

# Contribution of investment in economic growth of major sectors: With focus on Agriculture and Allied sector in Bihar

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**Abstract.** This paper attempts to measure the contribution of investment in major sectors, i.e., Agriculture & Allied, Industry and Service sectors in economic growth of Bihar by decomposing their contribution with the help of the methodology used by Jalava and Pohjola [10]. A set of structural relations has been formulated to interlink growth of these sectors and role of investment. Variables in these structural relations were first looked into for stationarity of the series on the basis of Augmented Dicky-Fuller test; and structural relations have been estimated using the Ordinary Least Square (OLS) to study the contribution of investment in Agriculture & Allied sector in the overall growth rate of economy. The study brings out structural relations interlinking growth in Agriculture & Allied, Industry, and Service sectors. Estimated results indicate strong influence of Agriculture & Allied sector on Industry and Service sectors. Besides, crowding – in effect of public investment on private investment in Agriculture & Allied sector was also established. Finally, alternate simulation scenarios have been examined that support to pursue policy of public sector investment in Agriculture & Allied sector. Effect of pursuing policy of augmenting public investment in Agriculture & Allied sector lead to increase in sectoral as well as aggregate growth rate in GDP at a feasible and manageable within limits of the overall government expenditure, thus it is rational – more so, in light of providing food security.

**Keywords:** Growth, inter – sector linkages, stationarity of variables, Augmented Dicky – Fuller test, augmentation of public investment, Agriculture & Allied sector

**JEL classification:** E22, E23, E27, H54

## 1. Introduction

Investment plays an important role in economic growth of a region by raising the productive capacity, generating employment opportunities, promoting technological innovations, and adding to the Government's tax revenue. India achieved a remarkable saving-investment profile in comparison to countries with similar per capita income in the early years by policy initiatives, such as the Government's lead role in investment in core strategic sectors in the early Five-year Plans, Bank Nationalisation in 1969- which resulted in transformation of savings to investment and opening up of the Indian Economy to Foreign Direct Investment. A high investment rate of over 36% of

GDP supported India's impressive growth rate of 8.2% during the 11<sup>th</sup> plan and a still higher growth rate of 9% and 9.5% are envisaged with an even higher investment rate of 38.4% and 41.4% in the Approach Paper to the 12<sup>th</sup> plan. Bihar, which continued to lag behind in terms of several socio-economic parameters up to tenth plan, exceeded national achievement in growth rate during the 11<sup>th</sup> plan and targets to continue its achievement in the 12<sup>th</sup> and subsequent plans to reduce the existing gap. All these need careful analysis of contribution of investment to economic growth in the Agriculture & Allied sector, Industries sector and Service sector.

Structural transformation has been witnessed over the past thirty years in India with the rising share of

service sector and declining trend in the share of Agriculture & Allied sector in the country's GDP. Similar trend in structural transformation has also been observed in Bihar. But the analysis emerging from investment contribution of economic growth in various sectors are not pointing towards optimal path. Mazumdar [15] found that Indian economy was characterised by an investment growth asymmetry after the 1991 reforms. Capital formation was biased towards the Industry sector, whereas output structure was biased towards Service sector – with the result that the manufacturing output growth becoming highly prone to cyclical fluctuation and instability and the service intensive growth trajectory unable to fully utilise the capital accumulation potential of the economy, rather than being low on capital intensity. Mallick [13] found that industry was the largest contributor to growth in private investment in India, followed by service and agriculture. Both the studies were descriptive in nature and lack focus on measurement of investment contribution of major sectors and their growth dynamics for the Indian economy. Bihar also lack similar analysis to justify its investment pattern.

This paper attempts to measure the linkages and investment contribution of major sectors, i.e., Agriculture & Allied (comprising of agriculture & animal husbandry, forestry and fisheries) Industry (consisting of mining & quarrying; manufacturing; construction; electricity, gas & water supply), and Service (transport, storage & communication; trade, hotel & restaurants; banking & insurance; real estate, ownership of dwelling & business services; public administration; and other services) sectors in economic growth of Bihar. It further examines the alternate scenarios with higher public investment in Agriculture & Allied sector – which has to meet basic requirement of food security and a majority of workforce are dependent on this sector for gainful employment.

## 2. Methodology

Analysis consists in first decomposing contribution of Agriculture & Allied, Industry, and Service sectors to economic growth with the help of the methodology used by Jalava and Pohjola [10], wherein the aggregate growth of the economy ( $Y$ ) is taken to be the sum of (i) share-weighted output growth of Agriculture & Allied sector ( $Y_a$ ), (ii) share-weighted output growth of Industry sector ( $Y_i$ ), and (iii) share-weighted output growth of Service sec-

tor ( $Y_s$ ). Corresponding weights ( $w_a$ : Agriculture & Allied;  $w_i$ : Industry; and  $w_s$ : Service) are the share of sector specific value added in aggregate output.

$$Y = w_a.Y_a + w_i.Y_i + w_s.Y_s;$$

such that  $w_a + w_i + w_s = 1$ .

The framework for studying the investment contribution is as follow:

Many studies have shown a strong relationship between performance of agriculture and industry – notable early attempt among them in India were Rangarajan [16]; Ahlawalia and Rangarajan [8]; Dhawan and Saxena [9] and Thamrajakshi [20]. Recent studies relating linkages in growth rate of various sectors are due to Kanwar [11]; Bathala [21]; Sastry et al. [17]; Krishnamurthy et al. [12]; and Mani et al. [14] that showed the agriculture continues to play an important role in determining the overall growth rate of the economy. Based on these studies, structural relations were formulated to study the contribution of investment in the overall growth rate of economy. First, a set of relations to explain the factors responsible for growth in the Agriculture & Allied, Industry and Service sectors were estimated. These were then used to explain rate of growth in the Aggregate GDP as follow:

1. Aggregate growth rate of GSDP ( $AG_r$ ) is dependent on the growth rate in Agriculture & Allied ( $AA_r$ ), Industry ( $I_r$ ) and Service ( $S_r$ ) sectors.

$$AG_r = \alpha_0 + \alpha_1 AA_r + \alpha_2 I_r + \alpha_3 S_r$$

where  $\alpha$ 's are the constant (1)

of the equation

2. Growth rate in Agriculture & Allied sector ( $AA_r$ ) is dependent on growth rate of acreage ( $ACE_r$ ), spread of optimal rainfall in the monsoon season (RAIN), and growth rate of Investment in Agriculture & Allied sector ( $IAG_r$ ).

$$AA_r = \beta_1 + \beta_2 * ACE_r + \beta_3 * RAIN + \beta_4 * IAG_r$$

where  $\beta$ 's are the constant of the equation (2)

3. Growth rate in Industry sector ( $I_r$ ) is dependent on growth rate of investment in Industry sector ( $I_r$ ), growth rate of Agriculture & Allied sector ( $IAG_r$ ) and the aggregate government expenditure (AGE).

Table 1  
Share and semi-logarithm annualised growth rate of the major sectors in the total GSDP/GDP at 2004–05 prices for Bihar and India

Sector		Bihar			India		
		Agri + Allied	Industry	Services	Agri + Allied	Industry	Services
Share of the sectors in the GSDP/GDP	1980–81	51.74	10.58	37.68	36.54	25.22	38.24
	1990–91	44.98	12.43	42.59	30.21	26.59	43.20
	2000–01	37.72	11.66	50.62	23.22	24.97	51.81
	2010–11	21.99	19.05	58.96	14.98	24.62	60.60
	2014–15	18.19	21.17	60.64	12.19	23.91	63.90
Semi-logarithm annualised growth rate	1980–81 to 1989–90	2.06	24.59	6.11	3.24	7.95	4.74
	1990–91 to 1999–2000	(–)3.11	(–)9.80	3.29	2.46	4.33	5.85
	2000–01 to 2014–15	(–)0.82	(–)2.06	6.47	2.48	7.89	5.84

$$I_r = \mu_0 + \mu_1 * II_r + \mu_2 * IAG_r + \mu_3 * AGE_r \text{ where } \mu's \text{ are the constant of the equation} \quad (3)$$

4. Growth rate in Service sector is dependent on growth rate of investment in service sector, growth rate of Agriculture & Allied and Industry sectors, and the aggregate government expenditure.

$$S_r = \Omega + \Omega_1 * IS_r + \Omega_2 * AA_r + \Omega_3 * I_r + \Omega_4 * AGE_r \text{ where } \Omega's \text{ are the constant of the equation} \quad (4)$$

5. Private investment in Agriculture & Allied sector (PvIAG) is dependent on public investment (PuIAG) and growth rate in the sector (AA<sub>r</sub>).

$$PvIAG = \mathcal{L}_0 + \mathcal{L}_1 * PuIAG + \mathcal{L}_2 * AA_r \text{ where } \mathcal{L}'s \text{ are the constant of the equation} \quad (5)$$

6. Private investment in Industry (PvII) is dependent on public investment in Agriculture & Allied (PuIAG) and Industry (PuII); and growth rate of Industry sector (I<sub>r</sub>).

$$PvII = \mathcal{Y}_0 + \mathcal{Y}_1 * PuIAG + \mathcal{Y}_2 * PuII + \mathcal{Y}_3 * I_r \text{ where } \mathcal{Y}'s \text{ are the constant of the equation} \quad (6)$$

Standard inference procedures do not apply to regression which contain an integrated dependent variables. So, variables of these structural relations were first looked into for stationarity of the series on the basis of Augmented Dicky-Fuller test and thereafter these structural relations were estimated using the Ordinary Least Square (OLS) with specification of each equation in conformity with the stationary requirements.

### 3. Data

Capital is measured as net fixed capital stock in the respective sectors at 2004–05 prices. Public investment in the Agriculture & Allied and Industry are measured in terms of net fixed capital formation in these sectors at 2004–05 prices. Private sector capital formation in the Agriculture & Allied and Industry sectors were residual of public investment from the total investment. Output of each of these sectors were measured by the GSDP at factor cost. The Central Statistical Office (CSO) provides data on GSDP for Indian states, as compiled by the DES, Bihar at the sectoral level, and for the aggregate economy. Data on net capital formation and capital stock are not compiled by the DES, Bihar for Bihar – as such data on capital formation and capital stock were worked out by following the approach adopted by Sinha and Verma [18,19] and utilised them for analysis. Besides, data on net sown area as a measure of acreage under cultivation and monsoon rainfall were taken from the DES, Bihar. For the period 2013–15, growth rate of net sown area were extrapolated by taking the moving average of the previous two periods' growth rates.

### 4. Decomposition of sectoral contribution to economic growth

Share of the three major sectors in the total GSDP/GDP at 2004–05 prices for Bihar and India along with the annual growth rate (semi-logarithm annualised growth rate) are indicated in Table 1.

Average share of value added and contribution in logarithm annualised growth of the Agri + Allied, Industry, and Services in GSDP/ GDP of Bihar & India at 2004–05 prices are indicated in Table 2.

Table 2 reveals relevant facts about the contribution of major sectors in growth rates of economy.

Table 2

Average share of value added and contribution in growth rate of the Agri + Allied, Industry, and Service sectors in GSDP/GDP of Bihar &amp; India at 2004–05 prices

Period	Average share of value added			Contribution in growth rate				
	$w_a$	$w_m$	$w_s$	Agri + Allied	Industry	Service	Aggregate	
BIHAR	1980–81 to 1989–90	0.42	0.16	0.42	1.32	0.02	2.16	4.32
	1990–91 to 1999–2000	0.33	0.20	0.47	0.05	(–)0.01	0.36	0.54
	2000–01 to 2014–15	0.25	0.19	0.56	0.22	0.01	3.32	4.56
INDIA	1980–81 to 1989–90	0.28	0.30	0.42	0.52	0.26	2.37	4.80
	1990–91 to 1999–2000	0.23	0.29	0.48	0.53	0.39	2.67	4.67
	2000–01 to 2014–15	0.17	0.25	0.58	0.75	0.24	4.13	6.67

Table 3

Average rate of public investment and growth rate – Bihar &amp; India

	Period	Rate of investment			Growth rate			
		Agri.	Industry	Services	Agri.	Industry	Services	Aggregate
INDIA	1980–81 to 1982–83	1.84	4.37	7.43	5.86	4.25	5.35	5.37
	1983–84 to 1985–86	1.58	4.82	7.11	6.42	4.63	5.86	5.45
	1986–87 to 1988–89	1.37	3.47	6.74	3.43	5.37	7.01	5.67
	1989–90 to 1991–92	1.31	3.92	6.32	3.21	6.23	7.57	5.76
	1992–93 to 1994–95	0.98	4.14	7.34	2.96	6.21	5.26	3.95
	1995–96 to 1997–98	0.65	5.11	7.11	2.57	6.08	6.01	5.98
	1998–99 to 2000–01	0.84	5.32	6.95	3.02	3.47	7.53	5.73
	2001–02 to 2003–04	0.98	4.88	6.79	2.06	3.78	8.51	7.38
	2004–05 to 2006–07	1.32	3.52	7.32	1.84	9.32	8.63	7.63
	2007–08 to 2009–10	1.23	8.64	7.65	3.04	8.27	9.64	7.53
	2010–11 to 2012–13	1.29	8.35	8.94	3.45	7.28	9.74	7.76
BIHAR	1980–81 to 1982–83	1.01	0.82	5.73	7.45	4.52	5.79	6.48
	1983–84 to 1985–86	1.23	0.96	6.54	8.56	4.65	5.96	6.84
	1986–87 to 1988–89	1.12	0.87	6.76	–1.75	5.16	4.81	2.17
	1989–90 to 1991–92	1.35	1.04	6.83	–1.45	5.61	4.32	2.78
	1992–93 to 1994–95	1.33	1.54	6.94	2.76	2.17	3.45	2.95
	1995–96 to 1997–98	1.12	1.63	6.98	2.51	–2.22	4.23	3.13
	1998–99 to 2000–01	1.64	1.87	7.03	–2.12	2.69	5.27	3.91
	2001–02 to 2003–04	1.77	1.99	7.13	6.44	2.82	4.23	3.43
	2004–05 to 2006–07	2.43	3.12	8.76	7.44	3.21	6.86	7.75
	2007–08 to 2009–10	2.77	4.44	9.32	3.43	1.48	12.11	8.75
	2010–11 to 2012–13	3.12	4.58	9.76	4.33	8.96	12.44	9.08

Agriculture & Allied Sector contribution to annualised growth rate were too smaller than their share in the GSDP/GDP. Share of Agriculture & Allied sector in India dwindled from 28% to 17% during time zone under study (1980–81 to 1989–90) to (2000–01 to 2014–15) but its contribution to annualised growth rate remained at 11%, but in Bihar though the share of these sectors reduced from 42% (1980–81 to 1989–90) to 25% (2000–01 to 2014–15) in the GSDP-its contribution to annualised growth rate shranked from 30% to 5% during the same period, indicating serious concern and urgent need of instruments to check it. Share of the Industry was almost negligible in Bihar and so its contribution to growth rate, but at the national level its contribution to growth rate was little less than its share to the GDP. Contribution to annualised growth rate in Service sector uniformly exceeded its share in the GSDP/GDP in Bihar and India. Besides, Service

Sector contribution to growth rate has shown faster acceleration in Bihar as compared to India during the study period. Thus, it could be conclusively inferred that Service sector has remained a crucial component in growth phenomena in both Bihar & India.

## 5. Investment and growth rate

Rate of public sector investment (defined as the percentage share of sectoral GFCF to sectoral GSDP/GDP) in the agriculture & allied; industry and service sector is closely related to their contribution in growth rate of the sector and the aggregate growth rate of economy. Table 3 gives three year s average rate of investment and growth rate in agriculture, industry and service sector during 1980–81 to 2012–13 for Bihar and India

Table 3 reveals that the rate of public investment was least in Agriculture & Allied sector – both in India and Bihar. It has, however, increased in Bihar from 1998-99 onwards and is currently over twice the national level. But, possibly this may include capital expenditure on flood protection. Rate of public investment in Industry sector was abysmally low up to 2003–04 to sustain it, though improved thereafter. Rate of investment in Service sector in Bihar was in consonance with the national level.

### 6. Estimation of structural relations

Stationarity test of the relevant variables was looked into before estimation of the structural relations by the Augmented Dickey – Fuller (ADF) test. The results are presented in Table 4.

The Eqs (1)–(6) were estimated for period 1980–81 to 2014–15 using the Ordinary Least Squares (OLS) with specification of each equation in conformity with stationarity requirement by adopting suitable computer programming. The results are presented as follows.

Equation (2) for the Agriculture & Allied sector works out as:

$$AA_r = -9.14 + 0.54 * ACE_r + 0.04 * RAIN + 0.64 * IAG_r + 4.63 * D1 \quad (7)$$

(−3.52\*\*) (3.86\*\*) (3.96\*\*) (1.85\*) (5.45\*\*)

$$R^2 = 0.79 \quad \bar{R}^2 = 0.74 \quad Durbin\_h = -0.267$$

Bihar is frequently exposed to natural calamities in terms of drought and flood, which severely affect the output of Agriculture & Allied sector. A dummy variable (D1) is included to take into account the high negative growth rates in 1982–83, 1987–88, 1992–93, 1995–96, & 2001–02. (D1) assumes the value 1 for these years and 0 for rest of the years.

Equation (3) for the industry sector becomes,

$$I_r = 3.98 + 0.99 * II_r + 0.36 * IAG_r + 0.59 * AGE + 4.22 * D2 \quad (8)$$

(4.39\*\*) (2.24\*\*) (3.31\*\*) (1.58\*) (4.53\*\*)

$$R^2 = 0.83 \quad \bar{R}^2 = 0.74 \quad Durbin\_h = 2.18$$

Bihar showed monetary and fiscal stimuli during 2006–07 onwards in the industry sector, which had definite

impact on the output of this sector and for which no independent variable has been included in the equation. These effects were captured by the dummy variable (D2). It takes the value 1 in years during 2006–07 onwards and 0 for other years.

Equation (4) for the service sector was estimated as,

$$S_r = 3.69 + 0.19 * IS_r + 0.15 * AA_r + 0.21 * I_r + 0.08 * AGE + 2.14 * D3 \quad (9)$$

(4.38\*\*) (3.68\*\*) (1.78\*) (1.96\*) (3.26\*\*) (4.29\*\*)

$$R^2 = 0.78 \quad \bar{R}^2 = 0.72 \quad Durbin\_h = 1.79$$

The dummy variable(D3) was introduced to capture impact of monetary and fiscal stimuli on the output of service sector – for which no independent variable was included in the equation during 2006–07 onwards. (D3) assumed the value 1 in years 2006-07 onwards and 0 for other years.

The three sectoral growth rates, as estimated in Eqs (7)–(9), were linked with the aggregate growth rate of the NSDP by the following:

$$AG_r = -0.638 + 0.41 * AA_r + 0.11 * I_r + 0.46 * S_r - 0.32 * D(4) + 0.18 * SDSR - 0.15 * SDAG \quad (10)$$

(−2.06\*) (20.87\*\*) (12.61\*\*) (13, 65\*\*) (−1.02) (3.45\*\*) (−4.89\*\*)

$$R^2 = 0.76 \quad \bar{R}^2 = 0.71 \quad Durbin\_h = 1.84$$

Equation (10) includes two slope dummies SDSR and SDAG for service sector and Agriculture & Allied sector respectively, and one intercept dummy D(4) to take care of structural changes. The estimated coefficient indicate average share of the respective sectors – implying thereby that the average share of Agriculture & Allied, Industry and Services sector over the period under study were 41percent, 11 percent, and 46 percent respectively. The slope dummy of the Agriculture & Allied sector is negative – implying decline in its share in GSDP from 41 percent to 26 percent. The slope dummy of the Service sector was positive – indicating increase in its share in the GSDP from 46 percent to 64 percent. The contribution of Industry sector remains unchanged at 11 percent.

The relationship between public and private investment in the Agriculture & Allied and Industry sector

Table 4  
Results of the Augmented Dickey – Fuller (ADF) test

Variable	level	First difference	Inference
NDP in Agriculture	-2.203	-9.221	Non stationary –I(1)
Growth rate Agri. GDP	-7.136	–	Stationary – I(0)
GDP in Industry	-2.477	-8.415	Non stationary –I(1)
Growth rate Industry GDP	-4.846		Stationary – I(0)
Growth rate Service GDP	-5.679		Stationary – I(0)
Growth rate Aggre. GDP	-8.295		Stationary – I(0)
Growth rate acerage	-9.765		Stationary –I (0)
Growth rate capital stock Agriculture	-4.934		Stationary – I(0)
Growth rate capital stock Industry	-2.103	-4.312	Non stationary – I(1)
Growth rate capital stock Services	-6.527		Stationary – I(0)
Public Investment in Agri.	-1.023	-3.872	Non stationary – I(1)
Private investment in Agri.	-1.206	-4.027	Non stationary – I(1)
Total investment in Agri.	-2.436	-4.483	Non stationary – I(1)
Public Investment in Industry	-2.325	-4.783	Non stationary – I(1)
Private investment in industry	-2.548	-4.067	Non stationary – I(1)
Government Expenditure	-1.963	-6.352	Non stationary – I(1)
Growth rate in Govt. Exp.	-7.853		Stationary –I (0)
Monsoon Rainfall	-8.732		Stationary – I(0)

were estimated for the reference period as follow:

$$\begin{aligned}
 \text{PvIAG} &= 217.19 + 0.66 * \text{PuIAG} \\
 &\quad (0.98) \quad (2.10^*) \\
 &-0.38 * \text{AA}_r + 9011.51 * (\text{ag}) \quad (11) \\
 &\quad (-2.33^*) \quad (7.52^{**})
 \end{aligned}$$

$$R^2 = 0.73 \quad \bar{R}^2 = 0.70 \quad \text{Durbin}_h = 2.06$$

$$\begin{aligned}
 \text{PvII} &= -528.51 + 0.71 * \text{PuIAG} + 0.76 * \text{PuII} \\
 &\quad (-2.61) \quad (1.98^*) \quad (6.32^{**}) \\
 &+0.18 * \text{Ir} + 9048.13\text{D(ind)} \quad (12) \\
 &\quad (0.94) \quad (5.85^{**}) R^2 = 0.73
 \end{aligned}$$

$$R^2 = 0.79 \quad \bar{R}^2 = 0.74 \quad \text{Durbin}_h = 1.89$$

Equations (11) and (12) include dummies D(ag) and D(ind) to account for exceptional cases. These equations indicate that public investment significantly crowds – in private investment more strongly in the Industry sector than in the Agriculture & Allied sector. Besides, private investment in the industry sector was also influenced by the public investment in the Agriculture Allied sector. Thus to trigger significant private sector investment in the Agriculture & Allied and Industry sector, the government must pursue policies to boost role of the public sector in these sectors.

Impact of increased public investment in Agriculture & Allied sector will be analysed hitherto. Increased public investment in Agriculture & Allied sector will boost private sector investment and thereby enhanced total investment in this sector will check

its swiftly dwindling contribution in aggregate growth syndrome of the state. Besides, higher growth in Agriculture & Allied sector will also raise growth rates in Industry and Service sector. As indicated earlier, increase in public investment into agriculture will have to be supported by a corresponding increase in the aggregate government expenditure which must be manageable. Following counterfactual simulation exercises were taken up under alternative policy scenarios in Agriculture & Allied sector:

Scenario A: The growth rate of public investment in Agriculture & Allied sector is taken to be 10% higher than the actual rate.

Scenario B: The rate of public investment in Agriculture & Allied sector is fixed at 1.5 % of the Aggregate GDP (The actual rate of public investment in Agriculture & Allied sector has remained well below one percent).

The results of effecting these scenario-A and B are indicated in Tables 5 and 6 respectively These tables show how the sectoral and aggregate growth rates get raised resulting from the increase in public investment in Agriculture & Allied sector under the alternate scenarios – which are significant enough to justify the policy of public investment augmentation. The percentage increase in the aggregate government expenditure in these tables as a result of pursuing policy of enhancing public investment in Agriculture & Allied sector are feasible and within manageable limits.

Results in Tables 5 and 6 reveal that there is significant crowding – in effect of public investment on private investment in Agriculture & Allied sector. These tables also show how the sectoral and aggregate GSDP

Table 5  
Result of effecting Scenario – A

YEAR	Crowding in of private investment (Rs crore)	Increase in GDP growth rate (percent per annum)				% Increased Government expenditure per annum
		Agriculture & Allied	Industry	Services	Aggregate	
2000–01	4.00	0.00	0.12	0.01	0.03	0.16
2001–02	36.80	0.05	0.18	0.02	0.04	0.29
2002–03	56.70	0.08	0.02	0.05	0.05	0.34
2003–04	107.10	0.12	0.9	0.03	0.07	0.43
2004–05	137.90	0.15	0.21	0.05	0.11	0.59
2005–06	155.60	0.14	0.10	0.14	0.14	0.63
2006–07	260.80	0.16	0.24	0.16	0.18	0.94
2007–08	280.70	0.14	0.18	0.13	0.14	0.89
2008–09	250.90	0.21	0.13	0.07	0.09	0.81
2009–10	455.10	0.30	0.19	0.36	0.25	1.18
2010–11	699.70	0.31	0.33	0.35	0.34	1.76
2011–12	997.00	0.66	0.68	0.36	0.56	1.62
2012–13	1460.10	0.86	0.74	0.66	0.78	2.27
2013–14	2014.00	1.08	0.79	0.82	0.98	2.29
2014–15	2679.80	1.76	1.21	1.06	1.38	2.81

Table 6  
Result of effecting Scenario – B

YEAR	Crowding in of private investment (Rs crore)	Increase in GDP growth rate (percent per annum)				% Increased Government expenditure per annum
		Agriculture & Allied	Industry	Services	Aggregate	
2000–01	464.41	0.01	– 0.01	0.39	0.18	2.40
2001–02	566.69	0.06	0.92	0.12	0.28	2.74
2002–03	684.50	0.10	0.08	0.08	0.09	3.10
2003–04	734.30	1.19	0.72	0.30	0.63	2.98
2004–05	731.50	0.93	0.22	0.28	0.54	2.88
2005–06	790.40	1.25	0.61	0.48	0.81	2.94
2006–07	754.70	1.25	0.81	0.49	0.86	2.65
2007–08	873.60	1.02	0.49	0.45	0.68	2.74
2008–09	875.60	1.22	0.59	0.46	0.80	2.33
2009–10	838.40	0.97	0.36	0.41	0.63	2.20
2010–11	829.80	1.23	0.61	0.40	0.71	2.27
2011–12	782.30	1.07	0.69	0.39	0.69	1.86
2012–13	738.90	0.86	0.23	0.39	0.56	1.70
2013–14	745.90	0.98	0.46	0.39	0.59	1.44
2014–15	789.70	1.32	0.54	0.42	0.73	1.32

growth rate increases with increase in public investment in Agriculture & Allied sector under two alternate scenarios. Required percentage increase in overall government expenditure resulting from increase in public investment in Agriculture & Allied sector is feasible and well within manageable limits.

## 7. Conclusion & policy implication

The study reveals that during last 35 years, share of Agriculture & Allied sector in India dwindled from 28% to 17% during time zone under study (1980–81 to 1989–90) to (2000–01 to 2014–15) but its contribution to annualised growth rate remained at 11%, but in Bihar though the share of these sectors reduced from 42% (1980–81 to 1989–90) to 25% (2000–01 to 2014–15) in the GSDP -its contribution to annualised growth rate

shranked from 30% to 5% during the same period, indicating serious concern and urgent need of instruments to check it.

The estimated average share of the Agriculture & Allied, Industry and Services sector over the period under study were 41percent, 11 percent, and 46 percent respectively. The share of the Agriculture & Allied sector has declined from 41 percent to 26 percent. The share of the Service sector has increased from 46 percent to 64 percent. The contribution of Industry sector remains unchanged at 11 percent.

The study brings out structural relations interlinking growth in Agriculture & Allied, Industry, and Service sectors. Estimated results indicate strong influence of Agriculture & Allied sector on Industry and Service sectors. Besides, crowding – in effect of public investment on private investment in Agriculture & Allied sector was also established.

Since proper validation tests indicate structural relations to be reliable, two alternate simulation scenarios were analysed to study effect of pursuing policy of augmenting public investment in Agriculture & Allied sector. Results reveal that such increase lead to increase in sectoral as well as aggregate growth rate in GDP at a feasible and manageable within limits overall government expenditure. Thus pursuing policy of augmentation of public investment in Agriculture & Allied sector is rational – more so, in light of providing food security.

## 8. Limitations

This study suffers from many limitations. Availability of adequate reliable data were the biggest challenge. The CSO provides data of GCF for the public sector only. It does not provide data for the private sector and it is not possible to distinguish private investment into domestic and foreign investment. The DES, Bihar does not even compile GFCF and the available estimates are underestimates as per the authors. Finally, optimal effect in pursuing policy of augmenting public investment in Agriculture & Allied sector needs to be analysed within feasible limits of the overall government expenditure.

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