

STRUCTURE OF INDIAN ECONOMY AND THE LINKAGES PATTERN

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Abstract:

This present paper makes an attempt towards measuring technical progress through estimating input coefficients (technical coefficients) across various years. Such a measurement would shed considerable light on the trends in the rate of technical progress as an important source of growth in the Indian economy and lay to rest various speculations about the role of liberalization in promoting technological progress in the Indian economy. Such an effort would also make it possible to compare the two significant phases of the Indian economy: the 'inward-looking' phase and the 'outward-looking' phase. In the present paper many tools have been used to find out technological change and to identify the key sectors such as Chenery-Watanabe Categorization, in which, all the sectors of the economy are classified into four categories on the basis of U-W ratios. The study clearly finds that primary sector have low backward and low forward linkages with tertiary sector, high linkages with itself and average linkages with secondary sector. Secondary sector has low linkages with primary sector but high linkages with tertiary sector. Electricity alone has high linkages with all the three sectors. The capital intensive basic industries like iron and steel, electricity, non ferrous basic metals, construction, etc. are supposed to play the role of engine in the process of growth. Investment in these sectors can speed up the industrialization process; as such sectors will stimulate greater economic activities in other sectors.

Key Words: *Structural change, technological change, economic growth, inter-Sectoral linkages, Indian economy etc.*

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Introduction: Economic growth of an economy is always associated with structural changes in the economy. The changes take place in the form of sectoral composition as well as occupational structure of the workforce. Economic structure is generally divided into three broad sectoral economic activities: primary, secondary and tertiary. The primary sector mainly covers the agriculture and allied activities; the secondary sector covers the manufacturing, construction etc; and the tertiary sector refers to the services. Service sector consists of trade and commerce, transport and other such activities. Most of the studies have shown that with development, the share of agriculture in production and employment that is typically high in the early stages begins to decline and that of manufacturing begins to increase. The next stage in this sectoral evolution is the shift towards services. According to Fisher, "In every progressive economy, there has been steady shift of employment and investment from the essential primary activities to secondary activities of all kinds and to a still greater extent into tertiary production".

The pattern of growth that the Indian economy is currently experiencing has received particular attention. This growth process has witnessed the slowing of agriculture at a time when the rest of the economy is growing at unprecedented rates. Manufacturing output has even registered double digit growth in some recent years. Growth of the services economy has been less spectacular but more steady over a longer period. The relative shift of the workforce from agriculture to non-agricultural activities conforms to the Fisher- Clark-Kuznets hypothesis on structural change in the economy. Although the direction of structural change is indicative of a progressing economy, yet in terms of employment requirements, the pace of shift of the workforce is slow. This indicates that a large number are trapped in agriculture and need to be shifted elsewhere. Productivity growth in developed countries mainly relies on technological innovation. For developing countries, however, growth and development are much less about pushing the technology frontier and much more about changing the structure of production towards activities with higher levels of productivity. This kind of structural change can be achieved largely by adopting and adapting existing technologies, substituting imports and entering into world markets for manufacturing goods and services, and through rapid accumulation of physical and human capital. India experienced higher economic growth with increasing inequality in both the agricultural and

the manufacturing sector during 1980-2008, however, as the disaggregated regional growth analysis reveals, at the micro-level, the states with higher agricultural and manufacturing orientation enjoyed higher average economic growth. A few developing countries have been able to undertake original research and development in some fields, but technological innovation continues to be highly concentrated in the industrialized world.

The technology and structure of the Indian economy have been changing since Independence. This change in the structure and technology manifests in the form of specific inter-linkages between various sectors like agriculture, manufacturing, and services and their sub-sectors. These inter-linkages get reflected through their quantification via national accounts or more specifically, input-output tables. This paper makes an attempt towards measuring technical progress through estimating input coefficients (technical coefficients) across various years. Such a measurement would shed considerable light on the trends in the rate of technical progress as an important source of growth in the Indian economy and lay to rest various speculations about the role of liberalization in promoting technological progress in the Indian economy (Prasad, K. N.). Such an effort would also make it possible to compare the two significant phases of the Indian economy: the 'inward-looking' phase and the 'outward-looking' phase.

However, over time, the input coefficients would change on account of both pure technological progress expanding options for techniques of production as well as change in relative input prices leading to input substitutions in the production if we assume that input substitution is possible within a sector. For the purpose of the present paper, the definition of technical progress ignores the distinction between these two sources of change in the input coefficients and treats the observed change in input coefficients as a measure of technical change.

Objectives of the Paper

1. To examine the nature and direction of inter-sectoral linkages and identify the key sectors;
2. To analyze the relation of inter-sectoral dependence and growth and thereby identifying the sources of growth;

3. To analyze the technological change which take place in Indian Economy during the study period.

Methodology: The structural relationship of an economy is examined by using the input-output tables. The study of the sectoral linkages and the identification of the key sectors based on the input-output technique show the nature and the degree of interdependence of an economy. Thus in order to study the structure of the Indian economy with the classification of sectors based on input usage input-output technique is appropriate. For this purpose the Indian Input-Output Transaction Tables sourced from Central Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India has been used. Keeping in view the broad objectives of the study, the secondary data on the Indian economy have been used. For analysis of structural change, the sector level data from 'National Accounts Statistics' is used.

Analysis of Backward and Forward Linkages

In the framework of the input-output model, industry production has two kinds of economic effects on other industries in the economy: Increased demand and supply. When industry i increases its production, there is increased demand for inputs from industries. In the input-output model, this demand is referred to as *backward linkage*. An industry with higher backward linkages than other industries means that expansion of its production is more beneficial to the economy in terms of causing other induced productive activities. On the other hand, an increase in production by other industries leads to additional output required from industry i to supply inputs to meet the increased demand. This supply function is referred to as *forward linkage*. An industry with higher forward linkages than other industries means that its production is relatively more sensitive to changes in other industries' output. In this paper, we derive both backward and forward linkages from the Leontief inverse matrix.

Chenery Watanable Categories based on U-W Statistics

In these methods the sectors of the economy are classified into four 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 I whereas, W_i is the total intermediate demand for output of sector is to total

demand for sector i . U_{js} shows the strength of the backward linkages and W_{is} the strength of the forward linkages. The categorization of the sectors is given below.

Table 1: Classification of productive sector of Economy by Type

By output Use	Final	Intermediate
By Input Type	Low W	High W
Manufacturing (High U)	III. Final manufacture (High backward & low Forward linkage)	II. Intermediate manufacture (High backward & forwards linkage)
Primary production (Low U)	IV. Final primary Prod. (Low backward & Low forward linkage)	I. Intermediate primary prod. (Low backward & High forward)

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 final users and owners of primary factors.

In India, various attempts have been made to examine the nature of technological progress experienced by the economy. Sen Gupta (1993) tried to assess the growth in the Indian manufacturing sector and the factors driving it. Categorizing the high growth in the manufacturing sector, He explained the phenomenon in light of historical developments concerning the Indian manufacturing sector. Dividing the post-independence period into three periods, He also attributed the high growth phase up to mid-60s due to heavy public investment in capital and intermediate goods sector coupled with extensive import substitution. The low growth phase lasting from mid-60s to end 70s was attributed to decrease of public investment and exhaustion of import substitution opportunities by other scholars also (like Sandesara, 1993). However during the high growth phase of the 1980s, not only the demand for consumer goods picked up but there was a clear policy response in terms of an expansionary supply regime. Therefore, according to Sen Gupta (1993); the growth phase of this period was 'demand-induced'.

In this paper many tools have been used to find out technological change and to identify the key sectors, which are discussed as follows:

Chenery-Watanabe Categorization

In this method the sectors of the economy are classified into four 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 I whereas, W_i is the total intermediate demand for output of sector i to total demand for sector i. U_{js} shows the strength of the backward linkages and W_{is} the strength of the forward linkages. The categorization of the sectors is given in methodology. In the 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 final users and owners of primary factors.

Table 5.1 highlights the classification of the sectors falling in each of the four categories for the years 1973-74, 1978-79, 1983-84, 1989-90, 1993-94, 1998-99, 2003-04 and 2006-07. The sector numbers follow the sector classification index (Appendix A-I). The detailed estimates of U-W statistics for the different years are given in Appendix Tables (Appendix A-II).

The Table shows that amongst (1 to 11) primary sectors there were only two sectors that shifted to final primary production, i.e., Forestry and logging (6) shifted from intermediate primary production to final primary production in the year 1978-79 and animal husbandry (5) moved from final manufacturing to final primary production during the same time period. Food crops(1) having low backward and low forward linkages up to the period 1998-99 has shifted to intermediate primary production during the year 2003-04. It has been clearly shown in the table that there is not a single sector under primary sectors which had both high backward and high forward linkages during all the year. Cash crops (2), Coal and lignite (8), Crude petro and natural gas (9) and other minerals (11) were the sectors which remained in the intermediate primary production up to the year 2006-07. Like-wise Iron ore (10), plantation crops (3), other crops (4) and fishing (7) were remained in the IV category i.e. final primary production up to the same year. Food crops, plantation crops, other crops and fishing have both low linkages during the whole time period where as Cash crops, coal & lignite, crude petroleum & natural gas and other minerals provide heavy outputs to other sectors and remain in first category during the whole time period.

On the other hand under secondary sectors (12 to 47) print, publishing and allied activities (23) and Plastic and rubber products (25) showed a significant shift from intermediate

manufacturing to final manufacturing in the year 1983-84. Paper and paper products (22), petroleum products (26), coaltar products (27), inorganic heavy chemicals (28), Organic heavy chemicals (29), Fertilizers (30), paint varnishes and lacquers (31),

Table 5.1: Classification of 60 Sectors in Chenery-Watanable Categories for different years

Category	1973-74	1978-79	1983-84	1989-90	1993-94	1989-99	2003-04	2006-07
I	2, 6, 8, 9, 11 34, 50, 54	2, 8, 9, 11, 34, 42, 50, 54, 59	2, 8, 9, 11, 50, 54, 55	2, 8, 9, 11, 48, 50, 51, 54, 55, 59	2, 8, 9, 11, 50, 51, 54, 55	2, 8, 9, 10, 11, 20, 50, 54, 55	2, 8, 9, 11, 20, 50, 51, 54, 55	1, 2, 8, 9, 11, 20, 48, 50, 51, 54, 55
II	20, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 46	18, 20, 22, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 46	18, 20, 22, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 42, 46, 48	20, 22, 26, 27, 27, 28, 29, 30, 31, 32, 33, 35, 36, 40, 42, 46	18, 20, 22, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 46	18, 22, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 46, 48	18, 22, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 42, 44, 46	18, 22, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 44, 46
III	5, 12, 13, 14, 15, 16, 17, 18, 19, 24, 38, 39, 40, 41, 42, 43, 44, 45, 48, 53, 58	12, 13, 14, 15, 16, 17, 19, 23, 24, 38, 40, 41, 43, 44, 45, 47, 48, 53, 58	5, 12, 13, 14, 15, 16, 17, 23, 24, 25, 38, 39, 40, 41, 43, 45, 47, 49, 53, 58	12, 13, 14, 15, 16, 17, 18, 19, 23, 24, 25, 34, 37, 38, 39, 41, 43, 45, 58, 58	12, 13, 14, 15, 16, 17, 19, 23, 24, 34, 37, 38, 39, 40, 41, 42, 43, 44, 45, 47, 48, 53, 58	12, 13, 14, 15, 16, 17, 19, 21, 23, 24, 25, 34, 37, 38, 39, 40, 41, 42, 43, 44, 45, 49, 53, 58	1, 12, 13, 14, 16, 17, 19, 21, 23, 24, 38, 39, 40, 41, 43, 45, 48, 49, 50, 53	12, 13, 14, 16, 17, 19, 21, 23, 24, 25, 38, 39, 40, 41, 42, 43, 45, 49, 53
IV	1, 3, 4, 7, 10, 21, 47, 49, 51, 52, 55, 56, 57, 59, 60	1, 3, 4, 5, 6, 7, 10, 21, 39, 49, 51, 52, 55, 56, 57, 60	1, 3, 4, 5, 6, 7, 10, 21, 39, 49, 51, 52, 55, 56, 57, 60	1, 3, 4, 5, 6, 7, 10, 21, 44, 47, 49, 52, 56, 57, 60	1, 3, 4, 5, 6, 7, 10, 21, 49, 52, 56, 57, 59, 60	1, 3, 4, 5, 6, 7, 47, 51, 52, 56, 57, 59, 60	3, 4, 5, 6, 7, 10, 15, 47, 52, 56, 57, 58, 59, 60	3, 4, 5, 6, 7, 10, 15, 47, 52, 56, 57, 58, 59, 60

Source: Calculated

Pesticides, drugs and other chemicals (32), cement (33), Iron and steel industries & foundries (35), other basic metal industry (36), Metal products excl. machinery (37), electronic & elect. machinery (41), other transport equipment (43), and electricity (46) were the sectors which remained in the II category during all the years. The only sector wood products excluding Furniture (20) shifted to intermediate primary production in the year 1998-99. Jute, hemp and Mesta textile (18) and Misc. manufacturing industries (44) moved from final manufacturing to intermediate manufacturing in the year 1978-79 which remained in the same category upto 2006-07 except the year 1989-90. By the year 1998-99, Sugar (12), Food products (excluding Sugar) (13), Beverages (14), cotton textiles (16), Wool, Silk and synthetic textiles (17), textile products (19), leather & leather products (24), Agriculture machinery (38), Machinery for food and text industry (39), other machinery (40), Railway transport equipment (42), other transport equipment (43) and construction (45) included in the category of final manufacturing during all the years. Only Furniture and fixtures (21) moved from final primary production to final manufacturing by the year 1998-99. Non-metallic mineral products (34) also shifted from intermediate primary production to final manufacturing by the year 1989-90 and after that to intermediate manufacturing. Tobacco products (15) remained in final manufacturing upto 1998-99 but after that shifted to final primary production. Gas & water supply (47) have low backward and low forward linkages and remained in final primary production in all the years. Paper and paper

products, petroleum products, coaltar products, inorganic heavy chemicals, Organic heavy chemicals, Fertilizers, paint varnishes and lacquers, Pesticides, drugs and other chemicals, cement, Iron and steel industries & foundries, other basic metal industry and electricity were the sectors which have both high linkages and remained in the II category during all the years.

Amongst all the tertiary services Railway transport services (48) was the only sector which had both high backward and high forward linkage during the years 1983-84 and 1998-99. Storage and warehousing (50) and banking (54) were remained in the first category during all the years. Other transport services (49) moved from final primary production to final manufacturing sectors in the years 1983-84 and 1998-99. Insurance (55) also moved from final primary production to intermediate primary production by the year 1983-84, whereas Trade (52), Ownership of dwelling (56), Education & Research (57) and public Adm. & Defence (60) were remained in IV category during all the years except other services (59) which got shifted to intermediate primary production in the years 1978-79 and 1989-90. Communication (51) shifted from final primary production to intermediate primary production by the year 1989-90. Hotels and Restaurants (53) have high backward and low forward linkages and remained in final manufacturing in all years. Medical and health (58) remained in final manufacturing upto 2003-04 after that shifted to final primary production storage & warehousing and banking have high forward linkages during the whole period Whereas trade, ownership of dwelling, education & research and public administration & defence have both low linkages during all the years.

Linkage structure of the economy has helped in understanding interdependence of sectors and thereby it has served as a first step in the identification of potential areas of project development and evaluation (Bathla, S. 2003). Regarding the linkage pattern it has been analysed that primary sector have both low backward and low forward linkages with tertiary sector, high linkages with itself and average linkages with secondary sector. Secondary sector has low linkages with primary sector but high linkages with tertiary sector. Electricity alone has high linkages with all the three sectors. Banking provides better services to primary sector, whereas, hotels & restaurants provides services to tertiary sector more. Other transport services and storage & warehousing takes services from tertiary sector and also provides services to that.

Sector-wise Linkage Patterns

A look on the sectoral linkages pattern highlights (Table 5.2) the classification for the sector falling in each of the four categories:- intermediate primary production; intermediate

manufacturing; final manufacturing; and final primary production. Total backward and forward linkages have been worked out for the sector economy: primary sector; secondary sector and tertiary sector. In the first category, i.e., intermediate primary production, backward linkages are low and forward linkages are high. In Intermediate manufacturing both linkages are high, in final manufacturing backward linkages are high but forward linkages are low. In last category, i.e., final primary production both linkages are low.

Primary Sector: In classification primary sector covers sectors from 1 to 11 as per sector classification index. The table shows that sector 1 (food crops) and 5 (Animal husbandry) are only two sectors which fall under second category during whole period. These two sectors have high backward and high forward linkages. Food crops and animal husbandry take heavy amount of inputs from primary sector and also provide amount of outputs to this sector. Upto 1989-90 others crops (4) were also under second category but after 1993-94 it moves to Ist category. Now its forward linkages are high but backward linkages are low. In 1989-90 Coal and lignite (8) had high backward and high forward linkages with secondary sector. However later on it also moves to intermediate primary production. Cash Crops (2) remain under category IInd upto the 1983-84 then it shift to Ist category upto 1998-99 and again from 2003-04 it move to IInd category. Cash crops have low backward but high forward linkages with secondary sector but low forward and low backward linkages with tertiary sector. In 1989-90 cash crops have high backward but low forward linkages with secondary sector but later on it move to category first. In 1993-94 and 1998-99 cash crops have low backward but high forward linkages with secondary sector. Forestry & logging (6) and fishing (7) have low backward and low forward linkages with all the three sectors during the whole time period .Plantation crops (3) had high backward but low forward linkages with primary and secondary sectors during 1989-90. But 1993-94 onwards it move to intermediate primary production and have high forward but low backward linkages with both sectors. With tertiary sector it have low backward and low forward linkages during the whole time period. Coal and lignite (8), Crude petroleum and natural gas (9) and Iron ore (10) have low backward and low forward linkages with primary sector and tertiary sectors during the whole time period except Coal and lignite (8) which had high backward but low forward linkages with tertiary sector 1993-94.

Other than 1989-90 Iron ore (10) and other minerals (11) have low backward but high forward linkages with secondary sector. Crude petroleum and Natural Gas (9) have low

backward but high forward linkage with secondary sector during the whole period. Crude Petroleum & natural gas have forward link with secondary sector. Food crops and animal husbandry have both high linkages with primary sector. Primary sector have low backward and low forward linkages with tertiary sector, i.e., primary sector takes less amount of inputs and also provides low outputs to tertiary sector. Primary sector has weak linkages with tertiary sector.

SECONDARY SECTOR: - It covers sectors from 12 to 47. From the table, it can be seen that sugar (12), Beverages (15), cotton textiles (16), Wood prod. excl. Furniture (20), Furniture & Fixtures (21), Paper & paper products (22), Coaltar products (27), cement (33) and non-metallic mineral products (34) have high backward but low forward linkages with primary sector from 1983-84 to 1998-99. Sugar (12) remain under IIIrd category during the whole period. Petro Prod. (26), Fertilizers (30) and electricity (46) have high linkages with primary sector. Electricity has both high backward and high forward linkages with secondary sector also. Pest, drug & other chemicals (32), Iron & Steel ind. & foundaries (35) and metal products excluding machinery (37) have both high forward and high backward linkages with secondary sector throughout the whole study period. Misc. Manufacturing industries (44) has both high linkages with tertiary sector upto 1993-94 but after that it move to intermediate primary production i.e. it has high forward but low backward linkages but again from 2003-04 onwards it moves to second category. Pest drug & other chemicals (32), Agriculture machinery (38) and other machinery (40) have low backward but high forward linkages with primary sector. Jute, Hemp & mesta textiles (18), wood products excl. furniture (20) and coaltar products (27) have high forward but low backward linkages with secondary sector. Furniture & fixtures (21) with some fluctuations and Petro products (26) throughout the whole period have high forward but low backward linkages with tertiary sector. Electricity (46) has high linkages with tertiary sector with some fluctuations. Beverages (14), cotton textiles (16), Wool silk & synthetic textiles (17), textiles products (19), print, publ. & allied act. (23), leather & leather products (24), plastic & rubber products (25), Fertilizers (30), Electronic & Elect. Machinery (41), Railway transport equipment (42), other transport equipment (43), Misc. manufacturing industries (44) and construction (45) have high backward but low forward linkages with secondary sector. Tobacco products (15), wool, Silk & synth textiles (17), coaltar products (27), Inorganic heavy chemicals (28), Non metallic mineral products (34), Iron & steel ind. & foundaries (35), metal products excluding machinery (37), machinery for food and textiles industry (39), electronic & elect. Machinery (41) and other

transport equipment (43) have low forward but high backward linkages with tertiary sector. They remain in category III during the whole period.

Fertilizers (30) have low backward linkages but high forward linkages during almost whole period. Sugar (12), Food products (excl. sugar) (13) and Tobacco products (15) have both low linkages with secondary sector. Wool, Silk & Synthetic Textiles (17), Printing publishing & allied activities (23), Plastic & rubber products (25), paint, varnishes & lacquers (31), organic heavy chemicals (29), metal products excl. Machinery (37), machinery for Food & textiles Industry (39), electronic & elect. Machinery (41), other transport equipment (43), Misc. manufacturing industries (44) and Gas & water supply (47) have low backward and low forward linkages with primary sector. Pest drug and other chemicals, agricultural machinery and other machinery have high forward link with primary sector. Jute hemp mesta textiles, wood products excluding furniture and coaltar products have high forward linkage with secondary sector. Furniture & fixtures and petro products have high forward link with tertiary sector. It can be concluded that secondary sector has low linkages with primary sector but high linkages with tertiary sector. Construction has high linkages with all sectors with some fluctuations. Electricity alone has high linkages with all the three sectors during the whole period.

TERTIARY/SERVICE SECTOR: Service sector includes sectors from 48 to 60. The table shows that amongst tertiary sector there are other transport services (49) and storage and warehousing (50) sectors which have high backward and high forward linkages with tertiary sector itself during the whole period. Other transport services (49) have high backward and high forward linkages with secondary sector during the same time period. But with primary sector it has low linkages except during 1998-99 when it has low backward but high forward linkages. Storage and ware housing (50) has low backward and low forward linkages with primary as well as secondary sectors during the whole time period. Railway transport services (48) has low backward but high forward linkages with primary sector, both high linkages with secondary sector but both low linkages with tertiary sector with some fluctuations. Communication (51) has low linkages with primary and secondary sectors but low

Table 5.2: Sector-wise Classification of Linkages

	1973-74			1978-79			1983-84			1989-90		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
I	30, 32, 46, 48, 52	2, 6, 9, 34, 36, 52, 54, 59	4, 7, 23, 25, 6, 51, 55, 59	30, 46, 48, 52, 54	2, 5, 9, 20, 28, 34, 36, 59	4, 22, 23, 25, 26, 42, 43, 46, 48, 51, 59	30, 32, 49, 52, 54	2, 5, 6, 8, 9, 20, 26, 34, 36, 54	4, 23, 25, 26, 42, 43, 44, 48, 53, 55	2, 35, 38, 40, 45, 48, 52, 54	9, 18, 20, 27, 28, 55	14, 21, 26, 51, 53, 55
II	1, 2, 4, 5, 13, 16, 26, 45	4, 5, 13, 16, 32, 35, 37, 41, 46, 48, 49	1, 5, 32, 43, 44, 45, 48, 49, 50, 52, 54	1, 2, 4, 5, 13, 26, 45	4, 13, 16, 32, 35, 37, 40, 46, 49, 52	1, 5, 32, 45, 49, 52, 54	1, 2, 4, 5, 13, 26, 45, 46	4, 13, 16, 32, 35, 37, 41, 46, 48, 49, 52, 59	1, 5, 32, 45, 46, 49, 50, 52, 54, 59	1, 4, 5, 13, 26, 30, 46	8, 22, 29, 31, 32, 33, 35, 36, 37, 39, 40, 46, 48	20, 22, 23, 25, 32, 42, 44, 46, 49, 50, 54, 58
III	12, 15, 53	1, 17, 19, 40, 43, 44, 45, 57, 58	13, 16, 35, 37, 40, 41, 53, 57, 58	12, 15, 16, 32, 53	1, 17, 19, 41, 43, 44, 45, 48, 58	12, 13, 16, 35, 53, 58	12, 16, 20, 53	1, 17, 19, 30, 40, 43, 44, 45, 58	13, 16, 17, 35, 41	3, 12, 14, 15, 16, 18, 20, 21, 22, 24, 27, 33, 34, 53	2, 3, 11, 14, 16, 17, 19, 23, 24, 25, 26, 30, 34, 38, 41, 42, 43, 44, 45, 47, 49, 58	12, 15 to 19, 27 to 31, 33 to 37, 39, 40, 41, 43, 45, 47, 52, 59
IV	3, 6 to 11, 14, 17 to 25, 27 to 29, 31, 33 to 44, 47, 49 to 51, 54 to 60	3, 7, 8, 10, 11, 12, 14, 15, 18, 22, 24, 27 to 31, 33, 34, 36, 38, 39, 42, 47, 50, 51, 53, 55, 56, 60	2, 3, 6, 8 to 12, 14, 15, 17 to 22, 24, 27 to 31, 33, 34, 36, 38, 39, 42, 46, 47, 56, 60	3, 6 to 11, 14, 17 to 25, 27, 28, 29, 31, 33 to 44, 47, 49 to 51, 55 to 60	3, 6, 7, 8, 10, 11, 12, 14, 15, 18, 21 to 27, 29, 30, 31, 33, 38, 39, 42, 47, 50, 51, 53 to 57, 60	2, 3, 6 to 11, 14, 15, 17 to 21, 24, 27 to 31, 33, 34, 36 to 41, 44, 47, 50, 55, 56, 57, 60	3, 6 to 11, 14, 15, 17, 18, 19, 21 to 25, 27, 28, 29, 31, 33 to 44, 47, 50, 51, 55 to 60	3, 7, 10, 11, 12, 14, 15, 18, 21 to 25, 27, 28, 29, 31, 33, 38, 39, 42, 47, 50, 51, 53, 55, 56, 57, 60	2, 3, 6 to 12, 14, 15, 18 to 22, 24, 27 to 31, 33, 34, 36 to 40, 47, 51, 56, 57, 58, 60	6, 7, 8, 9, 10, 11, 17, 19, 23, 25, 28, 29, 31, 35, 36, 37, 39, 41, 42, 43, 44, 47, 49, 50, 51, 55 to 60	1, 4 to 7, 10, 12, 13, 15, 21, 50 to 54, 56, to 59, 60	1 to 11, 13, 24, 38, 48, 56, 57, 60
	1993-94			1998-99			2003-04			2006-07		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
I	2, 4, 11, 32, 38, 40, 54	2, 3, 8 to 11, 18, 20, 27, 33, 46, 55	21, 22, 23, 25, 26, 32, 42, 46, 47, 53	2, 4, 5, 11, 32, 38, 40, 48, 49, 52, 54	2, 3, 8 to 11, 18, 20, 27, 33	21, 26, 42, 44, 51, 53, 54, 59	30, 32, 48, 49, 52, 54	2, 8, 9, 11, 26, 28, 29, 34, 36, 52, 54	4, 25, 42, 51, 55	4, 30, 32, 48, 49, 52, 54	2, 8, 9, 11, 26, 29, 34, 36, 52, 54, 59	4, 25, 26, 51, 55
II	1, 5, 13, 18, 26, 30, 46	22, 28, 29, 31, 32, 34, 35, 36, 37, 39	44, 48 to 51, 54, 55, 59	1, 5, 18, 26, 30, 46	22, 28, 29, 31, 32, 35, 36, 39, 46, 48	22, 23, 25, 32, 40, 46, 49, 50, 55	1, 2, 4, 5, 13, 26, 45, 46	32, 35, 37, 40, 41, 44, 45, 46, 49	13, 41, 43 to 46, 49, 50, 52 to 54, 59	1, 2, 5, 26, 45, 46	32, 35, 37, 40, 41, 44, 45, 46, 48, 49	1, 5, 13, 32, 41, 43 to 46, 49, 50, 52 to 54, 59
III	12, 15, 16, 20, 21, 22, 27, 28, 33, 34, 35, 36, 53	14, 17, 19, 23, 24, 25, 30, 38, 40 to 45, 48, 49, 58	8, 14, 15, 17, 24, 27, 28, 29, 34, 35, 37, 38, 39, 40, 41, 43, 52, 58	12 to 16, 19 to 22, 27, 33, 34, 36, 53	14, 16, 17, 19, 21, 23, 24, 25, 30, 37, 38, 40 to 45, 47, 49	12 to 19, 24, 27, 28, 31, 33, 34, 35, 37, 38, 39, 41, 43, 45, 58	12, 16, 35, 36, 53	1, 19, 25, 27, 43, 48, 53	1, 5, 16, 19, 32, 35	12, 13, 16, 35, 36, 53	1, 13, 19, 25, 43, 53	16, 19, 35, 40
IV	3, 6, 7, 8, 9, 10, 14, 17, 19, 23, 24, 25, 29, 31, 37, 39, 41, 42, 43, 44, 45, 47, 48 to 52, 55 to 60	1, 4 to 7, 12, 13, 15, 16, 21, 26, 47, 50 to 54, 56, 57, 59, 60	1 to 7, 9 to 11, 12, 13, 16, 18 to 20, 30, 31, 33, 36, 45, 56, 57, 60	3, 6 to 10, 17, 23, 24, 25, 28, 29, 31, 35, 37, 39, 41 to 45, 47	1, 4 to 7, 12, 13, 15, 26, 34, 50 to 60	1 to 11, 20, 29, 30, 36, 47, 48, 52, 56, 57, 60	3, 6 to 11, 14, 15, 17 to 25, 27, 28, 29, 31, 33, 34, 37 to 44, 47, 50, 51, 55 to 60	3 to 7, 10, 12, 14 to 18, 20 to 24, 30, 31, 33, 38, 39, 42, 47, 50, 51, 55 to 60	2, 3, 6 to 12, 14, 15, 17, 18, 20 to 24, 26 to 31, 33, 34, 36 to 40, 47, 48, 56 to 58, 60	3, 6 to 11, 4, 15, 17 to 25, 27 to 29, 31, 33, 34, 37 to 44, 47, 50, 51, 55 to 60	3 to 7, 10, 12, 14 to 18, 20 to 24, 27, 28, 30, 31, 33, 38, 39, 42, 47, 50, 51, 55 to 58, 60	2, 3, 6 to 12, 14, 15, 17, 18, 20 to 24, 27 to 31, 33, 34, 36 to 39, 42, 47, 48, 56 to 58, 60

backward and high forward linkages with tertiary sector during whole period. Trade (52) has low backward and high forward linkages with primary sectors, low linkages with secondary sector and high backward but low forward linkages with tertiary sector during almost all the years. Hotels and Restaurants (53) have high backward and low forward linkages with primary sector, low linkages with secondary sector and low backward but high forward linkages with tertiary sector but 2003-04 onwards it moves to second category i.e. it has both high linkages with itself. Banking (54) has low backward but high forward linkages with primary sector. But low linkages with secondary sector and it have both high linkages with itself. Insurance (55) has low linkages with primary sector, low backward but high forward linkages with secondary sector and in first category with tertiary sector during all years with some fluctuations. Ownership & Dwellings (56), education and research (57) and Public Adm. & defence (60) have low backward and low forward linkages with all the three sectors during the whole time period. Medical and Health (58) have low linkages with primary sector but high backward and low forward linkages with secondary and tertiary sectors during the whole period with some fluctuations. Other services (59) has low linkages with primary and secondary sectors but with tertiary sector it move from third to first category in upward direction and have low backward but high forward linkages in 1998-99. In nutshell it can be said that banking provides better services to primary sector and hotels & restaurants provides their services to tertiary sector more. Other transport services and storage & warehousing takes services from tertiary sector and also provide services to that.

Primary sector have low backward and low forward linkages with tertiary sector, high linkages with itself and average linkages with secondary sector. Secondary sector has low linkages with primary sector but high linkages with tertiary sector. Electricity alone has high linkages with all the three sectors.

Main Conclusions

The identified key sectors display a structure of the Indian economy which is neither traditional nor a highly modernized one. The study of the structure of the Indian economy reveals that the capital intensive basic industries like iron and steel, electricity, non ferrous basic metals, construction, etc. are supposed to play the role of engine in the process of growth. The development of these basic industries as channels of transmitting the benefits of growth is, no doubt, the consequence of the attempt to diversify the production structure of the Indian economy over the years. The agro based industries like cotton textiles, jute, hemp and mesta

textiles, other textiles, paper and paper products and other resource intensive sectors like non-metallic mineral products, coal tar products etc. have shown strong linkage in terms of both forward and backward linkages. Services like trade and transport services and capital-intensive sectors like fertilizers, paints, varnishes and lacquers, synthetic fiber and resin etc. have qualified as key sectors of the Indian economy. Investment in these sectors can speed up the industrialization process; as such sectors will stimulate greater economic activities in other sectors.

At the sector and sub-sector level, however, there are evidences of positive and negative impacts on the rate of technical change. We have also found that majority of the sectors in the Indian economy experienced statistically constant rate of technical change over the whole period of 36 years. The present chapter by analyzing the huge datasets has attempted to provide better insights into the Indian growth story particularly with respect to the role of technological progress. Since technical progress is a major source of growth acceleration, lessons from the Indian experience presented here can be useful to the policy makers in policy choices to achieve further acceleration in the growth rate of their countries in future.

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APPENDIX A-I

Table 1: Sector Specification for the Input-Output Transactions

IOTT Sector No.	Name	IOTT Sector No.	Name
001	Paddy	059	Coal tar products
002	Wheat	060	Inorganic heavy chemicals
003	Jowar	061	Organic heavy chemicals
004	Bajra	062	Fertilizers
005	Maize	063	Pesticides
006	Gram	064	Paints, varnishes and lacquers
007	Pulses	065	Drugs and medicines
008	Sugarcane	066	Soaps, cosmetics, glycerine
009	Groundnut	067	Synthetic fibres, resin
010	Jute	068	Other chemicals
011	Cotton	069	Structural clay products
012	Tea	070	Cement
013	Coffee	071	Other non-metallic mineral products
014	Rubber	072	Iron and steel ferro alloys
015	Coconut	073	Iron and steel casting and forging
016	Tobacco	074	Iron and steel foundries
017	Other crops	075	Non-ferrous basic metals (including alloys)
018	Milk and milk products	076	Hand tools, hardware
019	Animal Services (agri-cultural)	077	Miscellaneous metal products
020	Other livestock products	078	Tractors and other agricultural implements
021	Forestry and logging	079	Industrial machinery for food and textile industries
022	Fishing	080	Industrial machinery (except food and textile)
023	Coal and lignite	081	Machine tools
024	Crude petroleum, natural gas	082	Office computing and accounting machinery
025	Iron ore	083	Other non-electrical machinery
026	Manganese ore	084	Electrical industrial machinery
027	Bauxite	085	Electrical cables, wires
028	Copper ore	086	Batteries
029	Other metallic minerals	087	Electrical appliances
030	Lime stone	088	Communication equipment
031	Mica	089	Other electrical machinery
032	Other non metallic minerals	090	Electronic equipment including TV
033	Sugar	091	Ships and boats
034	Khandsari, boora	092	Rail equipment
035	Hydrogenated oil (Vanaspati)	093	Motor vehicles
036	Edible oils other than Vanaspati	094	Motor cycles and scooters
037	Tea and coffee processing	095	Bicycles, cycle-rickshaw
038	Miscellaneous food products	096	Other transport Equipment
039	Beverages	097	Watches and clocks
040	Tobacco products	098	Miscellaneous manufacturing
041	Khadi, cotton textiles in handlooms	099	Construction
042	Cotton textiles	100	Electricity
043	Woolen textiles	101	Gas
044	Silk textiles	102	Water supply
045	Art silk, synthetic fibre textiles	103	Railway transport services
046	Jute, hemp, mesta textiles	104	Other transport services
047	Carpet weaving	105	Storage and warehousing
048	Ready made garments and made up textile goods	106	Communication
049	Miscellaneous textile products	107	Trade
050	Furniture and fixtures-wooden	108	Hotels and restaurants
051	Wood and wood products except furniture	109	Banking
052	Paper, paper products and newsprint	110	Insurance
053	Printing, publishing and allied activities	111	Ownership of dwellings
054	Leather footwear	112	Education and research
055	Leather and leather products except footwear	113	Medical and health
056	Rubber products	114	Other services
057	Plastic products	115	Public administration and defence
058	Petroleum products		

Notes: 1. Sectors 001 to 017 also include agricultural and horticultural services such as harvesting, baling and threshing, husking and shelling, preparation for marketing, pest destroying and spraying, pruning, picking and operating irrigation systems.

2. Sectors 018 to 020 include breeding and rearing of animals and poultry including private veterinary services.

3. Sectors 023 to 032 include extraction, breaking, milling, washing, cleaning, grading and processing.

25	Plastic and Rubber Products	0.67	36765	0.71	79011	0.47	145946	0.43	370470	0.56	990851	0.54	1604178	0.67	4044197	0.69	6606325
26	Petroleum products	0.79	52332	0.93	194323	0.78	619793	0.79	1053449	0.92	1669669	0.96	3939755	0.89	15492894	0.85	23864738
27	Coal tar products	0.88	12437	1.14	30881	0.99	68581	1.53	241648	1.57	460093	1.96	946301	1.52	1262748	2.05	2743681
28	Inorganic heavy chemicals	1.14	28178	1.12	74640	1.27	124132	0.96	226848	1.27	581967	0.80	1172837	0.96	2817270	1.03	4558498
29	Organic heavy chemicals	1.93	13796	1.36	36186	1.25	126707	0.87	345099	1.48	691693	1.26	1621021	1.19	2964914	1.29	4799641
30	Fertilizers	1.34	42395	1.44	151666	1.27	375693	1.35	962775	1.19	1265185	1.39	3421504	1.02	3259255	1.10	5245080
31	Paints, varnishes and lacquers	0.83	18677	0.96	52015	0.94	97320	0.91	240448	0.89	453747	0.87	892152	0.77	1351195	0.85	2265743
32	Pesticides, Drugs and Other Chemicals	0.77	130050	0.88	302583	0.68	555968	0.54	1169504	0.72	3258223	0.58	4408560	0.68	9972069	0.73	15746269
33	Cement	0.93	19697	1.03	41133	0.97	150541	2.12	875287	0.96	689731	2.07	2629534	1.04	1980889	1.31	4070887
34	Non-Metallic Mineral Products	0.90	76380	0.78	188208	0.76	239226	0.42	320326	0.48	486877	0.52	994958	0.84	3411843	1.07	7066978
35	Iron & steel Industries and Foundries	1.07	178160	0.99	407732	1.07	951529	0.95	2216995	0.99	4107870	0.92	6579903	0.84	11600176	0.95	24732097
36	Other Basic Metals Industry	1.49	43231	1.11	96284	1.27	181347	1.29	1125696	1.14	1301276	2.41	4607845	1.82	5411776	1.99	11217428
37	Metal Products except Machinery and Transport Equipment	0.70	81909	0.63	97153	0.62	231015	0.51	782722	0.51	934417	0.53	1948595	0.68	3918802	0.75	8202524
38	Agriculture Machinery	0.27	6131	0.29	12149	0.51	43255	0.78	252905	0.26	92986	0.38	268329	0.14	145833	0.12	226229
39	Industrial machinery for Food & Textiles	0.38	8883	0.39	13188	0.41	34732	0.55	110765	0.59	160742	0.51	251485	0.64	530204	0.48	744131
40	Other Machinery	0.29	29347	0.48	93648	0.30	126687	0.17	246442	0.32	564479	0.25	815317	0.44	3406225	0.46	6715238
41	Electrical, Electronic Machinery & Appliances	0.33	44383	0.33	82744	0.37	190154	0.55	844658	0.36	1001668	0.48	2137392	0.48	7890667	0.45	16904192
42	Railway Transport Equipment	0.39	9633	0.61	48127	0.67	121393	1.10	56686	0.51	318056	0.51	109680	1.18	1017566	0.69	922404
43	Other Transport Equipment	0.39	50076	0.34	77057	0.33	151581	0.30	794854	0.32	751845	0.23	1163347	0.27	2522727	0.26	3627685
44	Miscellaneous Manufacturing Industries	0.22	22299	0.22	35753	0.40	142671	0.37	323134	0.49	1026376	0.36	1935840	0.69	4925141	0.75	9070481
45	Construction	0.10	61848	0.12	146685	0.14	366638	0.14	854650	0.13	1422098	0.10	2219235	0.14	6003377	0.16	14253636
46	Electricity	0.77	76177	0.88	251372	0.89	711235	0.87	1934642	0.91	4658031	0.86	9503769	0.89	13213165	0.85	15468390
47	Water Supply	0.33	2774	0.48	17911	0.31	26453	0.70	197878	0.37	127589	0.85	792412	0.40	311264	0.48	536867
48	Railway Transport Services	0.52	59699	0.53	115212	0.58	294094	0.67	739063	0.69	1236859	0.69	2066668	0.60	3321322	0.71	5830596
49	Other Transport Services	0.41	131584	0.54	398595	0.52	752214	0.50	1841642	0.50	4974589	0.40	7402442	0.43	15810956	0.46	24764557
50	Storage and warehousing	1.00	5489	1.00	14450	1.00	26644	2.68	147155	0.99	90096	3.07	599564	0.98	303005	0.99	423670
51	Communication	0.31	11517	0.52	41667	0.52	80087	0.61	307457	0.65	740057	0.49	1404537	0.70	3988506	0.75	7360108
52	Trade	0.51	338522	0.52	846493	0.52	1571896	0.44	3085235	0.45	6462345	0.42	11139235	0.51	23187700	0.52	35316716
53	Hotels and restaurants	0.02	4076	0.05	13061	0.08	39384	0.39	372425	0.16	272515	0.35	1555609	0.22	2221303	0.19	3409447
54	Banking	0.74	65476	0.80	189339	0.73	408938	0.77	1220815	0.78	3330389	0.65	7018751	0.76	12809807	0.82	17995605
55	Insurance	0.35	13954	0.38	27628	0.93	153191	1.04	489668	0.95	642297	0.89	1364734	0.74	3137864	0.77	4459483
56	Ownership of dwellings	0.00	0	0.00	0	0.00	0	0.02	29260	0.00	0	0.01	87195	0.00	0	0.00	0
57	Education and research	0.00	22	0.00	39	0.00	1150	0.00	5268	0.00	11604	0.00	37916	0.01	82661	0.01	161352
58	Medical and health	0.00	541	0.01	2594	0.02	6954	0.12	107176	0.12	207190	0.01	46129	0.02	165661	0.02	273921
59	Other Services	0.54	55731	0.65	245198	0.54	644282	0.57	1567459	0.46	2445292	0.61	8801818	0.35	7446298	0.35	11703009
60	Public Administration and Defence	0.00	0	0.00	0	0.00	0	0.05	128180	0.00	0	0.02	196741	0.00	0	0.00	0
	Total	37.35	3411610	36.31	7046600	34.61	15587713	41.04	37084741	36.98	66955901	43.21	133246728	40.08	247727575	42.27	396696159
	Average W	0.62	56860	0.61	117443	0.58	259795	0.68	618079	0.62	1115932	0.72	2220779	0.67	4128793	0.70	6611603