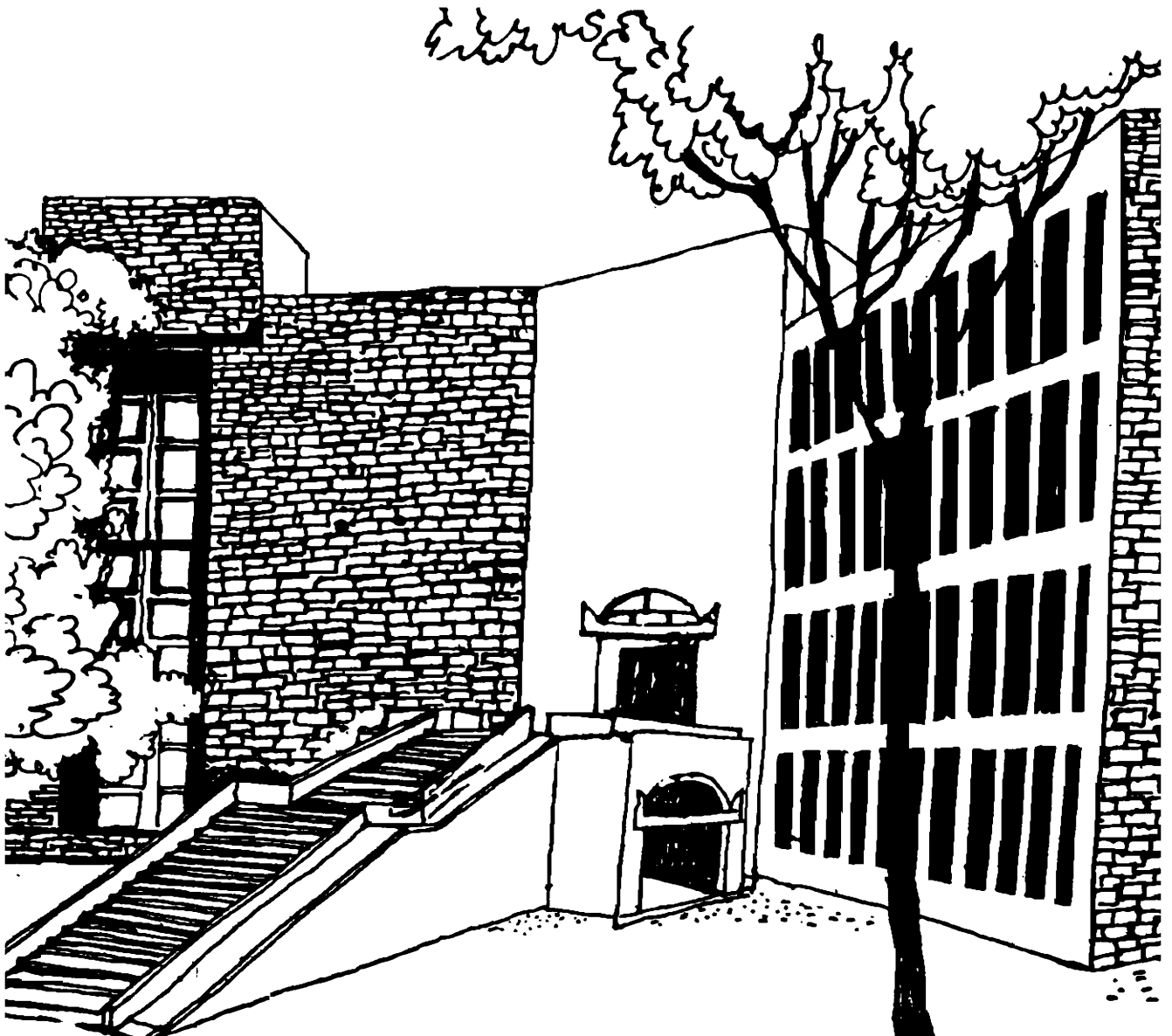




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Working Paper




**ANALYSIS OF AGRICULTURE-INDUSTRY LINKAGES
IN INDIAN ECONOMIC DEVELOPMENT**

By

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ANALYSIS OF AGRICULTURE-INDUSTRY LINKAGES IN INDIAN ECONOMIC DEVELOPMENT

Abstract

The purpose of this study is to examine the trends in India's growth rates and interdependency between agricultural and industrial sectors of Indian economy. A dual economic growth model was developed to investigate the relationship between the two sectors and factors affecting Indian economic growth. The study reveals that the GDP growth rate has increased considerably over the period 1950-95 and the increase is more pronounced in the post-economic reforms period. The industrial sector of the economy grew at a faster rate than agricultural sector. The Indian economy has made a transition from the predominantly agrarian economy to a more balanced economy with the share of agriculture being about 29 per cent and that of industrial sector about 30 per cent during 1992-95. But the share of agricultural sector is still higher than for most of the developing nations. The results of economic growth model indicate that land is an important input to the growth of agriculture in India. The traditional input, such as labour, does not play an important role in the economic development of both the sectors. Capital investment contributed significantly to the growth of industrial sector, but not to the agricultural sector. It was found that the agricultural growth in India is contributed by its industrial sector and the growth of industrial sector depends on its agricultural growth, indicating strong linkages between the agricultural and industrial sectors in Indian economic development.

Introduction

The agriculture-industry relationship has featured prominently in economic theory since its early beginning in classical political economy. The interdependency between agricultural and industrial sectors of an economy is crucial to its overall economic development. Agricultural growth depends on the industrial demand for agricultural commodities and similarly, industrial growth depends on an increase in purchasing power of agricultural sector for industrial commodities and on the supply of raw materials for processing.

The Indian economy has been undergoing much changes especially since 1991. These changes have affected almost all the sectors of the economy. The country's Gross Domestic Product (GDP) grew from Rs. 225,268 crore at 1980-81 prices in 1992-93 to Rs. 292,818 crore in 1996-97, with annual compound growth rate of averaging about 6.85 per cent. Indian economy can be divided into an agricultural sector based on rural communities and an industrial sector mainly concentrated in urban areas. The earlier

strategy of industrialisation in India was dominated by import substitution, emphasis on heavy industries and a central role for public sector within a mixed economy. Whereas in agricultural sector, growth came initially from expansion of cropped area, and subsequently after mid-sixties from green revolution based on intensive use of high yielding varieties of seed, fertiliser and irrigation.

Over the years, India has made a transition from a predominantly agrarian economy with 55 per cent of GDP derived from agriculture and only 13 per cent from industry in 1950-52 to a more balanced economic structure with the share of agriculture reduced to 28 per cent and that of industry increased to 26 per cent in 1993-95. However, this share of agriculture is still higher than for most of the developing economies. Indian economy has experienced a shift of resources from the agricultural sector to the industrial sector. This is mainly because the industrial sector grows faster and has high labour productivity than the agricultural sector. The purpose of this paper is to examine the relationship between India's agricultural and industrial sectors and to determine the important factors contributing to the growth in these sectors.

This study is organised as follows: Section I would discuss data base and methodology of the study. This section also presents a growth model for Indian agricultural and industrial sectors and the procedure to estimate the model. Section II is devoted to analysis of changes in India's GDP growth rate at the aggregate and broad sectoral levels as well as at the disaggregated sub-sectoral levels over the period 1950-51 to 1995-96 with 1980-81 as the base year and structural changes in terms of sectoral shares of GDP. Section III analyses the pattern and growth in capital formation in agricultural, industrial and services sectors of the economy. Section IV examines empirical results of the agriculture-industry growth model. The last section includes conclusions and implications

I Data Base and Methodology

Gross Domestic Product (GDP) at factor cost data for the main sectors (namely, agriculture, industry and services) were used to estimate the growth rates of aggregate and sectoral GDP. The data were obtained from National Accounts Statistics published by Central Statistical Organisation (Government of India, 1997), EPW Research Foundation (1997). All the data on GDP (at aggregate, sector and sub-sector level) are at 1980-81 prices for each measure of GDP, the period of study which spans over 46 years from 1950-51 to 1995-96 has been split into five periods.

Period I : 1950-51 to 1964-65

Period II : 1965-66 to 1975-76

Period III : 1976-77 to 1991-92

Period IV : 1992-93 to 1995-96

Period V : 1950-51 to 1995-96

For the study of growth rates of GDP, the following trend equation has been considered:

$$\ln Y = a + bt$$

Where 'Y' represents GDP from different sectors and 't' is the time period.

In order to study the structural shifts, period averages of percentage contribution of different sectors to the aggregate GDP have been calculated to avoid the impact of an extreme value which might coincide with any of the reference year under study.

In order to assess the trends in capital formation in agriculture, industrial and services sectors and at aggregate level, we have divided the entire time span (1950-1995) into five decades, viz., *decade I (1952-60)*, *decade II (1961-70)*, *decade III (1971-80)*, *decade IV (1981-91)* and *decade V (1992-95)* and the analysis was done for these five periods separately and at aggregate level (1952-95).

Compound growth rates of gross capital formation (GCF) and gross fixed capital formation (GFCF) were calculated with the help of exponential function for different periods at disaggregated sectoral levels.

The data series used for estimation of growth rate of GDP, GCF, and GFCF are the series of three-yearly moving averages. The three yearly moving averages were worked out in order to minimise the effects of extreme values.

Economic Growth Model

The framework to be adopted is a dual economy framework in which the economy is disaggregated into two broad sectors- agriculture and industry. The growth of industrial sector is generally looked upon as a part of wider process of development of economy, namely, a transformation from a predominantly traditional, agrarian set-up to a modern industrial economy. The literature on dual economy models deals with the characterisation of such economies and constraints to industrial growth therein.

The agriculture-industry relation has featured prominently in economic theory since its early beginnings in classical political economy and similar themes have re-emerged in the context of attempts by developing economies to accelerate the pace of accumulation and industrialisation. Economists have developed models to explain the interdependency between agricultural and industrial sectors. The pioneering models are Ricardo (1817), Lewis (1954), Jorgenson (1961), Fei-Ranis (1964), Dixit (1973), Rakshit (1982), Gillis *et. al.* (1983) and Rao (1992).

Ricardo (1817) examined the relationship between agricultural and industrial sectors and assumed that agricultural sector is subject to diminishing returns and that

surplus labour can be shifted to industrial sector without causing a rise in wage rate (Gillis, *et al.*, 1983). Lewis (1954) and Fei-Ranis (1964) refined this relationship. Fei-Ranis's model assumed the coexistence of a large agricultural sector and a small but active and dynamic industrial sector in the economy. In these dual economic growth models, these sectors are assumed to depend upon each other. Therefore, we propose to use Fei-Ranis model in the present paper for analysing the behaviour and linkages of agricultural and industrial sectors of Indian economy during the period from 1961-62 to 1995-96. The following function is assumed:

$$AI = f(AL, AK, L, IY) \quad (i)$$

$$IY = f(IL, IK, AI) \quad (ii)$$

Where:

AI = Gross domestic product originating in agricultural sector (Rs. crores)

AL = Total labour employed in agricultural sector in thousand people

AK = Total amount of capital invested in agricultural sector (Rs. crores)

L = Gross sown area in million hectares

IY = Gross domestic product originating from industrial sector

IL = Labour employed in industrial sector (thousand people)

IK = Total capital invested in industrial sector (Rs. crores)

In this model AI and IY are treated as endogenous variables under the assumptions that these sectors of economy help each other in the process of economic development, and other variables are treated as exogenous.

The model is based on time series data (1961-95) collected from different published sources. The data on GDP and capital investment were obtained from National Accounts Statistics (Government of India, 1997), EPW Research Foundation (1997). The input data used in study (gross sown area, total number of persons employed in agricultural and industrial sectors) were obtained from Economic Survey (Govt. of India, 1997) and CMIE (1996).

Equations (i) and (ii) are static in which changes in the value of independent variables affect gross national income at the same time. However, there are certain evidences that indicate that changes in the value of independent variables in time 't' affect the gross income in time 't' and several periods future. Assuming that the dynamics will take place under the partial adjustment hypothesis (Nerlove, 1958) in a linear functional form, equation (i) is expressed as follows:

$$AI_t = \alpha_0 + \alpha_1 AI_{t-1} + \alpha_2 AK_t + \alpha_3 L_t + \alpha_4 IY_t + e_t \quad (iii)$$

$$AI_t - AI_{t-1} = \lambda_1 (AI_t^* - AI_{t-1}) \quad (iv)$$

Where t = time period, ($t = 1961, 1962, \dots, 1995$)
 AI^* = desired GDP in agricultural sector
 λ_1 = a dynamic adjustment coefficient ($0 \leq \lambda_1 \leq 1$)

Combining equations (iii) and (iv) gives:

$$AI = \lambda_1 \alpha_0 + \lambda_1 \alpha_1 AL_t + \lambda_1 \alpha_2 AK_t + \lambda_1 \alpha_3 L_t + \lambda_1 \alpha_4 IY_t + (1-\lambda_1) AI_{t-1} + e_t \quad (v)$$

Similarly the industrial sector equation (equation ii) can be written as:

$$IY_t = \beta_0 + \beta_1 IL_t + \beta_2 IK_t + \beta_3 AI_t + e_t \quad (vi)$$

$$IY_t - IY_{t-1} = \lambda_2 (IY_t^* - IY_{t-1}) \quad (vii)$$

Combining equations (vi) and (vii)

$$IY_t = \lambda_2 \beta_0 + \lambda_2 \beta_1 IL_t + \lambda_2 \beta_2 IK_t + \lambda_2 \beta_3 AI_t + (1-\lambda_2) IY_{t-1} + e_t \quad (viii)$$

Equations (v) and (viii) are used to examine the relationship between the agricultural and industrial sectors of the economy.

To capture the impact of liberalisation we introduced dummy variables (D_1 and D_2). D_1 takes the value of one for the period 1961-62 to 1975-76 and a value of zero for all the years thereafter and D_2 takes value of one for the period 1976-77 to 1991-92 and a value of zero for the 1961-75 and post-liberalisation period (1992-95). Thus the standard growth models including the dummy variables become:

$$AI = \lambda_1 \alpha_0 + \lambda_1 \alpha_1 AL_t + \lambda_1 \alpha_2 AK_t + \lambda_1 \alpha_3 L_t + \lambda_1 \alpha_4 IY_t + (1-\lambda_1) AI_{t-1} + \lambda_1 \alpha_5 D_1 + \lambda_1 \alpha_6 D_2 \quad (ix)$$

$$IY_t = \lambda_2 \beta_0 + \lambda_2 \beta_1 IL_t + \lambda_2 \beta_2 IK_t + \lambda_2 \beta_3 AI_t + (1-\lambda_2) IY_{t-1} + \lambda_2 \beta_4 D_1 + \lambda_2 \beta_5 D_2 \dots \dots (x)$$

In this paper we experimented with two functional forms - linear and Cobb-Douglas. However, Cobb-Douglas gave the best fit and hence we resorted to the Cobb-Douglas form. The dynamic model of both the sectors of the economy (equations ix and x) were estimated simultaneously by using *three stage least squares* (3-sls) estimators.

II

Analysis of Growth Rates in GDP

As a first step in our attempt to understand the long term trends in GDP, we have estimated growth rates of GDP for different periods and its main sectors (namely, agriculture, industry and services) and the results are presented in Table 1.

The table shows that the growth rate of total GDP at factor cost increased from 3.91 per cent in 1952-64 to 5.74 per cent in 1992-95. It may also be observed from the table the GDP has grown at a distinctly higher growth rate at 5.74 per cent per annum during the post-economic reforms period compared to the earlier three periods. Moreover, the rate of growth has been shared by all the three sectors (agriculture,

industry, and services) of the economy. The agricultural sector has witnessed a steady increase in its growth over the successive periods. The growth rate of agricultural sector has increased by 0.96 per cent between the periods 1952-64 and 1992-95. However, industry grew at a faster rate as compared with agricultural sector for all sub-periods as well as the whole period. There are significant and sizeable increases in growth in manufacturing sector during the post-economic reforms period.

Service sector growth rate at factor cost increased from 4.63 per cent in 1952-64 to 6.87 per cent in the post-liberalisation period. Trade, hotels, and restaurants is the activity in the service sector which sees an sizeable increase in growth rate in the post liberalisation period compared to earlier periods.

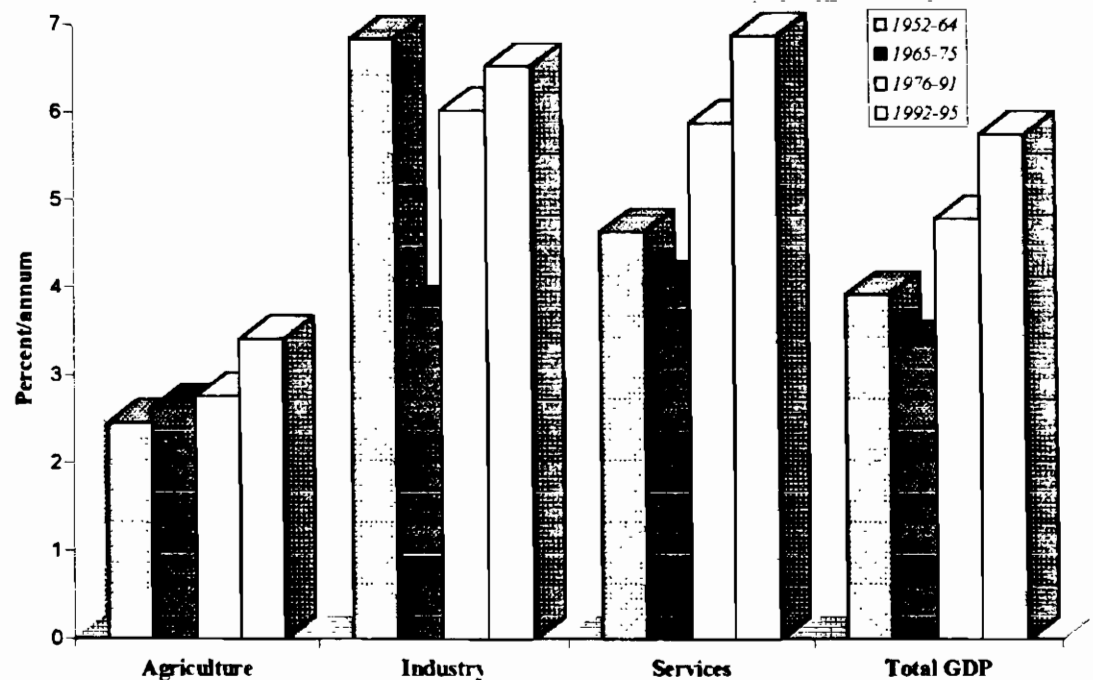
Table 1. Compound Annual Rates of Growth in Gross Domestic Product (GDP) by Economic Activity in India, 1952-95^a

(Per cent)

Sectors	Periods				
	1952-64	1965-75	1976-91	1992-95	1952-95
1. Agriculture and allied	2.45	2.63	2.76	3.41	2.42
1.1 Agriculture	2.54	2.65	3.05	3.53	2.53
1.2 Allied	1.71	2.43	-0.16	1.92	1.28
2. Industry	6.83	3.74	6.01	7.52	5.40
2.1 Mining & quarrying	5.65	2.51	7.18	3.93	5.34
2.2 Manufacturing	6.75	3.96	6.16	7.22	5.38
2.3 Electricity, gas & water supply	11.56	8.08	8.08	8.20	9.03
2.4 Construction	6.89	2.41	4.17	3.57	4.57
3. Services	4.63	4.03	5.87	6.87	4.96
3.1 Trade, hotels & restaurants	5.81	3.62	5.45	8.53	5.02
3.2 Transport, storage and communication	6.46	5.09	6.68	6.54	6.11
3.3 Financing, insurance, real estate and business services	3.13	3.64	6.14	7.62	4.53
3.4 Community, social and personal services	4.28	4.43	5.17	4.38	4.85
Gross Domestic Product at factor cost	3.91	3.35	4.78	5.74	3.99

^a: Based on three year moving average

Fig. 1. Trends in growth rates of GDP by economic activities in India



The above results clearly show that GDP growth rate has increased considerably over the period under consideration and the increase is more pronounced in the post-economic reforms period.

Acceleration Deceleration in Growth Rates:

Having made a preliminary exercise on the trends in the growth rates of GDP, we are now in a position to test the hypothesis of trend acceleration/deceleration in the GDP growth rate over the entire period since 1950-51 using the following functional form:

$$\ln Y = a + bt + ct^2$$

This equation tests the hypothesis of acceleration/deceleration in the trend growth rate on the basis of sign and statistical significance of the estimate of 'c'.

Estimates of quadratic function implied highly significant acceleration of total GDP at factor cost (Table 2). The coefficient of time-square (t^2) has been found to be positive and significant in case of agricultural and services sectors, meaning, thereby that there has been a significant acceleration in the growth rates of these sectors of the economy. On the contrary, an undesirable trend of deceleration in industrial GDP growth rate emerged, but deceleration has been very marginal and statistically non-significant. The allied activities in agricultural sector and electricity, gas and water supply and construction witnessed a marked and significant deceleration in the growth rates.

Table 2. Estimates of Quadratic Function in Time Variable Fitted to Triennial Averages of GDP in India, 1952-95

Sectors	Constant	b	c	R ²
1. Agriculture and allied	10.1332	0.0166 (12.79)	0.0002 (5.81)	0.99
1.1 Agriculture	10.0257	0.0151 (10.20)	0.0002 (6.96)	0.99
1.2 Allied	7.8355	0.0325 (11.82)	-0.0004 (7.42)	0.91
2. Industry	8.8714	0.0539 ((20.17))	-0.00003 (0.53)	0.99
2.1 Mining & quarrying	6.2264	0.0368 (10.72)	0.0003 (4.59)	0.99
2.2 Manufacturing	8.5369	0.0501 (19.99)	0.00003 (0.61)	0.99
2.3 Electricity, gas and water supply	4.8842	0.1122 (35.82)	-0.0006 (8.49)	0.99
2.4 Construction	7.2441	0.0631 (16.54)	-0.0004 (4.98)	0.98
3. Services	9.4242	0.0349 (25.44)	0.0003 (10.07)	0.99
3.1 Trade, hotels & restaurants	8.2222	0.0447 (23.51)	0.0001 (2.28)	0.99
3.2 Transport, storage and communication	6.9505	0.0534 (39.42)	0.0001 (4.51)	0.99
3.3 Financing, insurance, real estate and business services	8.3345	0.0127 (7.85)	0.0007 (20.13)	0.99
3.4 Community, social and personal services	8.1669	0.0392 (25.28)	0.0002 (5.45)	0.99
GDP at factor cost	10.7097	0.0276 (20.37)	0.0003 (8.78)	0.99

Figures in brackets are the 't' values.

The above trend analysis, to recapitulate, accepts the hypothesis of trend acceleration as reflected in log-quadratic equation over the entire period, 1950-52 to 1993-95.

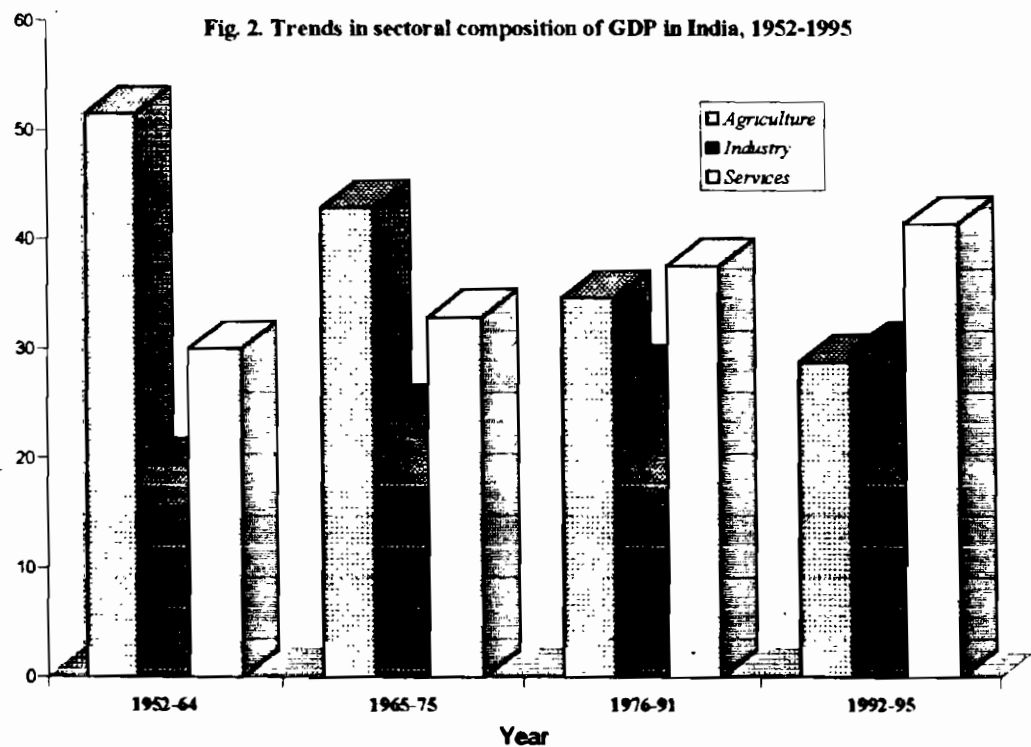
Sectoral shares in GDP

Sector-wise relative contribution to GDP has been calculated for different periods as well as whole period and the results have been summarised in Table 3. It is evident from the table that there has been a sharp decline in the contribution of agricultural sector to GDP as the share declined from 51.43 per cent in 1950-64 to 28.74 per cent in 1992-95. The share of industrial sector has steadily increased from 19.28 per cent in 1950-64 to 29.91 per cent in the post-economic reforms period. As regards the manufacturing sector, the performance is quite impressive. The contribution of manufacturing sector to the total GDP increased from 13.61 per cent in 1950-64 to about 21 per cent in 1992-95 period. There is a sizeable increase in growth in the contribution of electricity, gas and water supply to the total GDP (0.55 % in 1950-64 to 2.58 % in 1992-95).

Table 3. Trends in Sectoral Composition of Gross Domestic Product (GDP) in India, 1950-95

<i>Sectors</i>	<i>Periods</i>				
	<i>1950-64</i>	<i>1965-75</i>	<i>1976-91</i>	<i>1992-95</i>	<i>1950-95</i>
1. Agriculture and allied	51.43	42.89	34.64	28.74	37.73
1.1 Agriculture	46.01	37.95	31.76	26.77	34.24
1.2 Allied	5.42	4.94	2.88	1.97	3.49
2. Industry	19.28	24.23	27.81	29.91	26.18
2.1 Mining and quarrying	1.22	1.42	1.74	1.91	1.63
2.2 Manufacturing	13.61	16.59	19.43	20.99	18.27
2.3 Electricity, gas and water supply	0.55	1.21	1.98	2.58	1.72
2.4 Construction	3.90	5.01	4.66	4.43	4.56
3. Services	29.29	32.88	37.55	41.35	36.09
3.1 Trade, hotels & restaurants	9.44	10.95	12.31	13.42	11.81
3.2 Transport, storage and communication	2.84	3.72	4.95	5.55	4.50
3.3 Financing, insurance, real estate and business services	8.56	8.33	9.54	11.40	9.51
3.4 Community, social and personal services	8.45	9.88	10.75	10.98	10.27

The share of services sector to the GDP increased from 29.29 per cent in 1950-64 to 41.35 per cent in 1992-95 and exceeded to agricultural sector since mid-seventies. Trade, hotels and restaurants experienced a significant and sizeable increase in its share to total GDP as it increased from 9.44 per cent in 1950-64 to 13.42 per cent in 1992-95. There are sizeable increases in the share of transport, storage and communication, financing, insurance, real estate and business services and community, social and personal services



The above results clearly show that the share of agricultural sector in the total GDP has been declining over the period of time and that of industrial and services sector has been increasing steadily. But, despite decreasing share of agricultural sector to total GDP, there has been no change in the proportion of the labour employed in the agricultural sector which indicates that there has been a relative decline in the labour productivity in this sector.

III

Investment Performance

In this section an attempt has been made to examine the trends in capital formation at the national level, agricultural and industrial sectors in particulars with the help of secondary data for the years from 1950-51 to 1995-96 split into five periods. The trends

in gross fixed capital formation (GFCF) and the gross capital formation (GCF) with 1980-81 as the base year are presented in Tables 4 and 5. Tables 6 and 7 give the respective annual compound growth rates of capital formation in different sectors of the economy for the period 1952-95 and different decades.

The gross fixed capital formation in the country increased from Rs. 5,035 crores at constant prices (1980-81 prices) in 1950-52 to Rs. 57,713 crores in 1993-95, the compound growth rate being 5.34 per cent during 1950-95 period. Correspondingly, the gross capital formation increased from Rs. 5,587 crores to Rs. 61,356 crores during the same period. The growth rate of gross fixed capital formation was highest (8.24 %) during the post economic reforms period.

Table 4. Trends in Gross Fixed Capital Formation in India, 1950-52 to 1993-95

<i>Sectors</i>	<i>(Rs. crores)</i>					
	<i>1950-52</i>	<i>1960-62</i>	<i>1970-72</i>	<i>1980-82</i>	<i>1989-91</i>	<i>1993-95</i>
1. Agriculture and allied	1348	1782	2908	4676	4895	6129
1.1 Agriculture	1301	1685	2777	4431	4439	5548
1.2 Allied	47	97	131	245	456	581
2. Industry	1274	3262	5230	11233	20954	28759
2.1 Mining and quarrying	64	192	262	1480	2598	3492
2.2 Manufacturing	1027	2113	3063	5628	11230	16767
2.3 Electricity, gas and water supply	158	740	1608	3460	6242	7493
2.4 Construction	25	217	296	665	885	1007
3. Services	3100	7171	8874	13308	20894	27289
3.1 Trade, hotel & restaurant	101	176	743	846	1567	1733
3.2 Transport, storage and communication	933	2802	2615	3811	6893	9530
3.3 Financing, insurance, real estate and business	1254	1697	2007	3418	6208	8745
3.4 Community, social and personal services	478	1436	1911	2917	3594	4146
3.5 Public administration and defence	334	1061	1598	2316	2632	3135
Gross Fixed Capital Formation	5035	10134	14795	26211	43095	57713

The gross fixed capital formation in the agriculture and allied activities rose from Rs. 1,348 crores in 1950-52 to Rs. 6,129 crores in 1993-95, the increase being more than four times. The compound growth rates for GFCF in agricultural sector indicate that

trends were worsen during the 1981-91 period (Table 6). Thus on trend basis one can infer that capital formation in the agricultural declined through the decade 1981-91, whereas in contrast, other sectors of the economy; i.e., industry and services, grew at the rate of more than 5 per cent. this looking at the estimates of GCF and GFCF, it is clear that investment in agriculture has suffered a distinct loss in the momentum during the eighties. In the post liberalisation period, there was substantial improvement in GFCF in the agricultural sector.

The gross fixed capital formation in the industrial sector increased from Rs. 1,274 crores in 1950-52 to Rs. 28,759 crores in 1993-95, the increase being more than 22 times. Among the components a notable feature is a sizeable and significant increase in the gross fixed capital formation in mining and quarrying. The compound growth rate of GFCF in mining and quarrying increased from -0.07 per cent in 1952-60 to 15.86 per cent in the 1992- 95 period. The table also indicates that economic reforms led to a significant increase in GFCF in the industrial sector of the economy.

Table 5 Trends in Gross Capital Formation (GCF) in India, 1950-52 to 1993-95

<i>Sectors</i>	(Rs. crores)					
	<i>1950-52</i>	<i>1960-62</i>	<i>1970-72</i>	<i>1980-82</i>	<i>1989-91</i>	<i>1993-95</i>
1. Agriculture and allied	1392	1826	3087	4821	5026	6248
1.1 Agriculture	1344	1729	2954	4576	4559	5672
1.2 Allied	47	97	133	245	468	576
2. Industry	1575	4549	6942	13351	22699	30956
2.1 Mining and quarrying	71	197	280	1718	2739	3391
2.2 Manufacturing	1297	3189	4593	6985	12759	19029
2.3 Electricity, gas and water supply	165	861	1717	3708	6285	7444
2.4 Construction	42	302	352	941	916	1092
3. Services	3347	7510	9675	15199	22863	28636
3.1 Trade, hotel & restaurants	257	364	1198	2563	3445	2982
3.2 Transport, storage and communication	961	2842	2891	3963	6982	9559
3.3 Financing, insurance, real estate and business	1254	1699	2012	3428	6219	8747
3.4 Community, social and personal services	510	1491	1952	2928	3596	4181
3.5 Public administration and defence	365	1115	1622	2317	2621	3168
Gross Capital Formation	5587	11760	17376	30242	46956	61356

There is very large and significant increase in the growth of capital formation in the services sector. The GFCF in the services sector rose from Rs. 3,100 crores in 1950-52 to Rs. 27,289 crores in 1993-95, the compound growth rate being 4.29 per cent per annum during 1952-95. Among the components, trade, hotels and restaurants witnessed the highest (7.40%) growth rate in Gross Fixed Capital Formation, followed by public administration (4.34%) and the lowest (4.04%) in the transport, storage and communication during 1992-95 period.

Table 6. Trend Growth Rates of Gross Fixed Capital Formation by Economic Activity in India, 1952-95

(Per cent per annum)

<i>Sectors</i>	<i>Periods</i>					
	<i>1952-60</i>	<i>1961-70</i>	<i>1971-80</i>	<i>1981-91</i>	<i>1992-95</i>	<i>1952-95</i>
1. Agriculture and allied	1.59	6.45	5.82	0.30	5.15	3.69
1.1 Agriculture	1.07	6.52	5.81	-0.19	5.04	3.59
1.2 Allied	11.82	5.26	6.05	7.00	6.20	5.05
2. Industry	13.38	6.34	7.93	7.32	9.37	6.86
2.1 Mining and quarrying	-0.07	4.35	17.33	8.07	15.86	11.08
2.2 Manufacturing	13.09	5.89	7.04	7.45	10.76	5.90
2.3 Electricity, gas and water supply	16.28	8.62	8.07	7.51	4.43	8.47
2.4 Construction	23.40	4.89	4.32	3.71	7.08	6.10
3. Services	10.36	0.52	2.60	5.29	7.11	4.29
3.1 Trade, hotels & restaurants	7.52	9.87	-0.31	7.04	3.66	7.40
3.2 Transport, storage and communication	15.81	-1.85	2.38	7.19	9.15	4.04
3.3 Financing, insurance, real estate and business	3.22	1.93	5.01	6.57	8.73	4.12
3.4 Community, social and personal services	12.44	0.86	2.09	2.55	3.63	4.33
3.5 Public administration and defence	12.80	1.25	1.29	2.18	3.92	4.34
Gross Fixed Capital Formation	8.14	4.03	5.49	5.76	8.24	5.34

Comparing the growth rates of capital formation in agriculture, industry and services, it is observed that the investment in the industrial sector registered the highest growth rate of 6.86 per cent followed by the services (4.29%) and the lowest (3.69%) in the agriculture and allied activities.

Table 7. Trends in Compound Growth Rates of Gross Capital Formation by Economic Activity in India, 1952-95

(Per cent per annum)

Sectors	Period					
	1952-60	1961-70	1971-80	1981-91	1992-95	1952-95
1. Agriculture and allied	2.14	6.72	7.01	0.05	5.18	3.73
1.1 Agriculture	1.67	6.69	7.05	-0.44	5.14	3.66
1.2 Allied	11.60	6.66	6.11	6.98	5.62	4.85
2. Industry	13.06	4.82	6.49	6.88	8.65	6.73
2.1 Mining and quarrying	0.17	4.30	16.72	6.73	13.25	11.10
2.2 Manufacturing	12.88	4.44	4.89	7.67	9.82	5.93
2.3 Electricity, gas and water supply	16.88	7.33	8.06	6.72	4.37	8.27
2.4 Construction	19.07	2.81	7.85	-0.15	7.37	5.38
3. Services	12.17	-0.14	3.45	4.41	6.76	4.40
3.1 Trade, hotels & restaurants	10.63	8.56	7.85	-0.73	2.85	6.91
3.2 Transport, storage and communication	16.48	-1.97	1.73	6.86	8.79	4.01
3.3 Financing, insurance, real estate and business	3.28	1.92	5.02	6.56	8.72	4.13
3.4 Community, social and personal services	16.83	-1.32	2.20	3.09	3.71	4.31
3.5 Public administration and defence	18.70	-1.68	1.49	2.08	4.05	4.38
Gross Capital Formation	9.32	3.47	5.68	5.16	7.73	5.37

III

Agriculture-Industry Linkages

The results of the estimated equations of agricultural and industrial sectors of the Indian economy are presented in Table 8.

The F-value for both the estimated production functions revealed their significance. As indicated by the value of coefficient of multiple determination (R^2), about 99 per cent variation in the economic growth in both the agricultural and industrial sectors is explained by variables included in the model.

In agricultural growth model the regression coefficient (0.3048) of the industrial income variable is positive and statistically significant, indicating that one per cent growth in the industrial sector will increase agricultural income by 0.30 per cent. Similarly the regression coefficient (0.2695) of agricultural income was positive and statistically significant in industrial growth model.

Table 8. Estimated Coefficients of Indian Agricultural and Industrial Growth Models

<i>Variables</i>	<i>Agriculture</i>	<i>Industry</i>
Constant	-4.0280	-0.2115
Labour	-0.1352 (0.1335)	-0.1579 (0.0953)
Investment	-0.1082 (0.0429)	0.0953 (0.0398)
Land	2.5503 (0.3112)	-
Agricultural Income	-	0.2695 (0.0743)
Industrial Income	0.3048 (0.0826)	-
Lagged agricultural income	0.0322 (0.1125)	-
Lagged industrial income	-	0.7966 (0.0584)
Dummy for 1961-62 to 1975-76 period	-0.0518 (0.0373)	-0.0379 (0.0290)
Dummy for 1976-77 to 1991-92 period	-0.0277 (0.0216)	-0.0064 (0.0199)
Adjusted R ²	0.987	0.997
F-value	616.67	2994.75
Durbin-Watson Stat.	2.0104	2.0596

Figures in parentheses represent stand errors of regression coefficients

The labour variable has a negative sign in both the agricultural and industrial growth models but is statistically non-significant, indicating the labour has not been a significant factor in the growth of agricultural and industrial sectors in the Indian economy. This may be due to surplus labour in the agricultural sector.

The investment variable is negatively related to the agricultural income growth and is statistically significant at one per cent level, indicating that agricultural investment does not play an important role in the growth of agricultural sector. This is mainly because of decline in the investment in the agricultural sector during the period under study. For industrial sector growth model, the investment variable is positively related to its income and is statistically significant at one per cent level. This indicates that capital investment in industrial sector of the Indian economy has made a significant contribution to income growth in this sector. The economic liberalisation created a favourable business conditions through open door policy and attracted more foreign investment and technology mostly in industrial sector.

The regression coefficient of land variable is positive (2.5503) and statistically significant at one per cent level, indicating that increase in gross sown area has made a significant contribution to total agricultural growth in the economy.

The dummy variables representing the pre-economic reform periods are negative in both the agricultural and industrial sectors, indicating that India's economic reforms contributed to economic growth. The magnitude of the variables declined toward recent period, indicating that India has achieved economic growth over the years from 1961 to 1995.

The above results clearly indicate that there are strong linkages between agricultural and industrial sectors of the Indian economy but the agricultural sector's growth depends relatively more on the growth of industrial sector as compared to industrial growth sector dependence on agricultural growth.

Conclusions

This paper examined economic growth in Indian agricultural and industrial sectors from 1950-95. The results indicate that GDP as well as its major sectors have grown considerably over the period under consideration and there has been a distinct jump in the India's growth since the early nineties. The observed growth rate of GDP during 1992-95 at over 5.7 per cent was considerably higher than those in the previous four periods. However, the industry grew at a faster rate as compared to agricultural sector for all the sub-periods. There has been a sharp decline in the contribution of the agricultural sector to GDP, accounting for 28.74 per cent of the total GDP during 1992-95 as compared with an average of 51.43 per cent during 1950-64. As regards the industrial sector, the

contribution to GDP has increased substantially from 19.28 per cent to 29.91 per cent during the same period. The results of economic growth model indicate that there are strong linkages between the agricultural and industrial sectors of the Indian economy. The study reveals that land is an important factor in the growth of agricultural sector. Labour is not an important input to India's economic growth. Capital investment does not play an important role in the agricultural growth. For the industrial sector, the investment variable is significant and positively related to the income growth. To improve agricultural productivity in the country, a significant increase in capital investment in agricultural sector is needed. Limited investment in the agricultural sector has caused poor rural infrastructure and insufficient agricultural research. Therefore, India should attract more technology and investment in agricultural sector through open door policy.

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