	Year	*1951;1953*			*1959;1963*			*1953;1959*		
	Gap Years	*2*			*4*			*6*		
	Sector	*T*	*F*	*I*	*T*	*F*	*I*	*T*	*F*	*I*
1.	Agriculture	2.22	18.09	0.16	-7.70	24.38	-1.71	-1.72	10.99	0.11
2.	Coke and Coal	20.37	-7.95	-1.88	29.27	25.56	29.35	3.96	1.89	-4.59
3.	Other Mining	7.10	-24.00	-1.82	5.60	10.88	30.20	-61.22	42.97	-22.48
4.	Food, Drinks and Beverages	-1.93	4.17	-0.23	2.90	9.56	-0.15	5.82	-4.58	0.32
5.	Textiles	-0.12	7.35	-0.10	25.25	19.98	4.96	-6.20	37.84	-3.76
6.	Paper and Printing	4.59	15.42	0.15	14.15	83.89	-25.09	28.38	19.85	-11.53
7.	Leather and Rubber	6.24	29.84	0.66	57.40	125.52	-15.55	15.98	-12.73	4.46
8.	Non-metallic Minerals	17.05	16.72	1.12	84.71	121.76	-19.74	-5.11	-4.45	-2.99
9.	Chemicals and Petroleum	12.41	-17.23	-1.13	-2.16	134.72	-32.30	36.90	-47.22	39.93
10.	Cement	20.01	-0.19	1.28	158.38	-41.12	-40.57	-7.83	19.64	-1.54
11.	Iron and Steel	-9.94	1.72	-1.63	-24.79	54.81	55.65	78.20	28.56	-47.23
12.	Non-ferrous Metals	92.35	-25.60	-8.20	775.09	-582.71	964.90	-50.69	118.75	-120.72
13.	Metallic Products and Machinery	-8.19	-6.56	-1.07	-6.33	65.84	-7.54	7.02	170.46	13.25
15.	Electricity	0.81	19.59	-0.28	-3.20	52.15	1.73	103.23	4.51	4.26
	All 14 sectors	1.85	12.47	-0.03	0.14	26.19	-0.29	0.61	12.39	-0.31
	Range	102.29	55.44	9.48	799.88	717.43	1000.47	139.42	217.68	160.65
	Mean absolute deviation	13.88	15.56	1.40	85.42	83.72	87.79	29.36	34.95	19.75

(Contd..)

Table 4.5.4(a) (Contd..)

	Year	1951;1959			1953;1963			1951;1963		
	Gap Years	8			10			12		
	Sector	T	F	I	T	F	I	T	F	I
1.	Agriculture	1.46	29.50	0.81	-8.69	36.95	-2.50	-6.74	61.96	-3.72
2.	Coke and Coal	23.44	-9.94	-1.57	30.61	34.96	20.93	49.71	10.08	46.37
3.	Other Mining	-38.74	7.81	-20.89	-61.10	41.50	6.54	-38.97	-6.57	16.21
4.	Food, Drinks and Beverages	3.69	-0.37	0.28	9.19	3.67	1.19	7.18	8.05	1.12
5.	Textiles	-6.09	47.72	-4.64	18,09	65.25	8.72	17.73	77.52	10.50
6.	Paper and Printing	33.87	39.56	-9.18	32.29	85.14	18.99	41.17	115.20	27.70
7.	Leather and Rubber	27.49	10.83	8.97	65.70	126.40	-4.11	83.25	199.12	11.44
8.	Non-metallic Minerals	12.64	11.41	-6.09	72.01	88.12	-9.38	108.09	139.64	-9.51
9.	Chemicals and Petroleum	47.29	-53.87	28.48	29.08	144.15	-13.66	39.21	105.40	-0.48
10.	Cement	10.11	24.13	-0.70	176.22	-34.98	-46.40	216.09	-35.37	-44.77
11.	Iron and Steel	49.28	31.47	-36.94	4.50	193.35	-1.63	-8.31	183.25	-7.91
12.	Non-ferrous Metals	-0.99	50.79	-74.75	319.97	-45.55	220.72	559.24	-354.92	639.26
13.	Metallic Products and Machinery	-1.86	138.13	8.48	-6.81	330.66	17.99	-13.00	273.43	11.52
15.	Electricity	116.70	26.10	11.86	99.36	70.60	49.50	119.98	100.56	63.20
		2.36	26.46	-0.02	0.65	41.31	0.08	3.03	58.27	1.02
		153.44	192.00	108.23	381.07	376.21	267.12	598.21	628.35	648.03
		25.81	26.68	15.26	66.31	70.35	30.15	92.17	100.12	63.55

T = % change due to Technology

F = % change due to Final Demand

I = % change due to Interaction of Technology and Final Demand.

(Concluded)

Table 4.5.4(b) : COMPUTATION OF INTERACTION EFFECT BY USE OF TERMINAL YEAR WEIGHTS, EXPRESSED AS PERCENTAGE TO BASE YEAR SECTORAL GROSS OUTPUTS IN THE INDIAN ECONOMY, 1951-1963

	Year	*1951;1953*			*1959;1963*			*1953;1959*		
	Gap Year	*2*			*4*			*6*		
	Sector	*T*	*F*	*I*	*T*	*F*	*I*	*T*	*F*	*I*
1.	Agriculture	2.38	18.25	-0.16	-9.41	22.67	1.71	-1.60	11.09	-0.11
2.	Coke and Coal	18.49	-9.83	1.88	58.62	54.91	-29.35	-0.63	-2.70	4.59
3.	Other Mining	5.28	-25.82	1.82	35.80	41.08	-30.20	-83.70	20.49	22.48
4.	Food, Drinks and Beverages	-2.15	3.94	0.23	2.75	9.41	0.15	6.13	-4.26	-0.32
5.	Textiles	-0.22	7.25	0.10	30.21	24.94	-4.96	-9.97	34.09	3.76
6.	Paper and Printing	4.74	15.56	-0.15	-10.94	58.80	25.09	16.85	8.32	11.53
7.	Leather and Rubber	6.90	30.50	-0.66	41.86	109.96	15.55	20.44	-8.27	-4.46
8.	Non-metallic Minerals	18.17	17.84	-1.12	64.97	102.02	19.74	-8.10	-7.44	2.99
9.	Chemicals and Petroleum	11.28	-18.35	1.13	-34.46	102.42	32.30	76.83	-7.29	-39.93
10.	Cement	21.30	1.09	-1.28	117.81	-81.69	40.57	-9.37	18.10	1.54
11.	Iron and Steel	-11.57	0.09	1.63	30.86	110.46	-55.65	30.97	-18.67	47.23
12.	Non-ferrous Metals	84.15	-33.80	8.20	1740.00	382.18	-964.90	-171.41	-1.97	120.72
13.	Metallic Products and Machinery	-9.26	-7.63	1.07	-13.87	58.30	7.54	20.27	183.71	-13.25
15.	Electricity	0.53	19.31	0.28	-1.46	53.88	-1.73	107.49	8.77	-4.26
	All 14 sectors	1.82	12.43	0.03	-0.16	25.89	0.29	0.30	12.08	0.31
	Range	95.92	64.30	9.48	1774.46	463.87	1000.47	341.90	202.38	160.65
	Mean absolute deviation	8.13	14.46	0.87	34.88	45.16	20.30	30.16	25.80	12.01

(Contd..)

Table 4.5.4(b) (Contd..)

	Year	*1951;1959*			*1953;1963*			*1951;1963*		
	Gap Year	*8*			*10*			*12*		
	Sector	*T*	*F*	*I*	*T*	*F*	*I*	*T*	*F*	*I*
1.	Agriculture	2.56	30.02	-0.81	-11.19	34.44	2.50	-10.46	58.24	3.72
2.	Coke and Coal	21.87	-11.51	1.57	51.54	55.89	-20.93	96.08	56.46	-46.37
3.	Other Mining	-59.63	-13.08	20.89	-54.56	48.04	-6.54	-22.76	9.64	-16.21
4.	Food, Drinks and Beverages	3.97	-0.09	-0.28	10.38	4.86	-1.19	8.30	9.17	-1.12
5.	Textiles	-10.73	43.08	4.64	26.81	73.97	-8.72	28.23	88.02	-10.50
6.	Paper and Printing	24.69	30.38	9.18	51.28	104.13	-18.99	68.87	142.90	-27.70
7.	Leather and Rubber	36.46	19.80	-8.97	61.59	122.29	4.11	94.69	210.56	-11.44
8.	Non-metallic Minerals	6.55	5.32	6.09	62.63	78.73	9.39	98.58	130.13	9.51
9.	Chemicals and Petroleum	75.77	-25.38	-28.48	15.42	130.49	13.66	38.73	104.92	0.48
10.	Cement	9.40	23.44	0.70	129.81	-81.38	46.40	171.32	-80.14	44.77
11.	Iron and Steel	12.33	-5.46	36.94	2.87	191.72	1.63	-16.22	175.34	7.91
12.	Non-ferrous Metals	-75.75	-23.95	74.75	540.69	175.17	-220.72	1198.51	284.34	-639.26
13.	Metallic Products and Machinery	6.62	146.60	-8.48	11.17	348.65	-17.99	-1.48	284.95	-11.52
15.	Electricity	128.56	37.96	-11.86	148.86	120.10	-49.50	183.18	163.76	-63.20
	All 14 sectors	2.34	26.43	0.02	0.73	41.39	-0.08	4.05	59.29	-1.02
	Range	204.31	178.78	103.23	595.25	430.03	267.12	1121.27	365.09	648.03
	Mean absolute deviation	29.08	28.79	10.69	48.58	78.95	15.50	63.28	82.26	19.34

T = % change due to Technology;

F = % change due to Final Demand;

I = % change due to Interaction of Technology and Final Demand.

(Concluded)

of the sectors, in some of the binary comparisons, the magnitude of the interaction effect is found to exceed either of the main effects or both indicating a large divergence between the Laspeyres and Paasche-type estimates of the said output change due to the main effects. The Table 4.5.5 abstracts from the above tables the sectors showing such large interaction effect typologically classified for the different binary comparisons.

From the basic formulation given in equation (3) in section 3.1 it is found that a large interaction effect greater than, say, the main effect of technology emerges under conditions of larger final demand change relative to changes in technology (direct and indirect). On the other hand, a large interaction effect greater than the main effect of final demand occurs under conditions of larger technological change relative to changes in final demand. And an interaction effect greater than both the main effects is observed when both final demand change and technological change are large. From the Table 4.5.5 however it is observed that about two-thirds of the entries of the sectors, showing large interaction effect on Laspeyres basis are found to change their typological category on Paasche basis and only 8 entries of the following 6 sectors show typological stability on both the bases in the different binary comparisons specified below. The sectors on Cement (10) (1951-53), Non-ferrous Metals (12) (1953-63) and Other Mining (3) (1951-63) have shown interaction effect greater than final demand effect because of a relatively larger technological change (direct and indirect) in the above specified binary comparisons. The sectors on Paper and Printing (6) (1959-63) and Metal Products and Machinery (13) (1959-63; 1951-59; 1953-63) have shown, on the other hand, interaction effect greater than technology effect on account of relatively larger final demand change in the binary comparisons noted above. The sector on Coke and Coal (2) alone has shown the interaction effect greater than both the main effects in the 1953-59 comparison. It is interesting to note that the existence of a large interaction effect is confined only to the intermediate goods' sectors as indicated by almost all the sector entries in the above table. Further, the binary comparisons in which the above enumerated sectors show large interaction effects, involve, in most of the cases, the terminal year 1963.

Another look at the above Tables 4.5.4(a) and (b) shows that a pronounced impact of interaction effect is observed, whenever comparisons are instituted with the terminal year 1963, in 7 out of 14 sectors, as was earlier observed in the case of the main effects also, though not for the same set of them. This indicates that a large change in sectoral output levels either due to a larger change in technology or final demand or both entails a larger differential impact of one on the other.

Table 4.5.5 : TYPOLOGY OF SECTORS SHOWING LARGE INTERACTION EFFECT

	Laspeyres — Base year weighted formulation			*Paasche — Terminal year weighted formulation*		
Binary Comparisons	*Interaction greater than Technology effect*	*Interaction greater than Final Demand effect*	*Interaction greater than both main effects*	*Interaction greater than Technology effect*	*Interaction greater than Final Demand effect*	*Interaction greater than both main effects*
1951;1953		Cement (10)			Cement (10) Iron and Steel (11)	
1959;1963	Paper & Printing (6) Chemicals and Petroleum (9) Metal Products and Machinery (13)		Coke and Coal (2) Other Mining (3) Iron and Steel(11) Non-ferrous Metals (12)	Paper & Printing (6) Iron and Steel (11) Metal Products and Machinery (13)	Non-ferrous Metals (12)	
1953;1959	Other Mining (3) Chemicals and Petroleum (9)	Iron and Steel (11) Metal Products and Machinery (13)	Coke and Coal (2) Non-ferrous Metals (12)		Other Mining (3) Paper & Printing (6) Chemicals and Petroleum (9) Non-ferrous Metals (12)	Coke and Coal (2) Iron and Steel (11)
1951;1959	Iron and Steel (11) Metal Products and Machinery (13)		Non-ferrous Metals (12)	Metal Products and Machinery (13)	Other Mining (3) Food, Drinks and Beverages (4) Non-metallic Minerals (8)	Iron and Steel (11)
1953;1963	Metal Products and Machinery (13)	Cement (10) Non-ferrous Metals (12)		Metal Products and Machinery (13)	Non-ferrous Metals (12)	
1951;1963		Coke and Coal (2) Other Mining (3) Iron & Steel (11)	Non-ferrous Metals (12)	Metal Products and Machinery (13)	Other Mining (3) Non-ferrous Metals (12)	

Looked at from the index number point of view a large divergence between the Laspeyres and Paasche basis of estimates of the sectoral output change either due to technological change (direct and indirect) or final demand change entails a wider gap between the base year and the terminal year and results in "homogeneity error" i.e. within a binary comparison, the estimates of sectoral output change do not refer to the "same basket of goods" produced or used respectively implying changing product-mix and changing composition of final demand. Hence in case of the sectors and binary comparisons considered above one cannot rely on the estimates of sectoral output change due to final demand change or technological change based solely on Laspeyres or Paasche basis or any cross of them.

4.5.6 *Some Limitations of Impact Analysis*

We have more than once noted that our definition of technological change includes many factors which are not related to "changes in the technological requirements for producing a fixed basket of final goods". In fact we have equated changes in technical relationships as reflected in the input-output coefficient differences to technological change and have not adopted the "technical" definition of technological change in our empirical analysis. Also we have not attempted to further isolate the various "unrelated factors" that are confounded in our estimate of technological change, direct as well as direct and indirect. However in section 3.3 and also at the outset of this chapter we have pointed out the technical reasons as to why coefficients change over time within the input-output framework, but have not carried out any economic analysis of the same further.

In the context our impact analysis above, leading to factorization of change in output levels between changes in technology and final demand it is important to recall the data limitation that our final demand vectors are not autonomously determined. Thus, though our analysis suffers from a less rigorous definition of technological change on the one hand and less accurate data base regarding final demand on the other, it seems to give broad indications of intertemporal and intersectoral changes of outputs in the economy in terms of changes in technology and final demand.

Even so, the following comments by Garry Fromm are well worth noting as further limitations. Commenting on Vaccara-Simon research (1968) which also applies to ours, he says: "the Vaccara-Simon computations give no clue as to why output and coefficient shifts have taken place. They do not reveal to what extent the changes are due to technical progress or to reactions to altered relative prices. No information is gained as to whether the technical progress is capital or labour augmenting, whether it is embodied or disembodied, or whether it is merely the consequence of younger average vintages of equipment or

labour education. Nothing is learned about capital-labour substitutions or their consequences. These, of course, are all questions revolving about knowledge of production functions. Unfortunately, the input-output assumptions of Vaccara and Simon preclude acquiring any insights in that regard. Nevertheless, their paper is an interesting, although simplistic, initial attempt to provide first approximations of the output changes associated with shifting technical coefficients and final demands."(Vaccara, 1968, p.66.)

Notes

1. Kamath, J. observes : "From the data given in the different schemes, it looks that in registering the output no distinction has been made between producer's price and purchaser's price. The schemes report any value of output. The inputs, of course, are in purchaser's prices. But it would not be out of place to assume that in the case of small industries the commodity is directly sold to the customer and the producer-purchaser price differences are not significant. Such an assumption is made in this study... and the accuracy of the values would be limited by the validity of this assumption." (1971, p. 71.)

2. For an anti-view of deflation of value coefficients to study their stability in a time frame *vide* Tilanus (1966, p. 37.)

3. In this case the third term of equation (3) takes the form $[Y^{54}(C^{54} - C^{58}) - Y^{58}(C^{54} - C^{58})]$.

4. *Vide* section 4.2 of Chapter 4.

5. As per Table 3.4.6(a) and in 2 cases only as per Table 3.4.6(b).

6. On the usefulness of the Linkage concept *vide* Raj, K.N., (1976).

7. Also *vide* Kundu (1976) for the details about the convergence theorem relating to technology matrix and the original references to the same.

8. In the Chenery and Watanabe classification Hirschman (1958, p. 107) allots the first and last priority to the sectors that have high-backward-high-forward and low-backward-low-forward linkages respectively. Second and third priority are assigned to the sectors that have high-backward-low-forward and low-backward-high-forward linkages respectively. Within each category, the sectors are ranked according to the combined value of backward and forward linkage. This rank ordering of the sectors in terms of potential linkage generation constitutes an important step in the empirical formulation of Hirschman's strategy of economic development.

9. The rank correlation coefficients between Hirschman's ordinal ranking scheme and our rankings of the sectors based on decreasing order or linkage coefficients for direct flows (BL_j) and direct and indirect flows (TL_j) are very much higher and positive indicating that both the ranking systems are not significantly different though they do not exhibit one to one correspondence. The intertemporal rank correlation coefficients based on Hirschman's ordinal ranks are also high and positive and show that rankings over the years are also not significantly different. However a comparison of the magnitudes of intertemporal correlation coefficients based on Hirschman ranks and those based on direct backward linkage ranks and direct plus indirect linkage ranks given in Tables 4.2.1(b) and 4.2.2(b) shows that of the three sets of correlation coefficients those based on Hirschman ranks are the smallest, indicating that Hirschman rank ordering does not as closely fit out data as the natural rank ordering based on decreasing order of the individual linkage coefficients does. The rank correlation coefficients based on Hirschman's ordinal ranking are given below:

Year	Intertemporal			With BL_j	With TL_j
	1953-54	1959	1963		
1951-52	74412	.53824	.73235	.85588	.85588
1953-54		.50294	.71618	.72059	.70588
1959			.88235	.82058	.85000
1963				.76765	.70882

10. To do away with the problem of minor inputs, as also to facilitate the handling of large coefficient matrices for comparison purposes, the concept of "Framework coefficients" is introduced in input-output analysis. *Vide* for example Simpson, David and Tsukui, Jinkichi (1965). In the context of our 18 sector model, introduction of the concept in our analysis would be a waste of information.

11. Obviously the only component added by Domar in the above formulation to Leontief's desiderata is the denominator of the weighting factor to facilitate formulation to an index form. Quoting Leontief (1953, p. 28) he says that Leontief adds that "the weight is the mean value of the input, without specifically stating what the denominator of the weight is" (Domar, 1961, p. 727n). He further states that he has confirmed the denominator weight element with Leontief.

12. I_j will measure the changes from c to b in the period b to c.

13. *Vide* section 4.2, re: measurement of forward linkage on the basis of row coefficients table.

14. The analysis and interpretation used in this section heavily draws on the earlier author and Armstrong also uses the same. But it is important to note that Vaccara factors out changes in the industry real product or value added rather than output. She notes : "Since the total final demand is always equal to the total value added, no matter what technical relationships, changing technical relationships can only affect the industry distribution of real product, not its total." (1968, p.35.) The output totals resulting from matrix multiplication have been converted to estimates of value added by applying value added/output ratio. Hence she gets the all-industries index for change in real product due to technical coefficient change as 100. The final results are cast in the form of index numbers. Though Armstrong's data consists of outputs and their change due to the two factors are cast in the form of percentages changes as we have done above, it is surprising that his average percentage output change due to technical coefficients is also near zero. Perhaps technological changes in as developed an industrial economy as U.K., with stable relative position of sectors (commodities) the impact on output of technological changes during the period may be of that insignificant order.

15. Since our results in Table 4.5.1 are bidirectional averages using technology and final demand of both the initial and terminal year as weights which confound the interaction element in the main effects, a comparison of the results based on unidirection weights of the initial year shows that only two sectors, namely Chemicals and Petroleum (9) and non-ferrous Metals (12) shift their classification to the one showing impact of final demand change exceeding that of technology, but also throws a large interaction element, in respect of the two comparisons under discussion. Similar shift in respect of the unidirectional result based on terminal year weights is confined to only one sector viz. Coke and Coal (2), in the case of 1953-59 comparison. Thus the unidirectional results also show a greater number of sectors showing larger changes in output levels due to technological change. See Tables 4.5.4(a) and (b) in section 4.5.5.

16. The evidence of the western industrial economies suggests that the input-output coefficients change relatively slowly over time and consequently little error is introduced if input-output tables of older vintage are used to generate gross outputs from given final demand vectors. (Tilanus, 1966.) An unpublished discussion paper of the University of Essex finds indicators in the case of Soviet Union, that over the seven period the overall material input-output ratios did not change drastically.

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APPENDIX

Tables to Chapter II	:	A Series
Tables to Chapters III and IV	:	B Series

Table A 2.4.1 : COMMODITY COVERAGE AND WEIGHTING DIAGRAM, USED FOR CONSTRUCTION OF INDEX NUMBER OF WHOLESALE PRICES IN INDIA BY THE ECONOMIC ADVISER, GOVERNMENT OF INDIA

I.	FOOD ARTICLES (504)	1,000
	(a) Cereals	382
	i) Rice	224
	ii) Wheat	106
	iii) Jowar	19
	iv) Bajra	10
	v) Barley	10
	vi) Maize	9
	vii) Ragi	4
	(b) Pulses	84
	i) Gram	30
	ii) Other pulses	54
	(c) Fruits & Vegetables	45
	i) Potatoes	9
	ii) Onions	3
	iii) Oranges	6
	iv) Bananas	24
	v) Cashewnuts	3
	(d) Milk and Ghee	167
	i) Milk	93
	ii) Ghee	74
	(e) Edible Oils	93
	i) Groundnut	38
	ii) Gingelly	9
	iii) Mustard	26
	iv) Coconut	9
	v) Vanaspati	11
	(f) Fish, Eggs and Meat	34
	i) Fish	10
	ii) Eggs	8
	iii) Meat	16
	(g) Sugar and Gur	95
	i) Sugar	35
	ii) Gur	60
	(h) Other Food Articles	100
	i) Tea	38
	ii) Coffee	3
	iii) Spices	43
	iv) Betelnuts	11
	v) Salt	5
II.	LIQUOR AND TOBACCO (21)	1,000
	(a) Liquors	
	i) Liquors	59
	(b) Tobacco	941
	i) Tobacco, Raw	760
	ii) Tobacco, Manufactured	181
III.	FUEL, POWER, LIGHT AND LUBRICANTS (30)	1,000
	(a) Coal	297
	(b) Mineral oils	479
	i) Kerosene Oil	86
	ii) Petrol	247
	iii) Aviation Spirit	24
	iv) Diesel Oil	58
	v) Lubricating Oils	64
	(c) Electricity	171
	(d) Castor Oil	53
IV.	INDUSTRIAL MATERIALS RAW MATERIALS (155)	1,000
	(a) Fibres	393
	i) Cotton	204
	ii) Jute	150
	iii) Hemp	14
	iv) Wood	13
	v) Silk	12
	(b) Oilseeds	388
	i) Groundnut	177
	ii) Linseed	32
	iii) Castorseed	10
	iv) Gingelly seed	31
	v) Rapeseed	67
	vi) Cottonseed	35
	vii) Copra	36
	(c) Minerals	14
	i) Iron ore	2
	ii) Mica	9
	iii) Manganese ore	3

(Contd..)

Table A 2.4.1 (Contd..)

(d)	Other Industrial Raw Materials	205
i)	Hides	26
ii)	Skins	16
iii)	Tanning Materials	2
iv)	Sugarcane	65
v)	Rubber	5
vi)	Lac	16
vii)	Logs and Timber	72
viii)	Bamboos	3
V.	MANUFACTURED ARTICLES (290)	1,000
A.	Intermediate Industrial Products	141
i)	Linseed Oil	19
ii)	Leather	23
iii)	Cotton yarn	53
iv)	Rayon yarn	20
v)	Coir yarn	
vi)	Metals	26
(a)	Pig iron	3
(b)	Semis	3
(c)	Aluminium	3
(d)	Brass	5
(e)	Zinc spelter	3
(f)	Copper	6
(g)	Tin	1
(h)	Lead	1
(i)	German Silver	1

(Concluded)

Source : Economic Adviser, Government of India, "Index Number of Wholesale Prices in India" (Revised Series), Annual Number, April 1953 - December 1961, 1962, Appendix II, pp. 54-55.

Table A 2.4.3(a) : INPUT-OUTPUT TABLE FOR 1951-52

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(u)
1. Agriculture	155955	36	74	53250	11442	162	1047	451	342	235	7	4	252	393	-	669	6103	655	231077
2. Coke and Coal	69	363	-	237	268	82	64	155	130	126	99	34	108	123	605	1605	89	91	4248
3. Other Mining	664	135	402	494	381	30	89	870	235	127	359	392	182	1808	147	239	3839	191	10584
4. Food, Drinks and Beverages	5695	11	-	9325	77	29	92	-	649	-	-	-	7	-	-	136	44	121	16186
5. Textiles(All)	419	-	-	3	17411	20	512	2	-	-	-	-	70	-	-	37	42	98	18614
6. Paper and Printing	30	13	-	344	163	697	48	101	62	57	7	-	24	114	-	145	8	80	1893
7. Leather and Rubber	42	1	-	-	-	3	597	3	-	-	-	-	87	-	16	18	620	195	1582
8. Non-metallic Minerals	2221	-	88	554	17	6	6	76	91	-	8	-	49	4825	1	289	108	-	8339
9. Chemicals and Petroleum	1452	137	6	254	1653	342	233	246	2574	4	63	21	280	1222	-	132	210	6207	15036
10. Cement	2	-	-	-	-	-	-	4	-	57	-	-	12	3009	-	38	-	-	3122
11. Iron and Steel	138	-	28	27	107	8	38	203	-	28	2319	130	4133	4204	152	563	-	-	12078
12. Non-ferrous Metals	-	-	-	47	1	3	15	5	58	-	332	431	1266	1	11	31	-	91	2292
13. Metallic Products and Machinery	2866	297	252	756	3	-	2	1	33	-	-	3	701	3497	311	2507	3336	273	14838
14. Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15. Electricity	122	133	61	151	837	73	25	29	69	61	100	7	94	-	175	127	147	15	2226
16. Railway Transport	238	52	12	1498	894	171	70	119	206	148	329	121	541	1015	21	246	589	417	6687
17. Other Transport	682	13	-	998	722	62	202	28	235	33	52	3	90	729	8	141	70	463	4531
18. Other Industries *	2890	78	26	627	116	161	601	614	107	37	18	-	97	3509	-	-	31	1085	9997
Total	173485	1269	949	68565	34092	1849	3641	2907	4791	913	3693	1146	7993	24449	1447	6923	15236	9992	363330
Output	600578	6327	14193	119216	73035	6856	9550	13224	20966	2574	11346	2013	25435	70452	4300	36478	33803	26692	

* This sector consists of two sectors, one is unclassified of large scale and another is other production of small scale.

Table A 2.4.3 (b) : INPUT-OUTPUT TABLE FOR 1953-54

(Rs. in lakh at 1952-53 producers' prices)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(u)
1. Agriculture	189120	40	96	58332	13175	216	1537	1013	661	287	12	6	500	581	-	598	10129	1540	277843
2. Coke and Coal	55	332	-	239	291	90	55	207	251	140	640	45	121	146	729	1774	110	118	5343
3. Other Mining	557	161	425	579	459	44	95	1071	525	204	623	603	253	2021	148	238	3891	233	12130
4. Food, Drinks and Beverages	5793	7	-	7778	101	22	78	1	767	-	-	-	6	-	-	89	147	173	14962
5. Textiles(All)	278	-	-	4	18819	23	556	2	-	-	-	-	64	-	-	54	76	98	19974
6. Paper and Pringing	21	11	-	358	213	839	74	150	114	76	10	-	27	164	-	118	67	132	2374
7. Leather and Rubber	34	-	-	-	-	5	861	8	-	-	-	-	152	-	29	25	1071	353	2538
8. Non-metallic Minerals	2686	-	107	510	19	6	4	119	163	7	12	-	58	7419	3	226	166	-	11505
9. Chemicals & Petroleum	1326	106	9	228	1454	321	245	290	3722	4	70	21	278	1467	-	115	288	8574	18518
10. Cement	-	-	-	-	-	-	-	5	-	69	-	-	13	3763	-	59	-	-	3909
11. Iron and Steel	62	-	20	23	67	6	24	177	36	23	2090	104	3261	4188	-	705	67	1	10854
12. Non-ferrous Metals	-	-	-	82	9	4	-	9	133	-	593	683	2100	1	20	39	-	133	3806
13. Metallic Products and Machinery	2102	197	192	326	-	-	2	2	42	-	-	-	549	3668	380	2110	3436	335	13341
14. Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15. Electricity	121	122	46	184	735	75	31	55	109	70	123	8	96	-	275	92	196	18	2356
16. Railway Transport	392	10	6	1431	818	174	77	107	358	178	251	97	496	1646	23	247	796	509	7616
17. Other Transport	505	15	3	842	627	63	214	21	375	57	32	20	77	683	5	148	82	509	4278
18. Other Industries*	3078	64	31	759	133	150	869	754	208	37	8	8	113	4456	-	11	45	1750	12474
Total Output	206130	1065	935	71675	36920	2038	4722	3991	7464	1152	4464	1595	8164	30203	1612	6648	20567	14476	423821
	723530	6995	11537	121615	78241	8239	13059	17837	19719	3117	10228	3191	21412	76203	5165	31075	37932	31886	

* This sector consists of two sectors, one is unclassified among large scale and another is other production of small scale.

Table A 2.4.3 (c) : INPUT-OUTPUT TABLE FOR 1959

(Rs. in lakh at 1952-53 producers' prices)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14*	15	16	17	18	(u)
1. Agriculture	208184	-	-	38536	23268	745	1654	1345	68	-	-	8	1548	(4829)	-	8	10152	1015	291360
2. Coke and Coal	45	209	-	201	306	127	15	254	135	224	1231	15	291	-	866	2261	-	7	6187
3. Other Mining	-	79	306	660	99	49	20	1064	473	79	1246	335	108	-	30	-	-	138	4686
4. Food, Drinks & Beverages	8621	-	-	11872	17	68	77	-	1668	-	-	-	17	-	-	-	-	-	22340
5. Textiles(All)	34	-	57	528	16189	378	358	65	68	860	23	-	146	-	-	268	188	185	19347
6. Paper and Printing	-	-	-	104	484	1763	26	17	250	9	-	-	433	-	-	9	242	614	3951
7. Leather and Rubber	-	-	-	-	156	9	1310	18	9	-	-	-	448	-	-	778	2665	27	5420
8. Non-metallic Minerals	66	-	34	735	207	91	91	793	644	74	-	-	454	(6273)	-	421	41	215	10139
9. Chemicals & Petroleum	5118	165	-	775	4786	708	678	526	6422	18	392	9	2778	(725)	104	605	3829	639	28277
10. Cement	-	-	-	-	8	-	-	132	-	-	-	-	-	(3343)	-	-	-	-	3483
11. Iron and Steel	-	-	-	-	-	-	28	34	-	-	1848	7	3896	(14468)	-	-	-	21	20302
12. Non-ferrous Metals	-	-	-	260	-	48	-	16	8	-	236	268	1357	-	-	431	-	146	2770
13. Metallic Products and Machinery	-	454	170	1654	1068	57	208	28	28	9	2609	28	7146	(2148)	-	416	3818	38	19879
14. Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15. Electricity	581	255	-	747	1766	228	62	510	290	220	729	26	580	-	1933	466	-	70	8463
16. Railway Transport	1381	161	133	1050	1428	189	142	587	1220	274	1419	123	1429	-	435	161	-	151	10283
17. Other Transport	564	89	295	937	1000	134	179	250	322	45	125	98	348	-	-	357	714	437	5894
18. Other Industry	4451	-	-	260	-	17	805	450	-	-	-	-	-	-	-	17	-	658	6658
Total Output	229045	1412	995	58319	50782	4611	5653	6089	11605	1812	9858	917	20979	(31786)	3368	6198	21649	4361	469439
	791382	7082	6839	123506	100055	11262	14066	15599	25559	3437	16317	1511	62250	(72462)	10949	40350	48536	8719	

* In the original I-O table the construction column and row is not available. But for the purpose, the column and the output was estimated externally.

Table A 2.4.3 (d) : INPUT-OUTPUT TABLE FOR 1960-61

(Rs. in lakh at 1952-53 producers' prices)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(u)
1. Agriculture	58214	-	-	68641	31226	507	3715	4731	1219	-	-	8	1724	5525	-	-	-	-	175510
2. Coke and Coal	75	545	-	216	515	240	22	478	321	433	851	30	224	-	1022	2366	-	-	7338
3. Other Mining	-	-	-	-	-	31	-	591	5104	562	1227	532	30	-	-	-	-	-	8077
4. Food, Drinks & Beverages	4681	-	-	4119	477	-	170	-	928	-	-	-	-	-	-	-	-	-	10375
5. Textiles	373	-	-	631	2419	192	688	38	278	746	57	-	115	-	-	-	-	-	5537
6. Paper and Printing	70	-	-	436	494	2517	258	75	380	8	3	13	196	-	-	-	-	-	4450
7. Leather and Rubber	-	-	19	-	370	-	4339	-	-	-	-	-	1032	-	-	-	2007	-	7767
8. Non-metallic Minerals	273	-	33	74	528	49	-	694	562	-	-	-	306	26011	-	-	-	-	28530
9. Chemicals and Petroleum	6610	6	-	912	3675	811	1471	2879	6143	18	670	53	1313	829	178	1413	6394	-	33375
10. Cement	-	-	-	-	-	-	-	248	-	-	-	-	-	3824	-	-	-	-	4072
11. Iron and Steel	-	-	-	-	-	-	-	-	-	-	2966	-	6690	16552	-	-	-	-	26208
12. Non-ferrous Metals	-	-	-	-	-	6	-	-	252	-	975	674	4630	-	-	-	-	-	6537
13. Metallic Products & Machinery	-	359	123	624	47	88	28	113	889	-	406	-	2316	2458	-	-	-	-	7451
14. Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15. Electricity	703	281	79	510	2241	365	184	615	782	272	527	53	747	-	-	299	-	-	7658
16. Railway Transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26301
17. Other Transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14732
18. Other Industries	2537	407	199	7792	6753	-	909	3377	3696	320	1238	9	8182	-	1100	1532	2494	-	40545
Total	73536	1598	453	83955	48745	4806	11784	13839	20554	2359	8920	1372	27505	55199	2300	5610	10895	-	414463
Output	665567	8134	5672	112596	88910	13234	25549	32865	41462	4071	18552	2600	63374	125837	9051	42952	29018	40545*	

* The values of this row and column are not directly available from the table; but they are estimated from another table which has the same input names in different year.

Table A 2.4.3 (e) : INPUT-OUTPUT TABLE FOR 1963

(Rs. in lakh at 1952-53 producers' prices)

Sector	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	(u)
1. Agriculture	186737	735	259	62427	17234	781	3775	6748	1180	-	69	3	580	-	-	-	-	1206	281734
2. Coke and Coal	-	-	-	665	605	220	42	2438	1047	697	2149	33	1000	-	1459	552	-	449	11356
3. Other Mining	-	-	28	88	68	30	17	1215	2433	754	2655	268	31	-	-	-	-	828	8415
4. Food, Drinks & Beverages	7434	-	-	18961	473	101	657	12	3230	-	-	-	5	-	-	-	-	621	31494
5. Textiles	1168	-	-	623	47101	202	3371	78	401	754	23	3	141	-	-	71	-	449	54385
6. Paper and Printing	-	-	-	1511	653	3890	180	111	780	4	1	55	217	-	-	11	60	400	7873
7. Leather and Rubber	-	-	-	-	162	3	5894	-	3	-	-	-	845	-	-	17	5187	132	12243
8. Non-metallic Minerals	-	-	-	1274	96	110	68	5706	739	-	450	27	537	11441	-	159	-	1076	21683
9. Chemicals and Petroleum	5278	772	932	2029	8177	783	1128	1226	7410	59	326	142	1136	-	98	59	3184	3394	36133
10. Cement	-	-	-	-	9	-	-	812	-	-	-	-	-	5684	-	17	-	128	6650
11. Iron and Steel	-	-	73	27	176	2	127	330	1	6	5850	25	12673	3164	-	141	-	2154	24749
12. Non-ferrous Metals	-	-	-	61	398	7	16	36	109	-	327	2339	7543	-	-	196	-	6076	17108
13. Metallic Products and Machinery	750	817	293	1807	584	13	226	633	438	-	49	7	5814	-	-	652	3571	541	16195
14. Construction	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92
15. Electricity	487	654	377	982	1764	268	277	286	674	281	665	173	622	-	2649	238	-	990	11387
16. Railway Transport	860	3	10	345	305	104	35	512	1271	560	1899	15	43	3	1425	233	2	404	8029
17. Other Transport	559	2	1	154	56	7	12	23	56	24	65	1	4	2	31	12	3	19	1031
18. Other Industries	1102	-	-	2770	4002	757	2610	1155	3760	288	2391	239	8053	-	760	13	-	11942	39842
Total	204467	2983	1973	93724	81863	7278	18435	21321	23532	3427	16919	3330	39244	20294	6422	2371	12007	30809	590399
Output	910157	13059	9708	138813	150354	19426	37630	44834	51372	6090	30585	6953	94660	49541	16288	15644	24256	79051	1698421

Table A 2.4.4(a) : GROSS OUTPUT, INTERINDUSTRY DEMAND AND FINAL DEMAND VECTORS (AT 1952-53 PRICES) 1951-52

(*Rs. in lakh*)

	Sector	*Gross Output*	*Interindustry Demand*	*Final Demand*
1	Agriculture	600578	231077	369501
2	Coke and Coal	6327	4248	2079
3	Other Mining	14193	10584	3609
4	Food, Drinks and Beverages	119216	16186	103030
5	Textiles	73035	18614	54421
6	Paper and Printing	6856	1893	4963
7	Leather and Rubber	9550	1582	7968
8	Non-metallic Minerals	13224	8339	4885
9	Chemical and Petroleum	20966	15036	5930
10	Cement	2574	3122	-548
11	Iron and Steel	11346	12078	-732
12	Non-ferrous Metals	2013	2292	-279
13	Metallic Products and Machinery	25435	14838	10597
14	Construction	70452	-	70452
15	Electricity	4300	2226	2074
16	Railway Transport	36478	6687	29791
17	Other Transport	33803	4531	29272
18	Other Industries	26692	9997	16695
	Total	1077038	363330	713708

Table A 2.4.4 (b) : GROSS OUTPUT INTERINDUSTRY DEMAND AND FINAL DEMAND VECTORS (AT 1952-53 PRICES) 1953-54

(*Rs. in lakh*)

	Sector	*Gross Output*	*Interindustry Demand*	*Final Demand*
1.	Agriculture	723530	277843	445687
2.	Coke and Coal	6995	5343	1652
3.	Other Mining	11537	12130	-593
4.	Food, Drinks and Beverages	121615	14962	106653
5.	Textiles	78241	19974	58267
6.	Paper & Printing	8239	2374	5865
7.	Leather and Rubber	13059	2538	10521
8.	Non-metallic Minerals	17837	11505	6332
9.	Chemical & Petroleum	19719	18518	1201
10.	Cement	3117	3909	-792
11.	Iron and Steel	10228	10854	-626
12.	Non-ferrous Metals	3191	3806	-615
13.	Metallic Products and Machinery	21412	13341	8071
14.	Construction	76203	-	76203
15.	Electricity	5165	2356	2809
16.	Railway Transport	31075	7616	23459
17.	Other Transport	37932	4278	33654
18.	Other Industries	31886	12474	19412
	Total	1220981	423821	797160

Table A 2.4.4 (c): GROSS OUTPUT, INTERINDUSTRY DEMAND AND FINAL DEMAND VECTORS (AT 1952-53 PRICES) 1959

(*Rs. in lakh*)

Sector	*Gross Output*	*Interindustry Demand*	*Final Demand*
1. Agriculture	791382	291360	500022
2. Coke and Coal	7082	6187	895
3. Other Mining	6839	4686	2153
4. Food, Drinks & Beverages	123506	22340	101166
5. Textiles	100055	19347	80708
6. Paper & Printing	11262	3951	7311
7. Leather & Rubber	14066	5420	8646
8. Non-metallic Minerals	15599	10139	5460
9. Chemical & Petroleum	25559	28277	-2718
10. Cement	3437	3483	-46
11. Iron and Steel	16317	20302	-3985
12. Non-ferrous Metals	1511	2770	-1259
13. Metallic Products and Machinery	62250	19879	42371
14. Construction	72462	-	72462
15. Electricity	10949	8463	2486
16. Railway Transport	40350	10283	30067
17. Other Transport	48536	5894	42642
18. Other Industries	8719	6658	2061
Total	1359881	469439	890442

Table A 2.4.4 (d) : GROSS OUTPUT, INTERINDUSTRY DEMAND AND FINAL DEMAND VECTORS (AT 1952-53 PRICES) 1960-61

(*Rs. in lakh*)

Sector	*Gross Output*	*Interindustry Demand*	*Final Demand*
1. Agriculture	665567	175510	4990057
2. Coke and Coal	8134	7338	796
3. Other Mining	5672	8077	-2405
4. Food, Drinks & Beverages	112596	10375	102221
5. Textiles	88910	5537	83373
6. Paper & Printing	13234	4450	8784
7. Leather & Rubber	25549	7767	17782
8. Non-metallic Minerals	32865	28530	4335
9. Chemical & Petroleum	41462	33375	8087
10. Cement	4071	4072	-1
11. Iron and Steel	18552	26208	-7656
12. Non-ferrous Metals	2600	6537	-3937
13. Metallic Products and Machinery	63374	7451	55923
14. Construction	125837	-	125837
15. Electricity	9051	7658	1393
16. Railway Transport	42952	26301	16651
17. Other Transport	29018	14732	14286
18. Other Industries	40545	40545	-
Total	1329989	414463	915526

Table A 2.4.4 (e) : GROSS OUTPUT, INTERINDUSTRY DEMAND AND FINAL DEMAND VECTORS (AT 1952-53 PRICES) - 1963

(*Rs. in lakh*)

Sector	*Gross Output*	*Interindustry Demand*	*Final Demand*
1. Agriculture	910157	281734	628423
2. Coke and Coal	13059	11356	1703
3. Other Mining	9708	8415	1293
4. Food, Drinks and Beverages	138813	31494	107319
5. Textiles	150354	54385	95969
6. Paper and Printing	19426	7873	11553
7. Leather and Rubber	37630	12243	25387
8. Non-metallic Minerals	44834	21683	23151
9. Chemical & Petroleum	51372	36133	15239
10. Cement	6090	6650	-560
11. Iron and Steel	30585	24749	5836
12. Non-ferrous Metals	6953	17108	-10155
13. Metallic Products and Machinery	94660	16195	78465
14. Construction	49541	92	49449
15. Electricity	16288	11387	4901
16. Railway Transport	15644	8029	7615
17. Other Transport	24256	1031	23225
18. Other Industries	79051	39842	39209
Total	1698421	590399	1108022

Table B 3.3.1 (a) : COLUMN COEFFICIENT MATRIX OF 1951-52 TABLE (AT 1952-53 PRODUCERS' PRICES) a^{c}_{ij}(1)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	.259674	.005690	.005214	.446668	.156665	.023629	.109633	.034105	.016312	.091298	.000617	.001987	.009908	.005578	-	.018340	.180546	.024539
2.	.000115	.057373	-	.001988	.003669	.011960	.006702	.011721	.006201	.048951	.008726	.016890	.004246	.001746	.140698	.043999	.002633	.003409
3.	.001106	.021337	.028324	.004144	.005217	.004376	.009319	.065789	.011209	.049340	.031641	.094734	.007155	.025663	.034186	.006552	.113570	.007156
4.	.009483	.001739	-	.078219	.001054	.004230	.009634	-	.030955	-	-	-	.000275	-	-	.003728	.001302	.004533
5.	.000698	-	-	.000025	.238393	.002917	.053613	.000151	-	-	-	-	.002752	-	-	.001014	.001242	.003672
6.	.000050	.002055	-	.002886	.002232	.101663	.005026	.007638	.002957	.022145	.000617	-	.000944	.001618	-	.003975	.000237	.002997
7.	.000070	.000158	-	-	-	.000438	.062513	.000227	-	-	-	-	.003420	-	.003721	.000493	.018342	.007306
8.	.003698	-	.006200	.004647	.000233	.000875	.000628	.005747	.004340	-	.000705	-	.001926	.068487	.000233	.007923	.003195	-
9.	.002418	.021653	.000423	.002131	.022633	.049883	.024398	.018603	.122770	.001554	.005553	.010432	.011008	.017345	-	.003619	.006212	.232542
10.	.000002	-	-	-	-	-	-	.000302	-	.022145	-	-	.000472	.042710	-	.001042	-	-
11.	.000230	-	.001973	.000226	.001465	.001167	.003979	.015351	-	.010878	.204389	.064580	.162493	.059672	.035349	.015434	-	-
12.	-	-	-	.000394	.000014	.000438	.001571	.000378	.002766	-	.029261	.214108	.049774	.000014	.002558	.000850	-	.003409
13.	.004772	.046942	.017755	.006341	.000041	-	.000209	.000076	.001574	-	-	.001490	.027560	.049637	.072326	.068726	.098690	.010228
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.000203	.021021	.004298	.001267	.011460	.010648	.002618	.002193	.003291	.023699	.008814	.003477	.003696	-	.040698	.003482	.004349	.000562
16.	.000396	.008219	.000845	.012565	.012241	.024942	.007330	.008999	.009825	.057498	.028997	.060109	.021270	.014407	.004884	.006744	.017425	.015623
17.	.001136	.002055	-	.008371	.009886	.009043	.021152	.002117	.011209	.012821	.004583	.001490	.003538	.010347	.001860	.003865	.002071	.017346
18.	.004812	.012328	.001832	.005259	.001588	.023483	.062932	.046431	.005104	.014375	.001586	-	.003814	.049807	-	-	.000917	.040649
Total	.288863	.200570	.066864	.575131	.466791	.269692	.381257	.219828	.228513	.354704	.325489	.569297	.314251	.347031	.336513	.189786	.450731	.373971

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table B 3.3.1 (b) : COLUMN COEFFICIENT MATRIX OF 1953-54 TABLE (AT 1952-53 PRODUCERS' PRICES) a_{ij}^{C} (2)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	.261385	.005718	.008321	.479645	.168390	.026217	.117697	.056792	.033521	.092076	.001173	.001880	.023351	.007624	-	.019244	.267031	.048297
2.	.000076	.047462	-	.001965	.003719	.010924	.004212	.011605	.012729	.044915	.062573	.014102	.005651	.001916	.141142	.057088	.002900	.003701
3.	.000770	.023016	.036838	.004761	.005866	.005340	.007275	.060044	.026624	.065447	.060911	.188969	.011816	.026521	.028654	.007659	.102578	.007307
4.	.008007	.001001	-	.063956	.001291	.002670	.005973	.000056	.038896	-	-	-	.000280	-	-	.002864	.003875	.005426
5.	.000384	-	-	.000033	.240526	.002792	.042576	.000112	-	-		-	.002989	-	-	.001738	.002004	.003073
6.	.000029	.001573	-	.002944	.002722	.101833	.005667	.008409	.005781	.024382	.000978	-	.001261	.002152	-	.003797	.001766	.004140
7.	.000047	-	-	-	-	.000607	.065932	.000449	-	-		-	.007099	-	.005615	.000805	.028235	.011071
8.	.003712	-	.009275	.004194	.000243	.000728	.000306	.006672	.008266	.002246	.001173	-	.002709	.097358	.000581	.007273	.004376	-
9.	.001833	.015154	.000780	.001875	.018584	.038961	.018761	.016258	.188752	.001283	.006844	.006581	.012983	.019251	-	.003701	.007593	.268895
10.	-	-	-	-	-	-	-	.000280	-	.022137	-	-	.000607	.049381	-	.001899	-	-
11.	.000086	-	.001734	.000189	.000856	.000728	.001838	.009923	.001826	.007379	.204341	.032592	.152298	.054958	-	.022687	.001766	.000031
12.	-	-	-	.000674	.000115	.000485	-	.000505	.006745	-	.057978	.214039	.098076	.000013	.003872	.001255	-	.004171
13.	.002905	.028163	.016642	.002681	-	-	.000153	.000112	.002130	-	-	-	.025640	.048134	.073572	.067900	.090583	.010506
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.000167	.017441	.003987	.001513	.009394	.009103	.002374	.003083	.005528	.022457	.012026	.002507	.004483	-	.053243	.002961	.005167	.000565
16.	.000542	.001430	.000520	.011767	.010455	.021119	.005896	.005999	.018155	.057106	.024540	.030398	.023165	.021600	.004453	.007949	.020985	.015963
17.	.000698	.002144	.000260	.006923	.008014	.007647	.016387	.001177	.019017	.018287	.003129	.006268	.003596	.008963	.000968	.004763	.002162	.015963
18.	.004254	.009149	.002687	.006241	.001700	.018206	.066544	.042272	.010548	.011870	.000782	.002507	.005277	.058475	-	.000354	.001186	.054883
Total	.284895	.152251	.081044	.589361	.471875	.247360	.361591	.223748	.378518	.369585	.436448	.499843	.381281	.396346	.312100	.213937	.542207	453992

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table B 3.3.1 (c) : COLUMN COEFFICIENT MATRIX OF 1959 TABLE (AT 1952-53 PRODUCERS' PRICES) a^{c}_{ij}(3)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14*	15	16	17	18
1.	.263065	-	-	.312017	.232552	.066152	.117588	.086224	.002661	-	-	.005295	.024868	(.066642)	-	.000198	.209165	.116412
2.	.000057	.029511	-	.001627	.003058	.011277	.001066	.016283	.005282	.065173	.075443	.009927	.004675	-	.079094	.056035	-	.000803
3.	-	.011155	.044743	.005344	.000989	.004351	.001422	.068210	.018506	.022985	.006362	.221707	.001735	-	.002740	-	-	.015827
4.	.010894	-	-	.096125	.000170	.006038	.005474	-	.065261	-	-	-	.000273	-	-	-	-	-
5.	.000043	-	.008335	.004275	.161801	.033564	.025451	.004167	.002661	.250218	.001410	-	.002345	-	-	.006642	.003873	.021218
6.	-	-	-	.000842	.004837	.156544	.001848	.001090	.009781	.002619	-	-	.006956	-	-	.000223	.004986	.070421
7.	-	-	-	-	.001559	.000799	.093132	.001154	.000352	-	-	-	.007197	-	-	.019281	.054908	.003097
8.	.000083	-	.004971	.005951	.002069	.008080	.006469	.050837	.025197	.021530	-	-	.007293	(.086569)	-	.010434	.000845	.024659
9.	.006467	.023298	-	.006275	.047834	.062866	.048201	.033720	.251262	.005237	.024024	.005956	.044627	(.010005)	.009499	.014994	.078890	.073288
10.	-	-	-	-	.000080	-	-	.008462	-	-	-	-	-	(.046134)	-	*	-	-
11.	-	-	-	-	-	-	.001991	.002180	-	-	.113256	.004633	.062587	(.199663)	-	-	-	.002409
12.	-	-	-	.002105	-	.004262	-	.001026	.000313	-	.014463	.177366	.021799	-	-	.010682	-	.016745
13.	-	.064106	.024857	.013392	.010674	.005061	.014787	.001795	.001096	.002619	.159895	.018531	.114795	(.029643)	-	.010310	.078663	.004358
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.000734	.036007	-	.006048	.017650	.020245	.004408	.032694	.011346	.064009	.044677	.017207	.009317	-	.176546	.011549	-	.008028
16.	.001745	.022734	.019447	.008502	.014272	.016782	.010095	.037631	.047733	.079721	.086965	.081403	.022956	-	.039730	.003990	-	.017318
17.	.000713	.012567	.043135	.007587	.009995	.011898	.012726	.016027	.012598	.013093	.007661	.064858	.005590	-	-	.008848	.014711	.050120
18.	.005624	-	-	.002105	-	.001510	.057230	.028848	-	-	-	-	-	-	-	.000421	-	.075467
Total	.289425	.199378	.145488	.472195	.507540	.409429	.401888	.390348	.454049	.527204	.604156	.606883	.337013	(.438656)	.307609	.153607	.446041	.500170

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. No-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

* The coefficients are externally inserted.

Table B 3.3.1 (d) : COLUMN COEFFICIENT MATRIX OF 1960-61 TABLE (AT 1952-53 PRODUCERS' PRICES) a^{C}_{ij} (4)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	.087465	-	-	.609622	.351208	.038320	.145407	.143953	.029400	-	-	.003077	.027204	.043906	-	-	-	-
2.	.000113	.067003	-	.001918	.005792	.018132	.000861	.014544	.007742	.106362	.045871	.011538	.003535	-	.112916	.055085	-	-
3.	-	-	-	-	-	.002337	-	.017983	.123101	.138050	.066138	.204615	.000473	-	-	-	-	-
4.	.007035*	-	-	.036582	.005365	-	.006654	-	.022382	-	-	-	-	-	-	-	-	-
5.	.000560	-	-	.005604	.027207	.014487	.026929	.001156	.006705	.183247	.003072	-	.001815	-	-	-	-	-
*6.	.000105	-	-	.003876	.005552	.190196	.010095	.002296	.009154	.001959	.000174	.005117	.003096	-	-	-	-	-
7.	-	-	.003350	-	.004162	-	.169831	-	-	-	-	-	.016284	-	-	-	.069164	-
8.	.000410	-	.005818	.000657	.005939	.003738	-	.021117	.013555	-	-	-	.004828	.206704	-	-	-	-
9.	.009931	.000738	-	.008100	.041334	.061311	.057576	.087601	.148160	.004422	.036115	.020385	.020718	.006588	.019666	.032897	.220346	-
10.	-	-	-	-	-	-	-	.007546	-	-	-	-	-	.030389	-	-	-	-
11.	-	-	-	-	-	-	-	-	-	-	.159875	-	.105564	.131535	-	-	-	-
12.	-	-	-	-	-	.000467	-	-	.006078	-	.052555	.259231	.073058	-	-	-	-	-
13.	-	.044136	.021686	.005542	.000529	.006636	.001096	.003438	.021441	-	.021884	-	.036545	.019533	-	-	-	-
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.001056	.034546	.013928	.004529	.025205	.027571	.007202	.018713	.018861	.066814	.028407	.020385	.011787	-	-	.006961	-	-
16.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18.	.003812	.050037	.035085	.069203	.075953	-	.035579	.102754	.089142	.078605	.066731	.003462	.129106	-	.121534	.035668	.085947	.490635
Total	.110485	.196460	.079867	.745633	.548246	.363195	.461230	.421101	.495721	.579459	.480822	.527810	.434013	.438655	.254116	.130611	.375484	.490635

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Leverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

* The Coefficients of of this row and column are estimated from the 144x144 input-output Table made by M.R. Saluja published in *Sankhya*, Series B, Vol. 34 (Which has the input norms equal to that of 1960-61 input-output Table)

Table B 3.3.1 (e) : COLUMN COEFFICIENT MATRIX OF 1963 TABLE (AT 1952-53 PRODUCERS' PRICES) $a_{ij}^{C}(5)$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	.205170	.056283	.026677	.449720	.114623	.040204	.100319	.150511	.022970	-	.002256	.000431	.006127	-	-	-	-	.015256
2.	-	-	-	.004791	.004024	.011325	.001116	.054378	.020381	.114450	.070263	.004746	.010564	-	.089575	.035285	-	.005680
3.	-	-	.002884	.000634	.000452	.001544	.000452	.027100	.047361	.123810	.086807	.038545	.000327	-	-	-	-	.010474
4.	.008168	-	-	.136594	.003146	.005199	.017459	.000268	.062875	-	-	-	.000053	-	-	-	-	.007856
5.	.001283	-	-	.004488	.313267	.010398	.089583	.001740	.007806	.123810	.000752	.000431	.001490	-	-	.004538	-	.005680
6.	-	-	-	.010885	.004343	.200247	.004783	.002476	.015183	.000657	.000033	.007910	.002292	-	-	.000703	.002474	.005060
7.	-	-	-	-	.001077	.000154	.156630	-	.000058	-	-	-	.008927	-	-	.001087	.213844	.001670
8.	-	-	-	.009178	.000638	.005663	.001807	.127269	.014385	-	.014713	.003883	.005673	.230940	-	.010164	-	.013612
9.	.005799	.059116	.095997	.014617	.054385	.040307	.029976	.027345	.144242	.009688	.010659	.020423	.012001	-	.006017	.003771	.131266	.042534
10.	-	-	-	-	.000060	-	-	.018111	-	-	-	-	-	.114733	-	.001087	-	.001615
11.	-	-	.007519	.000195	.001171	.000103	.003375	.007360	.000019	.000985	.191270	.003596	.133879	.063866	-	.009013	-	.027248
12.	-	-	-	.000439	.002647	.000360	.000425	.000803	.002122	-	.010692	.336402	.079685	-	-	.012529	-	.203363
13.	.000824	.062562	.030179	.013018	.003884	.000669	.006006	.014119	.008526	-	.001602	.001007	.061420	-	-	.041677	.147221	.006844
14.	.000101			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.000535	.050080	.038831	.007074	.011732	.013796	.007361	.006379	.013120	.046141	.021743	.024881	.006571	-	.162635	.015214	-	.012524
16.	.000945	.000230	.001030	.002485	.002029	.005354	.000930	.011420	.024741	.091954	.062089	.002157	.000454	.000061	.087488	.014894	.000082	.005111
17.	.000614	.000153	.000103	.001109	.000372	.000360	.000319	.000513	.001090	.003941	.002125	.000144	.000042	.000040	.001903	.000767	.000124	.000240
18.	.001211	-	-	.019955	.026617	.038968	.069359	.025762	.073192	.047291	.078176	.034374	.085073	-	.046660	.000831	-	.024566
Total	.224650	.228425	.203221	.675182	.544468	.374653	.489901	.475554	.458072	.562727	.553180	.478931	.414578	.409640	.394278	.151560	.495011	.389737

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table B 3.3.2 (a) : ROW COEFFICIENT MATRIX OF 1951-52 TABLE (AT 1952-53 PRODUCER PRICES) a^{R}_{ij} (1)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	.259674	.000060	.000123	.088664	.019052	.000270	.001743	.000751	.000569	.000391	.000012	.000007	.000420	.000654	-	.001114	.010162	.001091
2.	.010906	.057373	-	.037459	.042358	.012960	.010115	.024498	.020547	.019915	.015647	.005374	.017070	.019441	.095622	.253675	.014067	.014383
3.	.046784	.000512	.028324	.034806	.026844	.002114	.006271	.061298	.016557	.008948	.025294	.027619	.012823	.127387	.010357	.016839	.270486	.013457
4.	.047770	.000092	-	.078219	.000646	.000243	.000772	-	.005444	-	-	-	.000059	-	-	.001141	.000369	.001015
5.	.005737	-	-	.000041	.238393	.000274	.007010	.000027	-	-	-	-	.000958	-	-	.000507	.000575	.001342
6.	.004376	.001896	-	.050175	.023775	.101663	.007001	.014732	.009043	.008314	.001021	-	.003501	.016628	-	.021149	.001167	.001669
7.	.004398	.000105	-	-	-	.000314	.062513	.000314	-	-	-	-	.009110	-	.001675	.001885	.064921	.020419
8.	.167952	-	.006655	.041984	.001286	.000454	.000454	.005747	.006881	-	.000605	-	.003705	.364867	.000076	.021854	.008167	-
9.	.069255	.006534	.000286	.012115	.078842	.016312	.011113	.011733	.122770	.000191	.003005	.001002	.013355	.058285	-	.006296	.010016	.296051
10.	.000777	-	-	-	-	-	-	.004554	-	.022145	-	-	.004662	1.168997	-	.014763	-	-
11.	.012163	-	.002468	.002380	.009431	.000705	.003349	.017892	-	.002468	.204389	.011458	.364269	.370527	.013397	.049621	-	-
12.	-	-	-	.023348	.000497	.001490	.007452	.002484	.028813	-	.164928	.214108	.628912	.000497	.005464	.015400	-	.045206
13.	.112679	.011677	.009908	.029723	.000118	-	.000079	.000039	.001297	-	-	.000118	.027560	.137488	.012227	.018565	.131158	.010733
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.028372	.030930	.014186	.035116	.194651	.016977	.005814	.006744	.016047	.014186	.023256	.001628	.021860	-	.040698	.029535	.034186	.003488
16.	.006525	.001426	.000329	.041066	.024508	.004688	.001919	.003262	.005647	.004057	.009019	.003317	.014831	.027825	.000576	.006744	.016147	.011432
17.	.020176	.000385	-	.029524	.021359	.001834	.005976	.000828	.006952	.000976	.001538	.000089	.002662	.021566	.000237	.004171	.002071	.013697
18.	.108272	.002922	.000974	.023490	.004346	.006032	.022516	.023003	.004009	.001386	.000674	-	.003634	.131463	-	-	.001161	.040649

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table B 3.3.2 (b) : ROW COEFFICIENT MATRIX OF 1953-54 TABLE (AT 1952-53 PRODUCERS' PRICES) a^{R}_{ij} (2)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	.261385	.000055	.000133	.080621	.018209	.000299	.002124	.001400	.000914	.000397	.000017	.000008	.000691	.000803	-	.000827	.013999	.002128
2.	.007863	.047462	-	.034167	.041601	.012866	.007863	.029593	.035883	.020014	.091494	.006433	.017298	.020872	.104217	.253609	.015725	.016869
3.	.048279	.013955	.026838	.050186	.039785	.003814	.008234	.092832	.045506	.017682	.054000	.052267	.021929	.175175	.012828	.020629	.337263	.020196
4.	.047634	.000058	-	.063956	.000830	.000181	.000641	.000008	.006307	-	-	-	.000049	-	-	.000732	.001209	.001423
5.	.003553	-	-	.000051	.240526	.000294	.007106	.000026	-	-	-	-	.000818	-	-	.000690	.000971	.001253
6.	.002549	.001335	-	.043452	.025853	.101833	.008982	.018206	.013837	.009224	.001214	-	.003277	.019905	-	.014322	.008132	.016021
7.	.002604	-	-	-	-	.000383	.065932	.000613	-	-	-	-	.011639	-	.002221	.001914	.082012	.027031
8.	.150586	-	.005999	.028592	.001065	.000336	.000224	.006672	.009138	.000392	.000673	-	.003252	.415933	.000168	.012670	.009306	-
9.	.067245	.005376	.000456	.011562	.073736	.016279	.012425	.014707	.188752	.000203	.003550	.001065	.014098	.074395	-	.005832	.014605	.434809
10.	-	-	-	-	-	-	-	.001604	-	.022137	-	-	.004171	1.207249	-	.018928	-	-
11.	.006062	-	.001955	.002249	.006552	.000587	.002346	.017305	.003520	.002249	.204341	.010168	.318831	.409464	-	.068928	.006551	.000098
12.	-	-	-	.025697	.002820	.001254	-	.002820	.041680	-	.185835	.214039	.658100	.000313	.006268	.012222	-	.041680
13.	.98169	.009200	.008967	.015225	-	-	.000093	.000093	.001962	-	-	-	.025640	.171306	.017747	.098543	.160471	.015645
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.023427	.023621	.008906	.035624	.142304	.014521	.006002	.010649	.021104	.013553	.023814	.001549	.018587	-	.053243	.017812	.037948	.003485
16.	.012615	.000322	.000193	.046050	.026323	.005599	.002478	.003443	.011521	.005728	.008077	.003121	.015961	.052969	.000740	.007949	.025615	.016380
17.	.013313	.000395	.000079	.022198	.016530	.001661	.005642	.000554	.009886	.001503	.000844	.000527	.002030	.018006	.000132	.003902	.002162	.013419
18.	.096531	.002007	.000972	.023804	.004171	.004704	.027253	.023647	.006523	.001160	.000251	.000251	.003544	.139748	-	.000345	.001411	.054883

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table B 3.3.2 (c) : ROW COEFFICIENT MATRIX OF 1959 TABLE (AT 1952-53 PRODUCERS' PRICES) $a^{R}_{ij}(3)$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	.263065	-	-	.048695	.029402	.000941	.002090	.001700	.000086	-	-	.000010	.001956	-	-	.000010	.012828	.001283
2.	.006354	.029511	-	.028382	.043208	.017933	.002118	.035866	.019062	.031629	.173821	.002118	.041090	-	.122282	.319260	-	.000988
3.	-	.011551	.044743	.096505	.014476	.007165	.002924	.155578	.069162	.011551	.182190	.048984	.015792	-	.004387	-	-	.020178
4.	.069802	-	-	.096125	.000138	.000551	.000623	-	.013505	-	-	-	.000138	-	-	-	-	-
5.	.000340	-	.000570	.005277	.161801	.003778	.003578	.000650	.000680	.008595	.000230	-	.001459	-	-	.002679	.001879	.001849
6.	-	-	-	.009235	.042976	.156544	.002309	.001510	.022199	.000799	-	-	.038448	-	-	.000799	.021488	.054520
7.	-	-	-	-	.011091	.000640	.093132	.001280	.000640	-	-	-	.031850	-	-	.055311	.189464	.001920
8.	.004231	-	.002180	.047118	.013270	.005834	.005834	.050837	.041285	.004744	-	-	.029104	-	-	.026989	.002628	.013783
9.	.200243	.006456	-	.030322	.187253	.027701	.026527	.020580	.251262	.000704	.015337	.000352	.108690	-	.004069	.023671	.149810	.025001
10.	-	-	-	-	.002328	-	-	.038406	-	-	-	-	-	-	-	-	-	-
11.	-	-	-	-	-	-	.001716	.002084	-	-	.113256	.000429	.238769	-	-	-	-	.001287
12.	-	-	-	.172071	-	.031767	-	.010589	.005295	-	.156188	.177366	.898080	-	-	.285241	-	.096625
13.	-	.007293	.002731	.026570	.017157	.000916	.003341	.000450	.000450	.000145	.041912	.000450	.114795	-	-	.006682	.061333	.000610
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.053064	.023290	-	.068225	.161293	.020824	.005663	.046580	.026486	.020093	.066581	.002375	.052973	-	.176546	.042561	-	.006393
16.	.034225	.003990	.003296	.026022	.035390	.004684	.003519	.014548	.030235	.006791	.035167	.003048	.035415	-	.010781	.003990	-	.003742
17.	.011620	.001834	.006078	.019305	.020603	.002761	.003688	.005151	.006634	.000927	.002575	.002019	.007170	-	-	.007355	.014711	.009004
18.	.510494	-	-	.029820	-	.001950	.092327	.051611	-	-	-	-	-	-	-	.001950	-	.075467

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table H 3.3.2 (d) : ROW COEFFICIENT MATRIX OF 1960-61 TABLE (AT 1952-53 PRODUCERS' PRICES) a_{ij}^{R} (4)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	.087465	-	-	.103132	.046916	.000762	.005582	.007108	.001832	-	-	.000012	.002590	.008301	-	-	-	-
2.	.009221	.067003	-	.026555	.063315	.029506	.002705	.058766	.039464	.053233	.104623	.003688	.027539	-	.125646	.290878	-	-
3.	-	-	-	-	-	.005765	-	.104196	.899861	.099083	.216326	.093794	.005289	-	-	-	-	-
4.	.041573	-	-	.036582	.004236	-	.001510	-	.008242	-	-	-	-	-	-	-	-	-
5.	.004195	-	-	.007097	.027207	.002159	.007738	.000427	.003127	.008390	.000641	-	.001293	-	-	-	-	-
6.	.005289	-	-	.032945	.037328	.190196	.019495	.005667	.028714	.000605	.000227	.000982	.014810	-	-	-	-	-
7.	-	-	.000744	-	.014482	-	.169831	-		-	-	-	.040393	-	-	-	.078555	-
8.	.008307	-	.001004	.002252	.016066	.001491	-	.021117	.017100	-	-	-	.009311	.791450	-	-	-	-
9.	.159423	.000145	-	.021996	.088635	.019560	.035478	.069437	.148160	.000434	.016159	.001278	.031668	.019994	.004293	.034079	.154214	-
10.	-	-	-	-	-	-	-	.060919	-	-	-	-	-	.939327	-	-	-	-
11.	-	-	-	-	-	-	-	-	-	-	.159875	-	.360608	.892194	-	-	-	-
12.	-	-	-	-	-	.002308	-	-	.096923	-	.375000	.259231	1.780767	-	-	-	-	-
13.	-	.005665	.001941	.009846	.000742	.001389	.000442	.001783	.014028	-	.006406	-	.036545	.038786	-	-	-	-
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.077671	.031046	.008728	.056347	.247597	.040327	.020329	.067948	.086399	.030052	.058226	.005856	.082532	-	-	.033035	-	-
16.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (All)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table B 3.3.2 (e) : ROW COEFFICIENT MATRIX OF 1963 TABLE (AT 1952-53 PRODUCERS' PRICES) $a^{R}_{ij}(5)$

	1	2	3	4	5	6	7	8	9	10	11	12	13.	14	15	16	17	18
1.	.205170	.000808	.000285	.068589	.018935	.000858	.004148	.007414	.001296	-	.000076	.000003	.000637	-	-	-	-	.001325
2.	-	-	-	.050923	.046328	.016847	.003216	.186691	.080175	.053373	.164561	.002527	.076576	-	.111724	.042270	-	.034382
3.	-	-	.002884	.009064	.007004	.003090	.001751	.125146	.250601	.077663	.273468	.027604	.003193	-	-	-	-	.085285
4.	.053554	-	-	.136594	.003407	.000728	.004733	.000086	.023269	-	-	-	.000036	-	-	-	-	.004474
5.	.007768	-	-	.004144	.313267	.001343	.022420	.000519	.002667	.005015	.000153	.000020	.000938	-	-	.000472	-	.002986
6.	-	-	-	.077782	.033615	.200247	.009266	.005714	.040152	.000206	.000051	.002831	.011171	-	-	.000566	.003089	.020591
7.	-	-	-	-	.004305	.000080	.156630	-	.000080	-	-	-	.022455	-	-	.000452	.137842	.003508
8.	-	-	-	.028416	.002141	.002453	.001517	.127269	.016483	-	.010037	.000602	.011978	.255186	-	.003546	-	.024000
9.	.102741	.015028	.018142	.039496	.159173	.015242	.021958	.023865	.144242	.001148	.006346	.002764	.022113	-	.001908	.001148	.061979	.066067
10.	-	-	-	-	.001478	-	-	.133334	-	-	-	-	-	.933336	-	.002791	-	.021018
11.	-	-	.002387	.000883	.005754	.000065	.004152	.010790	.000033	.000196	.191270	.000817	.414354	.103450	-	.004610	-	.070427
12.	-	-	-	.008773	.057242	.001007	.002301	.005178	.015677	-	.047030	.336402	1.084857	-	-	.028189	-	.873869
13.	.007923	.008631	.003095	.019089	.006169	.000137	.002387	.006687	.004627	-	.000518	.000074	.061420	-	-	.006888	.037724	.005715
14.	.001857	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	.029899	.040152	.023146	.060290	.108301	.016454	.017006	.017559	.041380	.017252	.040828	.010621	.038188	-	.162635	.014612	-	.060781
16.	.054973	.000192	.000639	.022053	.019496	.006648	.002237	.032728	.081245	.035796	.121388	.000959	.002749	.000192	.091089	.014894	.000128	.025825
17.	.023046	.000082	.000041	.006349	.002309	.000289	.000495	.000948	.002309	.000989	.002680	.000041	.000165	.000082	.001278	.000495	.000124	.000783
18.	.013940	-	-	.035041	.050626	.009576	.033017	.014611	.047564	.003643	.030246	.003023	.101871	-	.009614	.000164	-	.151067

1. Agriculture
2. Coke & Coal
3. Other Mining
4. Food, Drinks & Beverages
5. Textiles (all)
6. Paper and Printing
7. Leather and Rubber
8. Non-metallic Minerals
9. Chemicals & Petroleum
10. Cement
11. Iron & Steel
12. Non-ferrous Metals
13. Metallic Products & Machinery
14. Construction
15. Electricity
16. Railway Transport
17. Other Transport
18. Other Industries

Table B 3.4.1 : FINAL DEMAND VECTORS (f_k) FOR DIFFERENT TIME PERIODS

Sector/Year	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1	369501	445687	500022	490057	628423
2	2079	1652	895	796	1703
3	3609	-593	2153	-2405	1293
4	103030	106653	101166	102221	107319
5	54421	58267	80708	83373	95969
6	4963	5865	7311	8784	11553
7	7968	10521	8646	17782	25387
8	4885	6332	5460	4335	23151
9	5930	1201	-2718	8087	15239
10	-548	-792	-46	-1	-560
11	-732	-626	-3985	-7656	5836
12	-279	-615	-1259	-3937	-10155
13	10597	8071	42371	55923	78465
14	70452	76203	72462	125837	49449
15	2074	2809	2486	1393	4901
16	29791	23459	30067	16651	7615
17	29272	33654	42642	14286	23225
18	16695	19412	2061	-	39209

Table B 3.4.2 (a) : LEONTIEF INVERSE OF THE 18 X 18 TECHNICAL COEFFICIENTS MATRIX FOR 1951-52, $(I-A_1)^{-1}$

	1	2	3	4	5	6
1.	1.36091969	.01370145	.00819600	.66331530	.28677263	.04826317
2.	.00053095	1.06576078	.00108752	.00378770	.00888341	.01831456
3.	.00260016	.02694427	1.03055031	.00815389	.01090928	.00927637
4.	.01425448	.00335980	.00016922	1.09210731	.00583193	.00835597
5.	.00133161	.00035899	.00010218	.00082055	1.31340941	.00460429
6.	.00023097	.00272975	.00010689	.00377183	.00356306	1.11375106
7.	.00022642	.00066017	.00011664	.00039861	.00043004	.00107114
8.	.00520346	.00059786	.00652349	.00784419	.00183789	.00186853
9.	.00601838	.03126960	.00166155	.00798448	.03657995	.07198932
10.	.00000924	.00003910	.00001328	.00002632	.00002292	.00003571
11.	.00208268	.01299453	.00702882	.00387588	.00496149	.00427737
12.	.00060253	.00424568	.00153081	.00162308	.00082236	.00162547
13.	.00725116	.05516581	.01944502	.01310757	.00612803	.00608645
14.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
15.	.00044883	.02404003	.00482047	.00200119	.01637569	.01338470
16.	.00126348	.01150354	.00175242	.01521878	.01764978	.03012127
17.	.00193676	.00323474	.00021195	.01038431	.01407950	.01181551
18.	.00725698	.01438449	.00244831	.00998891	.00422480	.02839778

(Contd..)

Table B 3.4.2 (a) (Contd..)

	7	8	9	10	11	12
1.	.19426190	.05257589	.05338672	.13562941	.00516902	.00989867
2.	.01016795	.01440984	.00919909	.06097994	.01648848	.02914388
3.	.01670446	.07114444	.01692669	.05811008	.05281184	.26197101
4.	.01549688	.00212350	.03908079	.00235714	.00061934	.00110532
5.	.07580297	.00061311	.00018801	.00050780	.00012639	.00020112
6.	.00674940	.00897226	.00405498	.02578429	.00115417	.00061245
7.	1.06781672	.00075289	.00037500	.00064617	.00024258	.00020734
8.	.00202483	1.00672404	.00564004	.00153546	.00165068	.00252297
9.	.05240631	.03593559	1.14298043	.01064256	.01011464	.01778410
10.	.00001715	.00032557	.00001842	1.02271978	.00004670	.00009501
11.	.00773097	.02107488	.00219486	.01944940	1.26356860	.10939441
12.	.00338931	.00192173	.00455816	.00182704	.04758236	1.27764293
13.	.00675380	.00439873	.00582180	.01283445	.00634581	.01492207
14.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
15.	.00475092	.00349636	.00449456	.02776528	.01263791	.00789957
16.	.01207711	.01165470	.01290773	.06224451	.04045946	.08165397
17.	.02578233	.00378742	.01352474	.01455445	.00630226	.00311742
18.	.07200113	.04984220	.00715062	.01781473	.00264102	.00142071

(Contd..)

Table B 3.4.2 (a) (Contd..)

	13	14	15	16	17	18
1.	.01974247	.02555710	.00543118	.03208435	.25508307	.05910666
2.	.01088301	.00833755	.15816133	.04915371	.00597310	.00744589
3.	.03138055	.04112102	.04607056	.01266937	.12203058	.01589397
4.	.00134340	.00201559	.00072048	.00484583	.00481080	.01536210
5.	.00411653	.00065194	.00068218	.00175113	.00373272	.00584542
6.	.00156104	.00405376	.00062055	.00484925	.00075909	.00467339
7.	.00396652	.00095764	.00459549	.00095130	.02012544	.00866391
8.	.00280004	.06982184	.00090500	.00850382	.00542493	.00189228
9.	.01751739	.03857811	.00666086	.00780469	.01178051	.27872602
10.	.00053548	.04375129	.00005453	.00111619	.00007754	.00003105
11.	.21813470	.08975684	.06572003	.03604233	.02393882	.00456607
12.	.07371277	.00738130	.01146083	.00726219	.00786757	.00678164
13.	1.03318829	.05627356	.08757318	.07518551	.10775751	.01638585
14.	.00000000	1.00000000	.00000000	.00000000	.00000000	.00000000
15.	.00694396	.00305151	1.04719255	.00563736	.00619685	.00229186
16.	.03365753	.02372663	.01123463	1.01089324	.02189523	.02105440
17.	.00541538	.01335029	.00320219	.00478087	1.00371561	.02197386
18.	.00532147	.05703037	.00300930	.00186022	.00471437	1.04523912

(Concluded)

Table B 3.4.2 (b) : LEONTIEF INVERSE OF THE 18 X 18 TECHNICAL COEFFICIENTS MATRIX FOR 1953-54, $(1 - A_2)^{-1}$

	1	2	3	4	5	6
1.	1.36362316	.01443224	.01393809	.70382131	.31137372	.05435919
2.	.00055930	1.05413969	.00150493	.00400597	.00897077	.01735163
3.	.00213563	.02881276	1.04039166	.00853786	.01193540	.01108742
4.	.01194787	.00236415	.00027580	1.07486057	.00600673	.00651350
5.	.00075493	.00024080	.00011413	.00057419	1.31700986	.00440384
6.	.00021887	.00214752	.00017344	.00382283	.00439363	1.11411981
7.	.00022599	.00060418	.00023387	.00050878	.00056051	.00144527
8.	.00524198	.00068623	.00986473	.00748634	.00209133	.00192894
9.	.00554471	.02420257	.00286362	.00844011	.03314099	.06208095
10.	.00000686	.00002763	.00001703	.00003412	.00003358	.00005403
11.	.00116313	.00680692	.00607974	.00239459	.00301820	.00302601
12.	.00074492	.00502281	.00282066	.00219222	.00141711	.00228580
13.	.00447753	.03323179	.01840259	.00739342	.00473884	.00492089
14.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
15.	.00039180	.02000754	.00464597	.00223787	.01377224	.01173557
16.	.00132736	.00350264	.00143503	.01410025	.01547046	.02596326
17.	.00129834	.00317402	.00053139	.00846543	.01173261	.01045024
18.	.00657607	.01096215	.00364686	.01093366	.00457203	.02289708

(Contd..)

Table B 3.4.2 (b) (Contd..)

	7	8	9	10	11	12
1.	.20827267	.08701969	.10360539	.14261022	.00910849	.01297232
2.	.00779415	.01526327	.02048098	.05753716	.08963126	.02631218
3.	.01422689	.06674215	.04206216	.07685866	.10277818	.25709508
4.	.01152494	.00270418	.05274324	.00216917	.00094264	.00091080
5.	.06065688	.00052749	.00037337	.00054201	.00017589	.00021100
6.	.00782415	.01000911	.00856076	.02839475	.00184860	.00046217
7.	1.07222408	.00120075	.00109566	.00111970	.00040940	.00047431
8.	.00194425	1.00809760	.01166011	.00428318	.00292991	.00300701
9.	.05336525	.03698131	1.24003594	.01046554	.01470915	.01375505
10.	.00002405	.00030750	.00005820	1.02276597	.00007455	.00008739
11.	.00417528	.01391048	.00619379	.01394164	1.26369251	.05599248
12.	.00189142	.00275114	.01248860	.00291770	.09461062	1.27788081
13.	.00521851	.00375512	.00934319	.01175434	.00879870	.00945423
14.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
15.	.00421784	.00446486	.00840503	.02657997	.01868977	.00599248
16.	.01042761	.00850183	.02526404	.06143569	.03514253	.04153728
17.	.02076120	.00299449	.02474178	.02011609	.00536121	.00893843
18.	.07763306	.04657756	.01586781	.01534524	.00293355	.00489740

(Contd..)

Table B 3.4.2 (b) (Contd..)

	13	14	15	16	17	18
1.	.04305740	.04191254	.00782405	.03671089	.38178517	.11466452
2.	.02564979	.01517378	.15966911	.06544250	.00858003	.01196453
3.	.05690185	.05003195	.04158321	.01787823	.11466779	.02456977
4.	.00192187	.00310715	.00061107	.00394317	.00845824	.02221708
5.	.00468136	.00075703	.00078227	.00276407	.00508482	.00534795
6.	.00219613	.00573005	.00057580	.00478881	.00272392	.00761849
7.	.00821958	.00173286	.00713758	.00168290	.03128073	.01355294
8.	.00424505	.09973584	.00141907	.00809741	.00759334	.00407167
9.	.02341978	.05131899	.00596872	.00898090	.01595974	.35500218
10.	.00070908	.05062332	.00007001	.00201363	.00011372	.00006222
11.	.20471140	.08314068	.01759860	.04378656	.02304185	.00568441
12.	.14422650	.01400871	.01736247	.01419313	.01434212	.01142027
13.	1.03198339	.05540419	.08622679	.07386511	.09918809	.01778802
14.	.00000000	1.00000000	.00000000	.00000000	.00000000	.00000000
15.	.00899486	.00396112	1.06014587	.00564025	.00736285	.00366448
16.	.03463759	.03165522	.00828079	1.01208532	.02573397	.02575083
17.	.00633680	.01298343	.00219755	.00587081	1.00419069	.02466917
18.	.00804106	.06871554	.00289704	.00245176	.00684724	1.06434898

(Concluded)

Table B 3.4.2 (c) : LEONTIEF INVERSE OF THE 18 X 18 TECHNICAL COEFFICIENTS MATRIX FOR 1959, $(I - A_3)^{-1}$

	1	2	3	4	5	6
1.	1.36665406	.00958602	.01992405	.47939818	.38908420	.13817793
2.	.00057516	1.03718378	.00202781	.00401330	.00841162	.01955555
3.	.00064621	.01441406	1.04809629	.00834373	.00397311	.01079620
4.	.01743813	.00308827	.00094212	1.11344510	.01113097	.01755236
5.	.00050767	.00097167	.01115889	.00637647	1.19431792	.04875366
6.	.00089399	.00125688	.00080355	.00207375	.00833229	1.18769627
7.	.00022807	.00222866	.00362750	.00112275	.00365250	.00305009
8.	.00085851	.00215964	.00636929	.00803359	.00557030	.01385840
9.	.01327986	.04053884	.00916972	.01789268	.08495491	.10971770
10.	.00000731	.00001835	.00005479	.00006849	.00014268	.00012117
11.	.00007085	.00556272	.00248276	.00139608	.00126000	.00092693
12.	.00028979	.00261141	.00128718	.00365389	.00096748	.00704798
13.	.00062194	.07846323	.03472211	.01896846	.01736172	.01189840
14.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
15.	.00177136	.04776805	.00165271	.01015521	.02867760	.03422573
16.	.00352393	.03049989	.02264578	.01326961	.02441267	.02993828
17.	.00184358	.01544696	.04685630	.01057667	.01462497	.01844654
18.	.00839713	.00028663	.00055826	.00578093	.00281680	.00345518

(Contd..)

Table B 3.4.2 (c) (Contd..)

	7	8	9	10	11	12
1.	.21495401	.14381372	.06162218	.10772075	.01899238	.04214047
2.	.00474288	.02581331	.01438318	.08192388	.10343562	.02253023
3.	.00663525	.07895234	.03021650	.02881909	.10122627	.28489452
4.	.01572494	.00609090	.09804125	.00417274	.00468707	.00258677
5.	.03657907	.01068248	.00683650	.30044299	.00512411	.00476933
6.	.00986081	.00525697	.01618314	.00575209	.00277793	.00143396
7.	1.10492775	.00413793	.00344106	.00398149	.00550328	.00850352
8.	.01242808	1.05743404	.03758734	.02584768	.00525734	.00401520
9.	.08812659	.05944884	1.34576177	.03809208	.06009017	.02773801
10.	.00010809	.00894886	.00031861	1.00024276	.00004490	.00003436
11.	.00434722	.00344308	.00069785	.00127414	1.14348530	.00970945
12.	.00251857	.00305514	.00206937	.00181565	.02755726	1.21850632
13.	.02312297	.01027706	.00823681	.01682269	.22092417	.04691779
14.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
15.	.01068781	.04657453	.02319673	.09125063	.07259636	.02984875
16.	.02010392	.04947443	.06958953	.09427928	.11776209	.11055916
17.	.02079929	.02471021	.02135491	.02094607	.01986275	.09499968
18.	.07015314	.03417084	.00204203	.00177008	.00068907	.00096659

(Contd..)

Table B 3.4.2 (c) (Contd..)

	13	14	15	16	17	18
1.	.05153283	.11443215	.00236963	.01392262	.31350334	.21965821
2.	.01719227	.02735824	.10272110	.06063182	.00306479	.00748755
3.	.01887944	.02928053	.00549160	.00561796	.00457157	.02938644
4.	.00669421	.00399707	.00154344	.00233616	.01310043	.01265179
5.	.00509500	.01606177	.00065079	.00914998	.00805093	.03306551
6.	.01064967	.00181229	.00036462	.00113039	.00893283	.09283269
7.	.01084082	.00201168	.00134734	.02241559	.06279798	.00854871
8.	.01172136	.09456389	.00125522	.01229054	.00581908	.03332559
9.	.07739930	.03554524	.02079677	.02794588	.12260206	.12910514
10.	.00009959	.04693548	.00001067	.00010473	.00004989	.00028465
11.	.08132124	.23109086	.00062144	.00146780	.00681826	.00425870
12.	.03257847	.00685600	.00094094	.01371995	.00301024	.02359690
13.	1.14895576	.07995851	.00864206	.01854981	.09394714	.01540688
14.	.00000000	1.00000000	.00000000	.00000000	.00000000	.00000000
15.	.02151874	.02372448	1.22015912	.01867280	.00487283	.01871491
16.	.04255738	.03433778	.05254757	1.01019555	.01112789	.03309384
17.	.01238513	.00777497	.00247514	.01221159	1.01935178	.06255116
18.	.00140229	.00379898	.00016502	.00232292	.00602541	1.08472788

(Concluded)

Table B 3.4.2 (d) : LEANTIEF INVERSE OF THE 18 X 18 TECHNICAL COEFFICIENTS MATRIX FOR 1960-61, $(1 - A_4)^{-1}$

	1	2	3	4	5	6
1.	1.10228887	.00196460	.00258560	.70102123	.40697707	.06553703
2.	.00047427	1.07704140	.00215401	.00341799	.01068516	.02978796
3.	.00166240	.00197874	1.00107450	.00265829	.00737766	.01511675
4.	.00835591	.00010489	.00009889	1.04357592	.01006598	.00274159
5.	.00078132	.00017071	.00021091	.00665243	1.02894226	.01915703
6.	.00034117	.00028025	.00020212	.00538748	.00790312	1.23615632
7.	.00001858	.00098195	.00448738	.00017579	.00524020	.00039962
8.	.00066682	.00030881	.00609393	.00137158	.00729913	.00630053
9.	.01311419	.00356476	.00205962	.01933157	.05720366	.09270554
10.	.00000503	.00000233	.00004598	.00001035	.00005508	.00004754
11.	.00005094	.00623360	.00286126	.00084370	.00033241	.00155392
12.	.00015141	.00536441	.00246582	.00088408	.00075882	.00286986
13.	.00040539	.04960971	.02277119	.00671451	.00264543	.01236675
14.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
15.	.00154011	.03820103	.01461967	.00645132	.02841265	.03800703
16.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
17.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
18.	.01257176	.12929012	.08079157	.15557017	.17875635	.03764329

(Contd..)

Table B 3.4.2 (d) (Contd..)

	7	8	9	10	11	12
1.	.21722953	.16933669	.06453286	.07565660	.00613535	.00759307
2.	.00399589	.02080847	.01416612	.12507687	.06547247	.02132259
3.	.01111725	.03327780	.14856419	.14065743	.10396812	.28083350
4.	.01213268	.00378226	.02794396	.00203582	.00135949	.00086703
5.	.03440863	.00362860	.00868718	.18868650	.00428611	.00044078
6.	.01635889	.00425830	.01380715	.00400887	.00162435	.00898889
7.	1.20486926	.00030641	.00124460	.00169951	.00110265	.00129561
8.	.00166819	1.02342508	.01752678	.00232686	.00158485	.00222712
9.	.08753760	.10863380	1.18009854	.01812339	.05523535	.03444379
10.	.00001259	.00772277	.00013226	1.00001756	.00001196	.00001681
11.	.00049892	.00098608	.00385343	.00119110	1.19453730	.00102587
12.	.00115556	.00173795	.01298933	.00117063	.08852911	1.35111476
13.	.00397064	.00784766	.03066726	.00947932	.03372979	.00816434
14.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
15.	.01234063	.02346159	.02669227	.07861768	.04109098	.03328857
16.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
17.	.00000000	.00000000	.00000000	.00000000	.00000000	.00000000
18.	.11340509	.24106640	.24210194	.23036059	.19997726	.04757848

(Contd..)

Table B 3.4.2 (d) (Contd..)

	13	14	15	16	17	18
1.	.03928393	.08769828	.00149094	.00224154	.02924402	.00000000
2.	.01484033	.01711810	.12189380	.06064335	.00339782	.00000000
3.	.03688295	.02660071	.00314509	.00501821	.03350444	.00000000
4.	.00131063	.00159906	.00056139	.00092896	.00699648	.00000000
5.	.00331464	.00720410	.00019012	.00029651	.00429402	.00000000
6.	.00545600	.00142821	.00030318	.00047176	.00417380	.00000000
7.	.02063081	.00067202	.00013535	.00009598	.08360782	.00000000
8.	.00593773	.21208596	.00037955	.00059623	.00397733	.00000000
9.	.03714336	.03934698	.02361034	.03918242	.26608444	.00000000
10.	.00004481	.03198940	.00000286	.00000450	.00003001	.00000000
11.	.13109817	.15995185	.00077965	.00047557	.00088359	.00000000
12.	.11250781	.01432933	.00086118	.00072880	.00294207	.00000000
13.	1.04333719	.02694620	.00620483	.00378480	.00703203	.00000000
14.	.00000000	1.00000000	.00000000	.00000000	.00000000	.00000000
15.	.02058642	.01328920	1.00483844	.00997708	.00673506	.00000000
16.	.00000000	.00000000	.00000000	1.00000000	.00000000	.00000000
17.	.00000000	.00000000	.00000000	.00000000	1.00000000	.00000000
18.	.30141131	.09116824	.25795914	.08690647	.22992336	1.96322873

(Concluded)

Table B 3.4.2 (e) : LEONTIEF INVERSE OF THE 18 X 18 TECHNICAL COEFFICIENTS MATRIX FOR 1963, $(1 - A_5)^{-1}$

	1	2	3	4	5	6
1.	1.26623538	.07917420	.04478973	.66781698	.22580099	.08105738
2.	.00054108	1.00947012	.00917141	.00941089	.01187790	.01974118
3.	.00058883	.00540462	1.01051562	.00387096	.00757174	.00717332
4.	.01271129	.00633865	.00913278	1.16715609	.01536582	.01385436
5.	.00263952	.00156654	.00190818	.01001929	1.45888713	.02072859
6.	.00040877	.00196533	.00268357	.01695152	.01066802	.00061587
7.	.00023497	.00089757	.00053346	.00074677	.00231493	.01063618
8.	.00041711	.00238407	.00295773	.01373258	.00414417	.06751465
9.	.00945565	.07412751	.11703254	.03006289	.10062665	.00030301
10.	.00002896	.00008062	.00009143	.00031489	.00025905	.00333758
11.	.00042740	.01221728	.01594205	.00478317	.00575677	.01991473
12.	.00119166	.01397748	.01007966	.01304391	.02349359	.00464886
13.	.00167208	.06896131	.03504772	.01888078	.00943257	.00000819
14.	.00012789	.00000800	.00000452	.00006745	.00002281	.02557992
15.	.00130865	.06365595	.05086348	.01329401	.02545479	.01165721
16.	.00166228	.00881673	.00977138	.00633104	.00887970	.00069000
17.	.00080928	.00045737	.00041949	.00180815	.00090225	.05900403
18.	.00294516	.01658082	.01643474	.03147472	.05200433	1.25260191

(Contd..)

Table B 3.4.2 (e) (Contd..)

	7	8	9	10	11	12
1.	.19669418	.23166571	.09897571	.04706486	.02612626	.01223429
2.	.00727125	.07021195	.03160530	.12842268	.09851729	.01521221
3.	.00704799	.03888449	.06046771	.12941559	.11477635	.06332180
4.	.03188388	.00679275	.08868825	.00562759	.00459507	.00443526
5.	.15718906	.00846551	.01607334	.18266397	.00390685	.00255748
6.	.01057076	.00523571	.02503428	.00374450	.00248400	.01658398
7.	1.18644326	.00064509	.00096051	.00182757	.00128223	.00032985
8.	.00601467	1.14820963	.02307474	.00371612	.02490876	.00909682
9.	.06172773	.05207336	1.18947511	.05303517	.04502876	.04986008
10.	.00028723	.02088694	.00061662	1.00029641	.00072321	.00027784
11.	.01074245	.01675600	.00788792	.00948896	1.24579060	.01075716
12.	.03351875	.01794795	.03718445	.02536883	.05793190	1.52745119
13.	.01139992	.02540759	.01916300	.01993859	.01840094	.00638898
14.	.00001987	.00002340	.00001000	.00000475	.00000264	.00000124
15.	.01794608	.01927974	.02855535	.07637994	.04972815	.05191214
16.	.00628785	.01994488	.03439195	.10315448	.08533389	.01053265
17.	.00076111	.00099915	.00162373	.00440519	.00295887	.00045344
18.	.09867575	.04128830	.09834529	.06514651	.11043661	.06259514

(Contd..)

Table B 3.4.2 (e) (Contd..)

	13	14	15	16	17	18
1.	.02274475	.06057222	.01241468	.00859963	.05861103	.03952311
2.	.03000103	.03724390	.11348425	.04136033	.01017389	.01663932
3.	.02611250	.03115931	.00319989	.00406306	.01330856	.03109153
4.	.00417638	.00250869	.00231371	.00109716	.01911151	.01508009
5.	.00593540	.02316406	.00177870	.00769990	.03665409	.01090837
6.	.00637302	.00179788	.00123457	.00171862	.00958515	.01154118
7.	.01176559	.00045090	.00103632	.00209550	.25560539	.00239721
8.	.01352966	.26718576	.00291732	.01304092	.00633515	.02009186
9.	.03441160	.02099419	.02188724	.01141788	.17459347	.06856812
10.	.00045691	.11963692	.00027166	.00136183	.00021052	.00207890
11.	.18270880	.08452443	.00573166	.02010204	.03024485	.03946474
12.	.16866702	.01075865	.02291942	.02876447	.02693637	.32424596
13.	1.07116507	.00933992	.01365853	.04880230	.16268692	.01211860
14.	.00000230	1.00000612	.00000125	.00000087	.00000592	.00000399
15.	.02425994	.01639359	1.20545756	.02362147	.01122419	.03099482
16.	.01634173	.02195374	.10846595	1.01924176	.00837841	.01374904
17.	.00062538	.00096522	.00246420	.00092018	1.00059382	.00060148
18.	.11951198	.02406544	.06218071	.01060738	.05175855	1.04938841

(Concluded)

Table B 3.4.3 (a) : MATRIX PRODUCT $(1 - A_1)^{-1} * f_k$

Sector/Years	1951-52	1953-54	1959	1960-61	1963
1.	600577,45910E06	709229,84898E06	787570,27236806	771598,54959E06	972674,15241E06
2.	6327.00019034	5824.46411920	5698.53811754	5253.14222171	6965.05816032
3.	14193.29823489	10787.10667072	15301.31277911	8896.19726417	13261.30338237
4.	119216,24048E06	124184,56395E06	118769,48550E06	120254,60256E06	128812,64462E06
5.	73035,26362243	78402,97774782	107890,37358E06	112025,83784E06	129653,08639E06
6.	6856.10911471	7913.87139187	9568.94498714	11451.21420899	14754.54652630
7.	9550.04758387	12400.41195365	10584.62972463	19840.83196466	28566.21362700
8.	13223.98682222	15434.30870176	14732.28241578	17092.57134154	31688.10386964
9.	20966.27019221	17354.14975872	9672.45544945	23793.75679366	43065.74254035
10.	2573.19834821	2568.56007713	3194.04278678	5564.79867880	1663.42294821
11.	11346.09102162	11541.52329309	14917.78326200	16530.64773949	32137.44841068
12.	2012.96371696	1497.91282967	3034.44478337	555.18103685	-5129.08845872
13.	25434.93295358	23766.05721609	60566.01016591	73307.38466022	94979.98307103
14.	70452.00000000	76203.00000000	72462.00000000	125837,00000E06	49449.00000000
15.	4299.97741403	5141.18101428	5421.77320262	4336.47797248	8622.97706483
16.	36477.79605707	30472.15383234	38241.11577475	25683.01617060	17537.37940049
17.	33803.18661805	38547.47636448	47616.43033915	20219.99119279	30080.36188227
18.	26691.93282583	30689.56325440	12844.70905245	14289.67972743	53834.24421991

Table B 3.4.3 (b) : MATRIX PRODUCT $(1 - A_2)^{-1} * f_k$

Sector/Years	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1.	613889,66606E06	723530,04698E06	803051,22302E06	785170,05820E06	990872,58265E06
2.	7616.82040053	6994.95989654	7126.05279527	6778.43189226	9439.13238185
3.	15201.19376941	11537.03769558	16495.62380582	11087.69072308	16324.74067226
4.	116914,94994E06	121615,33987E06	116047,83711E06	117605,89296E06	126076,36668E06
5.	72946.52300774	78240.81142723	107852,88076E06	111828,85671E06	129293,38797E06
6.	7171.01981953	8238.96155401	9873.71431777	11851.13109482	15252.69640019
7.	10146.53976869	13059.06280556	11397.05539978	20460.01584149	29566.76044274
8.	15478.50634929	17836.79336414	17042.98742792	21000.09230999	33553.74019535
9.	23567.19388385	19719.27206814	10407.32894056	26024.77509994	48143.89115595
10.	3088.27667829	3116.98413188	3728.32816663	6455.58866940	2026.96977937
11.	10218.60264901	10228.14324607	13149.91680134	14366.16879822	30004.52814503
12.	3870.01677268	3190.94097524	6978.46996780	5409.58268710	1737.15296368
13.	23352.84424297	21411.83768075	57909.71916165	70901.10292631	92210.25013897
14.	70452.00000000	76203.00000000	72462.00000000	125837,00000E06	49449.00000000
15.	4334.64908313	5164.83111960	5397.07813792	4349.81370412	8810.67920855
16.	37078.52934862	31075.20986613	38770.35702637	26754.82395885	18373.36033350
17.	33327.97815809	37932.00597680	46890.79764559	19513.67039620	29364.17356786
18.	27858.19353944	31885.83682080.	13698.68943444	15830.83332363	55235.23083082

Table D 3.4.3 (C) : MATRIX PRODUCT $(1 - A_3)^{1} * f_k$

Sector/Year	1951-52	1953-54	1959	1960-61	1963
1.	600892,22601E06	711121,36078E06	791383,43305E06	778983,370116E06	984325,36993E06
2.	7810.41702566	7271.47758229	7082.02012582	7418.34867049	8892.18280214
3.	8695.25568699	4474.78605057	6838.93159913	2801.30385152	7582.90320705
4.	123614,37690E06	128698,42643E06	123506,38057E06	125603,89745E06	135311,43025E06
5.	68586.45443776	73387.55842537	100054,96827E06	104144,76002E06	120043,85880E06
6.	9178.41194688	10576.13206878	11261.92289822	13049.21492681	20708.69797266
7.	12175.81041258	15146.85550611	14066.01323696	22300.51612344	31721.70203710
8.	14894.55447552	16925.66352364	15598.63421109	19711.98329306	34590.01498984
9.	30880.32656613	26996.67266415	25558.88171520	39579.57603949	59991.46586434
10.	2833.75720433	2872.64517141	3436.96194816	5979.49854143	2023.58438155
11.	16937.14346024	18227.08701065	16317.03702234	25344.41719944	25261.07551372
12.	1992.44496349	1573.85347447	1510.97206311	-1315.20489143	-7289.88929807
13.	24962.22477769	22914.94116700	62249.99277666	78398.76312494	103238,89849E06
14.	70452.00000000	76203.00000000	72462.00000000	125837,00000E06	49449.00000000
15.	9316.81450712	10495.63128703	10948.70954213	10806.93085028	17037.37203733
16.	38889.47185423	32835.61181739	40349.98381009	28903.12288224	23179.95695088
17.	35150.83483331	39726.62832212	48536.32989220	19829.38366901	32150.56315373
18.	23245.63617478	27113.33890152	8718.67369000	7054.57014573	51792.62513834

Table B 3.4.3 (d) : MATRIX PRODUCT $(1 - A_4)^{-1} * f_k$

Sector/Year	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1.	512423,24805E06	601548,92373E06	667348,24292E06	665076,91839E06	826215,03563E06
2.	7120.91644655	6492.47254626	6588.32429796	6489.07683748	7915.04636603
3.	9283.93323437	4688.34786136	8140.57473850	5046.44142529	9544.31416559
4.	111807,81672E06	116200,75336E06	111127,36662E06	112468,42121E06	119418,20459E06
5.	57980.69717620	62094.37477436	85370.55866344	88838.37002006	101897,41014E06
6.	7770.01387288	8948.72715793	11028.46291933	13160.87117740	17074.07479824
7.	12654.02552791	16044.78506612	15364.21733484	24314.80721085	34747.14285341
8.	21092.21095110	23775.76200482	22474.43038034	32791.10631443	36388.12659958
9.	30762.40468155	27982.55316940	28701.57064382	36511.78999570	51022.71453289
10.	1752.12765184	1703.14486709	2325.63976965	4070.50228125	1217.29046432
11.	12010.96320604	12706.52219136	12597.50513310	18526.43335019	25465.21708304
12.	2186.33679391	1500.21630690	4142.67291977	2537.69431443	-3014.12461173
13.	14738.04178955	12103.60872090	47716.92840312	63170.68340842	85764.95099550
14.	70452.00000000	76203.00000000	72462.00000000	125837,0000E06	49449.00000000
15.	7122.39844227	7971.45386693	8932.81271269	8689.04105734	13460.48644822
16.	29791.00000000	23459.00000000	30067.00000000	16651.00000000	7615.00000000
17.	29272.00000000	33654.00000000	42642.00000000	14286.00000000	23225.00000000
18.	86627.45671649	93661.95584696	74270.03067298	73926.30412165	167615,53929E06

Table B 3.4.3 (e) : MATRIX PRODUCT $(1 - A_5)^{-1} * f_k$

Sector/Year	*1951-52*	*1953-54*	*1959*	*1960-61*	*1963*
1.	560100,71982E06	660675,44674E06	730487,66571E06	723231,50168E06	909884,05852E06
2.	9472.27602275	9135.91180539	9155.24840789	10403.85267825	13044.76585325
3.	8662.59988041	4488.85797623	7221.87798111	4250.81681372	10030.22572779
4.	127775,19401E06	132795,52995E06	127090,26986E06	129027,73205E06	138706,82288E06
5.	85983.17041114	92395.01386706	125320,17422E06	130951,04003E06	150270,08168E06
6.	9679.52980111	10898.42761417	12854.17123599	14899.22587585	19476.31755690
7.	17500.10937524	21639.45231329	22140.85561864	25888.72946164	37609.16019718
8.	27516.46809456	30680.78552161	28811.17826337	41776.60578563	44723.99970541
9.	29187.62111113	25453.37626392	25006.42126592	34149.67411956	51184.75496619
10.	8133.95763713	8607.13277903	8878.70719700	15269.85731346	6071.96625768
11.	10403.64571090	10688.23924827	12272.41024210	13555.07292502	30297.95643186
12.	13264.12118541	13397.95042081	13214.36670178	10380.06889153	18985.05980139
13.	22127.63246492	19952.16055422	58308.22655935	68082.91449757	94602.67840941
14.	70508.57017270	76269.72822012	72535.77925424	125910,04638E06	49540.89828991
15.	9457.01451633	10295.64620929	10788.25969119	9976.44761825	16497.00691413
16.	34874.58025217	28671.54353596	35598.23202667	22988.18686864	15611.95170678
17.	29962.75604376	34414.08577078	43460.60618308	15138.28554684	24254.14893229
18.	31426.46256284	34656.37795885	21276.03312702	1839.79804557	69183.21130811

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