CHAPTER -7

IMPACT OF COMMERCIAL BANK CREDIT ON CAPITAL FORMATION IN THE AGRICULTURAL SECTOR

The purpose of this chapter is to examine the impact of agriculture credit on capital formation in the agricultural sector. The chapter also highlighted the growth of Long-term direct credit, Short-term direct credit, and total direct credit supplied to the agricultural sector by scheduled commercial banks in India. Next section of this chapter empirically analyzes the following areas:

7.1 Evaluation of Capital Formation and Agricultural Credit

7.2 Growth Rates of Capital Formation and Direct Credit in Agriculture

7.3 Causal Relationship among Credit, Capital Formation and Agricultural Growth

7.1 Evaluation of Capital Formation and Agricultural Credit

Any investments in any sector lead to the creation of productive assets through the provision of capital in the form of infrastructure, asset quality and improved natural resources. Capital refers to the tangible assets that form the inputs needed to produce further goods and services. Agriculture's capital can be described as assets such as tractors, irrigation pump sets, farmhouses, warehouses, inputs etc. Investments refer to the acquisition of physical assets that result in the generation of incremental income over time. The creation of assets for agriculture enhances production in a direct and indirect way. Land reclamation, erosion control, irrigation and flood control are all examples of assets created. By increasing capital formation through agricultural investment, farmers are able to utilize their resources more efficiently, such as land, labor, equipment and other tools. This enables farmers to use their resources to the greatest extent. Growth in agricultural production can be accelerated through capital formation. Increased agricultural production and lower cost of rural living reduce rural poverty with public investment. Infrastructure and available resources are among the factors that drive private agriculture investment. For fixed capital formation, Indian farmers use both personal and borrowed funds, as there exists a positive relationship between agricultural capital formation, technological progress and availability of institutional credit and a negative relationship with rainfall (Dhawan and Yadav, 1997).Agriculture input and output prices are the major factors in determining the expected return to an investor. Agricultural investment

and short-term working capital in India are heavily dependent upon credit. The proportion of commercial banks that provide agricultural loans to the country has risen steadily since the nationalization of the banking sector. Capital in agriculture is derived from two main sources: private sources (individuals/households) and public sources (government). Public capital consists of government-owned assets such as sewage lines, roads, dams, power plants, canals, market sheds, etc. Private capital refers to the assets owned by private individuals or companies, such as farm machinery and other farm equipment. In order to develop agricultural sector, both public and private capital is required. During the green revolution and afterwards, both public and private capital formation contributed significantly to the growth of the agricultural sector. Infrastructure for irrigation, roads, and power has always been supported by public investment. The long-term lending by the formal financial institutions helped build up the private capital formation in irrigation facilities and other farm equipment. Since private investment is limited and focused on short-term gains, public investment is essential to create long-term capital. As new technological inputs become more capital intensive, the lack of capital has been a critical barrier to their adoption. Supply responses to structural reforms in agriculture are dependent on the country's level of agricultural development. Without adequate agricultural infrastructure like roads, irrigation, power, telecommunications, appropriate technologies, credit, farmer education, and a guarantee of inputs at the right price, public policy may not prove to be as effective.

7.1.1 Estimation of Long Term\Short Term Direct Credit and Capital Formation

MODEL: 7.1

LOG (PCF) = α_0+ α_1 LOG (LDC) +μ_1

Dependent Variable: Private Capital Formation in Agriculture (PCF)

Independent Variable: Long Term Direct Credit to Agriculture (LDC)

Table 7.1: Impact of Long Term Direct Credit on Private Capital Formation (1991-2014)

Dependent Variable: LOG(PCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.847967	0.154518	50.79002	0.0000
LOG(LDC)	0.323573	0.015774	20.51370	0.0000

Source: Author's Own Calculation

LOG (PCF) = 7.847967 + 0.323573 (LDC)

$R^2 = 0.95$

F-statistic = 420.8118

Prob(F-statistic) = 0.0000

Durbin-Watson stat = 1.98

The regression coefficient of LDC is positive. Data indicate that private capital formation increases to a 0.32 percent in the agricultural sector for every one percent increase in long-term direct credit. It means long term direct credit is having a positive impact on private capital formation. The R^2 value is 0.95, which demonstrates that 95 percent of variability in total private capital formation is explained by long-term direct credit (the independent variable). F test results indicate that the model is highly significant, F = 420.8118 at sig F = 0.00. T-statistics indicates the individual level regression coefficient for the independent variable is statistically significant.

MODEL: 7.2

$LOG\ (TDC) = \alpha_0 + \alpha_1\ LOG\ (LDC) + \alpha_2\ LOG\ (SDC) + \mu_1$

Dependent Variable: Total Direct Credit to Agriculture (TDC)

Independent Variable: Long Term Direct Credit to Agriculture (LDC)

Independent Variable: Short Term Direct Credit to Agriculture (SDC)

Table 7.2: Association among Short Term Direct Credit, Long Term Direct Credit and Total Direct Credit to Agriculture (1991-2014)

Dependent Variable: LOG(TDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.693329	0.013104	52.90788	0.0000
LOG(LDC)	0.399578	0.008412	47.50031	0.0000
LOG(SDC)	0.599456	0.007234	82.87127	0.0000

Source: Author's Own Calculation

LOG (TDC) = 0.693 + 0.399 (LDC) + 0.599 (SDC)

$R^2 = 0.999979$

F-statistic = 511203.1

Prob(F-statistic)= 0.000000

Durbin-Watson stat = 1.981392

The results of the estimation of regression summarized above indicate that total direct credit, long term direct credit, and short term direct credit all relate positively in the agricultural sector. According to the results of the coefficient, total direct credit is more positively related to short-term direct credit. In the analysis, it is shown that long term and short term direct credit are statistically significant at a 5 percent level. The R^2 value is 0.99, showing that the independent variables account for 99 percent of the variation in total direct credit. The coefficient of LOG(SDC) shows that a one percent increase in short term direct credit leads to a 0.59 percent increase in total direct credit to the agricultural sector. The estimated coefficient of long term direct credit LOG(LDC) is 0.399. This coefficient value indicates that a one percent increase in long term direct credit leads to a 0.399 percent increase in total direct credit to the agricultural sector.

MODEL: 7.3

$LOG\ (TCF) = \alpha_0 + \alpha_1\ LOG\ (PCF) + \alpha_2\ LOG\ (PBCF) + \mu_1$

Dependent Variable: Total Capital Formation (TCF)

Independent Variable: Private Capital Formation (PCF)

Independent Variable: Public Capital Formation (PBCF)

Table 7.3: Capital Formation in Agriculture: Contribution from Public and Private Sources (1991-2014)

Dependent Variable: LOG(TCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.498466	0.071128	7.007960	0.0000
LOG(PCF)	0.789786	0.006147	128.4792	0.0000
LOG(PBCF)	0.212576	0.012341	17.22521	0.0000

Source: Author's Own Calculation

LOG (TCF) = 0.498 + 0.789 (PCF) + 0.212(PBCF)

R^2 = 0.999724

F-statistic = 38076.66

Prob(F-statistic)= 0.000000

Durbin-Watson stat = 1.847054

As can be seen from above table, different variables used as explanatory variables are having significant relation among them. The coefficient value of private capital formation (PCF) is 0.789. It indicates a one percent change in private capital formation (PCF) leads to a 0.78 percent increase in total capital formation (TCF). The coefficient value of public capital formation (PBCF) is 0.212. It indicates a one percent change in public capital formation (PBCF) leads to a 0.21percent increase in total capital formation (TCF). From the value of F-statistics and Prob(F-statistic) in the above table, it is clear that the overall model is significant. A t-test for the significance of each explanatory variable within the model also indicates significant independent variables with a significance level of 0.95. As can be seen from the above regression result, the coefficient of determination is 0.99.

MODEL: 7.4

LOG (PCF) = α_0+ α_1 LOG (LDC) + α_2 LOG ($PBCF_{t-1}$) + μ_1

Dependent Variable: Private Capital Formation (PCF)

Independent Variable: Long term direct credit (LDC)

Independent Variable: Public Capital Formation one year lag ($PBCF_{t-1}$)

Table 7.4: A Comparison of the Impact of Public Capital Formation and Long Term Direct Credit on Private Capital Formation (1991-2014)

Dependent Variable: LOG(PCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.751657	1.677085	4.622102	0.0001
LOG(LDC)	0.321891	0.033330	9.657698	0.0000
LOG($PBCF_{t-1}$)	0.011628	0.201578	0.057684	0.9545

Source: Author's Own Calculation

LOG (PCF) = 7.751+ 0.321 (LDC) + 0.011 ($PBCF_{t-1}$)

R^2 *= 0.950325*

F-statistic = 200.8755

Prob(F-statistic)= 0.000000

Durbin-Watson stat = 1.992732

In the above regression model, private capital formation (PCF) or private agriculture investment are regressed on long term direct credit and public capital formation (Public investment in agriculture). From the coefficient of explanatory variables, it is clear that long term direct credit that is provided by commercial banks is a critical determinant of private

agriculture investment or private capital formation. The value of the coefficient of public capital formation one year lag ($PBCF_{t-1}$) is 0.011. It indicates that the elasticity of private capital formation with respect to long term direct credit is only about 0.011 means one percent change in public investment leads to only a 0.011 percent increase in private capital formation in the agricultural sector. It means the level of the previous year public capital formation or public investment increases the present year's private investment. The above results underline an important observation that institutional credit, especially long-term direct credit, significantly influences private capital formation. The value of the coefficient of Long term credit (LDC) is 0.321. It demonstrates a positive association between long-term credit and private capital formation. According to the results of the t-test, only long-term credit (independent variable) is significant at the 5-percent significance level. An R^2 value of 0.95 indicates that independent variables account for 95 percent of the variation in total private capital formation.

The results show that there is a direct relationship between long term direct credit and private capital formation in the agriculture sector from 1991 to 2014, as well as a strong positive and significant association between private capital formation and direct credit. Therefore, this implies that most of the farmers in the agricultural sector are largely dependent and supported by long-term investment resources, specifically loans from commercial banks. However, we must acknowledge the role that public capital formation plays in the agriculture sector. It is actually the public investment in rural infrastructure, particularly irrigation and land development, which provides the basic support for agricultural development. Many empirical studies, such as Chakarbarty(1987), Shetty(1999), Storm(1993), Krishnamurthy(1985), Dhawan(1996), etc, support and favour the notion that public investments encourage private investments in the Indian agriculture sector.

7.2 Growth Rates of Capital Formation and Direct Credit in Agriculture

MODEL: 7.5

LOG (PCF) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Private Capital Formation (PCF)

Independent Variable: Time (1991-2014)

Table 7.5: Growth Rate of Private Capital Formation both Instantaneous and Compound (1991-2014)

Dependent Variable: LOG(PCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.17337	0.049492	205.5576	0.0000
TIME	0.064957	0.003464	18.75361	0.0000
R-squared	0.941129	F-statistic		351.6979
Adjusted R-squared	0.938453	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.628401	**Instantaneous rate of growth**		**6.49**
Anti-Log(α_1)	1.0671131	**Compound rate of growth**		**6.71**

Source: Author's Own Calculation

The result reveals what is presented in the table above that the private capital formation in the agriculture sector is increasing significantly at a rate of 6.49 percent per annum and the compound rate of growth is 6.71 percent during the period 1991 to 2014. The value of the coefficient of determination is quite high i.e. 0.94. The F-value in this regression equation is quite significant which also indicate the significance of the explanatory variable.

MODEL: 7.6

LOG (PCF) = α_0+ α_1 t + μ_1

Dependent Variable: Private Capital Formation (PCF)

Independent Variable: Time (1991-2000)

Table 7.6: Growth Rate of Private Capital Formation both Instantaneous and Compound (1991-2000)

Dependent Variable: LOG(PCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.30218	0.036576	281.6637	0.0000
TIME	0.042830	0.005895	7.265813	0.0001
R-squared	0.868404	F-statistic		52.79204
Adjusted R-squared	0.851954	Prob(F-statistic)		0.000087
Durbin-Watson stat	2.502348	**Instantaneous rate of growth**		**4.28**

Anti-Log(α_1)	1.0437604	**Compound rate of growth**	**4.37**

Source: Author's Own Calculation

The table above shows the compound and instantaneous rate of growth of private capital formation in agriculture from 1991 to 2000. According to the results, private capital formation increased significantly at a rate of 4.28 percent per annum and the compound growth rate is 4.37 percent in agriculture sector during the first 10 years of the post-reform period.

MODEL: 7.7

LOG (PCF) = α_0+ α_1 t + μ_1

Dependent Variable: Private Capital Formation (PCF)

Independent Variable: Time (2000-2010)

Table 7.7: Growth Rate of Private Capital Formation both Instantaneous and Compound (2000-2010)

Dependent Variable: LOG(PCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.601765	0.105331	91.15813	0.0000
TIME	0.102808	0.006871	14.96247	0.0000
R-squared	0.961353	F-statistic		223.8756
Adjusted R-squared	0.957059	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.369721	**Instantaneous rate of growth**		**10.28**
Anti-Log(α_1)	1.1082786	**Compound rate of growth**		**10.82**

Source: Author's Own Calculation

The above result shows a significant and positive growth of private capital formation during the span of 10 years. Based on the results, it is clear that private capital formation increases at a rate of 10.28 percent per annum, significant at 5 percent level. Using regression analysis, we visualized that the compound growth rate of private capital formation is 10.82 percent during the period 2000 to 2010.

MODEL: 7.8

LOG (PBCF) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Public Capital Formation (PBCF)

Independent Variable: Time (1991-2014)

Table 7.8: Growth Rate of Public Capital Formation both Instantaneous and Compound (1991-2014)

Dependent Variable: LOG(PBCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.343164	0.058034	160.9941	0.0000
TIME	0.027376	0.004062	6.740380	0.0000
R-squared	0.673749	F-statistic		45.43273
Adjusted R-squared	0.658919	Prob(F-statistic)		0.000001
Durbin-Watson stat	1.626726	**Instantaneous rate of growth**		**2.73**
Anti-Log(α_1)	1.0277542	**Compound rate of growth**		**2.77**

Source: Author's Own Calculation

The results presented in the table above reveals that the public capital formation is increasing significantly at a rate of 2.73 percent per annum during the period 1991 to 2014. During the said period, the compound growth rate of public capital formation was 2.77 percent. The result indicates that the coefficient of determination is low i.e. 0.67. F statistics demonstrate that the overall model is statistically significant.

MODEL: 7.9

LOG (PBCF) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Public Capital Formation (PBCF)

Independent Variable: Time (1991-2000)

Table 7.9: Growth Rate of Public Capital Formation both Instantaneous and Compound (1991-2000)

Dependent Variable: LOG(PBCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.487733	0.056729	167.2455	0.0000

TIME	-0.003760	0.009143	-0.411201	0.6917
R-squared	0.720698	F-statistic		47.169087
Adjusted R-squared	0.691714	Prob(F-statistic)		0.00000
Durbin-Watson stat	1.807342	**Instantaneous rate of growth**		**-0.376**
Anti-Log(α_1)	0.996247059	**Compound rate of growth**		**-0.3752**

Source: Author's Own Calculation

The result in the above table reveals the falling share of public capital formation in the agriculture sector during the period 1991 to 2000. During the first decade of economic reforms, capital formation by the public sector fell at a rate of 0.376 percent per annum because the government paid more attention to the industrial sector. The decline in public investment in the agricultural sector has had a serious impact on agricultural growth in the long term. These findings have also been confirmed by earlier studies Purohit and Reddy, 1999; Gulati and Bathla, 2002. The Indian agricultural sector experienced significant drops in public investments primarily because resources were allocated towards subsidies for irrigation, credit, fertilizers, electricity, and other inputs instead of investment on fixed assets.

MODEL: 7.10

LOG (PBCF) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Public Capital Formation (PBCF)

Independent Variable: Time (2000-2010)

Table 7.10: Growth Rate of Public Capital Formation both Instantaneous and Compound (2000-2010)

Dependent Variable: LOG(PBCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.865181	0.185045	47.90833	0.0000
TIME	0.061476	0.012071	5.092915	0.0007
R-squared	0.742399	F-statistic		25.93778
Adjusted R-squared	0.713777	Prob(F-statistic)		0.000651
Durbin-Watson stat	1.266784	**Instantaneous rate of growth**		**6.14**
Anti-Log(α_1)	1.063404974	**Compound rate of growth**		**6.34**

Source: Author's Own Calculation

The figures presented in the table above reveals that the public capital formation increased significantly at a rate of 6.14 percent per annum during the period 2000 to 2010. During the said period, the compound growth rate of public capital formation was 6.34 percent. The result indicates that the value of R-squared is 0.74. Overall, the model is statistically significant, as shown by F statistics.

MODEL: 7.11

LOG (TCF) = α_0+ α_1 t + μ_1

Dependent Variable: Total Capital Formation (TCF)

Independent Variable: Time (1991-2014)

Table 7.11: Growth Rate of Total Capital Formation both Instantaneous and Compound (1991-2014)

Dependent Variable: LOG(TCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.52027	0.046552	225.9886	0.0000
TIME	0.057051	0.003258	17.51107	0.0000
R-squared	0.933057	F-statistic		306.6377
Adjusted R-squared	0.930014	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.433277	**Instantaneous rate of growth**		**5.70**
Anti-Log(α_1)	1.0587	**Compound rate of growth**		**5.87**

Source: Author's Own Calculation

It is quite understandable from the results mentioned in the above table that gross capital formation in the agricultural sector increased significantly at a rate of 5.7 percent per annum during the entire study period. A compound growth rate of 5.87 percent was seen in gross capital formation for the period. The result indicates a high coefficient of determination, i.e. 0.93. The F statistics indicate that the model as a whole is statistically significant.

MODEL: 7.12

LOG (TCF) = α_0+ α_1 t + μ_1

Dependent Variable: Total Capital Formation (TCF)

Independent Variable: Time (1991-2000)

Table 7.12: Growth Rate of Total Capital Formation both Instantaneous and Compound (1991-2000)

Dependent Variable: LOG(TCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.66327	0.027913	382.0243	0.0000
TIME	0.031232	0.004499	6.942741	0.0001
R-squared	0.857655	F-statistic		48.20166
Adjusted R-squared	0.839862	Prob(F-statistic)		0.000119
Durbin-Watson stat	2.651140	**Instantaneous rate of growth**		**3.12**
Anti-Log(α_1)	1.0317248	**Compound rate of growth**		**3.17**

Source: Author's Own Calculation

The above table depicts the growth rate of Indian agriculture's gross capital formation. The result shows that there is a significant positive trend of gross capital formation during the period under consideration. The rate of increase was 3.12 percent per year at the significance of five percent significant level. The compound growth rate of gross capital formation is 3.17 percent. The obtained R-squared and F-statistic are satisfactory in this regression model.

MODEL: 7.13

LOG (TCF) = α_0+ α_1 t + μ_1

Dependent Variable: Total Capital Formation (TCF)

Independent Variable: Time (2000-2010)

Table 7.13: Growth Rate of Total Capital Formation both Instantaneous and Compound (2000-2010)

Dependent Variable: LOG(TCF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.84516	0.064301	168.6633	0.0000
TIME	0.075202	0.009481	7.932152	0.0000
R-squared	0.874859	F-statistic		62.91904
Adjusted R-squared	0.860955	Prob(F-statistic)		0.000024

Durbin-Watson stat	1.322178	**Instantaneous rate of growth**	**7.52**
Anti-Log(α_1)	1.078101	**Compound rate of growth**	**7.81**

Source: Author's Own Calculation

The agricultural sector has experienced tremendous growth in total capital formation from 2000 to 2010. Both the instantaneous and compound growth rates have been exceptional as per the analysis presented in the above table. A regression analysis indicates agricultural capital formation is increasing at a compound annual rate of 7.81 percent. The above estimates indicate an increase of 7.52 percent in agricultural capital formation per year.

MODEL: 7.14

LOG (LDC) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Long Term Direct Credit (LDC)

Independent Variable: Time (1991-2014)

Table 7.14: Growth Rate of Long Term Direct Credit both Instantaneous and Compound (1991-2014)

Dependent Variable: LOG(LDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.227331	0.125221	57.71656	0.0000
TIME	0.197493	0.008764	22.53551	0.0000
R-squared	0.958479	F-statistic		507.8491
Adjusted R-squared	0.956591	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.389199	**Instantaneous rate of growth**		**19.74**
Anti-Log(α_1)	1.21834453	**Compound rate of growth**		**21.83**

Source: Author's Own Calculation

The coefficient of time is positive and is significant at 5 percent level. The results of instantaneous and compound growth rate shows a significant positive trend of long term direct credit supplied by commercial banks towards the agriculture sector during the entire study period. The regression model depicts that the compound growth rate of long term agricultural credit is 21.83 percent. Further, the result shows that long term credit increased at a rate of 19.74 percent per annum significant at 5 percent level. The coefficient of

determination is 0.95 here, so 95 percent of the variation in the dependent variable can be accounted for by the independent variable. F test results indicate significant significance for the overall model, F=507.84 at sig F=0.00.

MODEL: 7.15

LOG (LDC) = α_0+ α_1 t + μ_1

Dependent Variable: Long Term Direct Credit (LDC)

Independent Variable: Time (1991-2000)

Table 7.15: Growth Rate of Long Term Direct Credit both Instantaneous and Compound (1991-2000)

Dependent Variable: LOG(LDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.658637	0.103997	73.64299	0.0000
TIME	0.126424	0.016761	7.542926	0.0001
R-squared	0.876725	F-statistic		56.89573
Adjusted R-squared	0.861316	Prob(F-statistic)		0.000067
Durbin-Watson stat	1.227983	**Instantaneous rate of growth**		**12.64**
Anti-Log(α_1)	1.13476320	**Compound rate of growth**		**13.47**

Source: Author's Own Calculation

The estimation of regression revealed that instantaneous and compound growth rate shows a significant positive trend of long term direct credit supplied by commercial banks towards the agriculture sector during the period 1991 to 2000. According to the regression model, agricultural credits have experienced compound growth of 13.47 percent. Additionally, the result reveals that long term credit increases 12.46 percent annually. This model is significant according to the F test.

MODEL: 7.16

LOG (LDC) = α_0+ α_1 t + μ_1

Dependent Variable: Long Term Direct Credit (LDC)

Independent Variable: Time (2000-2010)

Table 7.16: Growth Rate of Long Term Direct Credit both Instantaneous and Compound (2000-2010)

Dependent Variable: LOG(LDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.765784	0.364157	15.83325	0.0000
TIME	0.287096	0.023755	12.08571	0.0000
R-squared	0.941960	F-statistic		146.0644
Adjusted R-squared	0.935511	Prob(F-statistic)		0.000001
Durbin-Watson stat	1.726602	**Instantaneous rate of growth**		**28.70**
Anti-Log(α_1)	1.3325521	**Compound rate of growth**		**33.25**

Source: Author's Own Calculation

During the period 2000 to 2010, the estimated rate of growth of long term direct credit provided by commercial banks to the agricultural sector showed a significant positive trend in both instantaneous and compound growth rates. Based on the regression model, agricultural credits have experienced a compound growth of 33.25 percent. In addition, the results from the above estimation reveal that the long term credit increased at 28.70 percent on average a year.

MODEL: 7.17

LOG (SDC) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Short Term Direct Credit (SDC)

Independent Variable: Time (1991-2014)

Table 7.17: Growth Rate of Short Term Direct Credit both Instantaneous and Compound (1991-2014)

Dependent Variable: LOG(SDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.198966	0.069057	104.2475	0.0000
TIME	0.233494	0.004833	48.31296	0.0000
R-squared	0.990663	F-statistic		2334.142
Adjusted R-squared	0.990238	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.508578	**Instantaneous rate of growth**		**23.34**
Anti-Log(α_1)	1.263005	**Compound rate of growth**		**26.30**

Source: Author's Own Calculation

In the above table, the instantaneous and compound growth rates for short term direct credit from commercial banks to the agriculture sector over the period 1991 to 2014 are presented. The coefficient of independent variable is positive and significant. The value of estimated

coefficient is 0.233. It indicates that there has been a significant, 23.34 percent growth in the flow of short term credit from commercial banks to the agricultural sector since 1991 to 2014. The regression model indicates the short term agricultural credit growth is 26.30 percent.

MODEL: 7.18

LOG (SDC) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Short Term Direct Credit (SDC)

Independent Variable: Time (1991-2000)

Table 7.18: Growth Rate of Short Term Direct Credit both Instantaneous and Compound (1991-2000)

Dependent Variable: LOG(SDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.502264	0.037968	197.5953	0.0000
TIME	0.180897	0.006119	29.56280	0.0000
R-squared	0.990929	F-statistic		873.9588
Adjusted R-squared	0.989795	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.856558	**Instantaneous rate of growth**		**18.08**
Anti-Log(α_1)	1.2630052	**Compound rate of growth**		**26.30**

Source: Author's Own Calculation

The above regression analysis revealed that the short term direct credit supplied by commercial banks to the agriculture sector over the period 1991-2000 has a significant upward trend in the instantaneous and compound growth rates. According to the regression model agriculture credits have experienced a compound growth rate of 26.30 percent. Further, the result demonstrates that short term credit increases 18.08 percent annually.

MODEL: 7.19

LOG (SDC) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Short Term Direct Credit (SDC)

Independent Variable: Time (2000-2010)

Table 7.19: Growth Rate of Short Term Direct Credit both Instantaneous and Compound (2000-2010)

Dependent Variable: LOG(SDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	6.458981	0.145094	44.51583	0.0000
TIME	0.278571	0.009465	29.43201	0.0000
R-squared	0.989717	F-statistic		866.2434
Adjusted R-squared	0.988575	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.890327	**Instantaneous rate of growth**		**27.85**
Anti-Log(α_1)	1.3212404	**Compound rate of growth**		**32.12**

Source: Author's Own Calculation

Regression analysis showed significant increasing trend in instantaneous and compound growth rates over the period 2000-2010 in short-term direct credits provided by commercial banks to the agriculture sector. Regression analysis suggests that agricultural credits have seen a compound growth rate of 32.12 percent. The result of the study demonstrates that short-term credit increased at a rate of 27.85 percent per annum.

MODEL: 7.20

LOG (TDC) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Total Direct Credit (TDC)

Independent Variable: Time (1991-2014)

Table 7.20: Growth Rate of Total Direct Credit both Instantaneous and Compound (1991-2014)

Dependent Variable: LOG(TDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.897310	0.089786	87.95679	0.0000
TIME	0.218833	0.006284	34.82528	0.0000
R-squared	0.982183	F-statistic		1212.800
Adjusted R-squared	0.981374	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.391705	**Instantaneous rate of growth**		**21.88**
Anti-Log(α_1)	1.2446234	**Compound rate of growth**		**24.46**

Source: Author's Own Calculation

Above table presents details about the growth of total direct credit flow from commercial banks to the agricultural sector from 1991 to 2014. Direct credit to the agricultural sector comprises short term, medium-term and long term credit given for agriculture and allied activities to the individual farmer. A perusal of the above table revealed that the direct credit flow increased at a rate of 21.88 percent during 1991 to 2014. During the study period, the

compound rate of growth for direct credit was 24.46 percent. In addition, the value of the coefficient of determination is quite high i.e. 0.98. The value of F- statistic is satisfactory; it indicates that the overall estimated regression model is significant at 5 percent significance level.

MODEL: 7.21

LOG (TDC) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Total Direct Credit (TDC)

Independent Variable: Time (1991-2000)

Table 7.21: Growth Rate of Total Direct Credit both Instantaneous and Compound (1991-2000)

Dependent Variable: LOG(TDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.263029	0.060341	136.9399	0.0000
TIME	0.156865	0.009725	16.13043	0.0000
R-squared	0.970170	F-statistic		260.1907
Adjusted R-squared	0.966442	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.433659	**Instantaneous rate of growth**		**15.68**
Anti-Log(α_1)	1.16983767	**Compound rate of growth**		**16.98**

Source: Author's Own Calculation

In the estimation of regression, it was observed that total direct credit provided by commercial banks towards the agricultural sector during the period 1991 to 2000 trend in a positive way, both with instantaneous and compound growth. Statistics show that the total direct agricultural credit has increased by 16.98 percent over the study period. Also, the result indicates that the total direct credit goes up 15.68 percent per annum.

MODEL: 7.22

LOG (TDC) = $\alpha_0 + \alpha_1 t + \mu_1$

Dependent Variable: Total Direct Credit (TDC)

Independent Variable: Time (2000-2010)

Table 7.22: Growth Rate of Total Direct Credit both Instantaneous and Compound (2000-2010)

Dependent Variable: LOG(TDC)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	6.865262	0.215647	31.83563	0.0000
TIME	0.281704	0.014067	20.02549	0.0000
R-squared	0.978050	F-statistic		401.0203
Adjusted R-squared	0.975611	Prob(F-statistic)		0.000000
Durbin-Watson stat	1.072885	**Instantaneous rate of growth**		**28.17**
Anti-Log(α_1)	1.32538634	**Compound rate of growth**		**32.53**

Source: Author's Own Calculation

From 2000 to 2010, both the instantaneous and compound growth rates of total direct credit provided by commercial banks to the agricultural sector increased significantly. The regression model shows that the total direct credit has a compound growth rate of 32.53 percent. Moreover, the above estimation shows that direct credit increases at a rate of 28.17 percent annually.

7.3 Causal Relationship among Credit, Capital Formation and Agricultural Growth

MODEL: 7.23

$$TDC_t = \sum_{i=1}^{n} a_i TCF_{t-i} + \sum_{j=1}^{m} b_j TDC_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$TCF_t = \sum_{i=1}^{n} c_i TDC_{t-i} + \sum_{j=1}^{m} d_j TCF_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
TDC= Total Direct Credit to Agriculture by Commercial Banks
TCF = Total Capital Formation
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.23: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(TDC) does not Granger Cause LOG(TCF)	2	11.1679	0.0032	Ho: Rejected
Case 2	LOG(TCF) does not Granger Cause LOG(TDC)	2	0.13611	0.7161	Ho: Accepted

Source: Author's Own Calculation

In the above table, the pair wise granger causality results between total direct credit and total capital formation are presented. The Null hypothesis: Total direct credit does not granger cause total capital formation is rejected because estimated F-statistics is significant at five percent significance level. On the other hand, Null hypothesis: the total capital formation does not granger cause total direct credit is accepted, because the F-value is statistically insignificant. The result indicates that there exists a unidirectional Granger causality between total direct credit and total capital formation and causality runs from total direct credit to total capital formation. It means in India total capital formation n agriculture sector increases with the increase in total direct credit provided by commercial banks to the agriculture sector.

MODEL: 7.24

$$IDC_t = \sum_{i=1}^{n} a_i TCF_{t-i} + \sum_{j=1}^{m} b_j IDC_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$TCF_t = \sum_{i=1}^{n} c_i IDC_{t-i} + \sum_{j=1}^{m} d_j TCF_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
IDC= Indirect Credit to Agriculture by Commercial Banks
TCF = Total Capital Formation
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.24: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(IDC) does not Granger Cause LOG(TCF)	2	4.58600	0.0447	Ho: Rejected
Case 2	LOG(TCF) does not Granger Cause LOG(IDC)	2	0.55437	0.4652	Ho: Accepted

Source: Author's Own Calculation

The above table presents the pair-wise Granger causality results of indirect credit and total capital formation. Because the F-statistics estimate is significant at five percent significance level, the Null hypothesis: indirect credit does not granger cause total capital formation is

rejected. In case 2, the Null hypothesis: total capital formation does not granger cause indirect credit is accepted because the F-value is statistically insignificant. According to the results, the causality between indirect credit and total capital formation is unidirectional. Causality runs from indirect credit to total capital formation. Therefore, indirect credit provided to the agriculture sector by commercial banks raises the total capital formation in India.

MODEL: 7.25

$$TDC_t = \sum_{i=1}^{n} a_i PCF_{t-i} + \sum_{j=1}^{m} b_j TDC_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$PCF_t = \sum_{i=1}^{n} c_i TDC_{t-i} + \sum_{j=1}^{m} d_j PCF_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
TDC= Total Direct Credit to Agriculture by Commercial Banks
PCF = Private Capital Formation
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.25: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(PCF) does not Granger Cause LOG(TDC)	2	2.29959	0.1451	Ho: Accepted
Case 2	LOG(TDC) does not Granger Cause LOG(PCF)	2	7.78208	0.0113	Ho: Rejected

Source: Author's Own Calculation

A pair wise Granger causality analysis of private capital formation and total direct credit is presented in the above table. In case 1, the F-statistics estimate is insignificant, therefore the Null hypothesis: private capital formation does not granger cause total direct credit is accepted. In case 2, the Null hypothesis: total direct credit does not granger cause private capital formation is rejected because the F-value is statistically significant. The causality between private capital formation and total direct credit is unidirectional, based on the results.

Causality runs from total direct credit to private capital formation. In this way, total direct lending to the agriculture sector by commercial banks contributes to the growth of private capital formation in agricultural sector in India.

MODEL: 7.26

$$PBCF_t = \sum_{i=1}^{n} a_i PCF_{t-i} + \sum_{j=1}^{m} b_j PBCF_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$PCF_t = \sum_{i=1}^{n} c_i PBCF_{t-i} + \sum_{j=1}^{m} d_j PCF_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
PBCF = Public Capital Formation in Agriculture
PCF = Private Capital Formation in Agriculture
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.26: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(PBCF) does not Granger Cause LOG(PCF)	2	0.64565	0.0431	Ho: Rejected
Case 2	LOG(PCF) does not Granger Cause LOG(PBCF)	2	3.18039	0.0897	Ho: Accepted

Source: Author's Own Calculation

A pair-wise Granger causality analysis of public and private capital formation is shown in the above table. In light of the F-statistics estimate being significant at a five percent significance level, the Null hypothesis: public capital formation does not granger cause private capital formation is rejected. On the other hand, the Null hypothesis: private capital formation does not granger cause public capital formation is accepted because the F-value is statistically insignificant. As shown in the above table, the causality between public capital formation and private capital formation is unidirectional. Causality extends from public capital formation to private capital formation. As a result, Indian agriculture's public capital formation raises private capital formation.

MODEL: 7.27

$$IDC_t = \sum_{i=1}^{n} a_i PCF_{t-i} + \sum_{j=1}^{m} b_j IDC_{t-j} + \mu_{1t} \text{ -------(1)}$$

$$PCF_t = \sum_{i=1}^{n} c_i IDC_{t-i} + \sum_{j=1}^{m} d_j PCF_{t-j} + \mu_{2t} \text{ ----------(2)}$$

Where:
IDC= Indirect Credit to Agriculture by Commercial Banks
PCF = Private Capital Formation
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.27: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(IDC) does not Granger Cause LOG(PCF)	2	4.39821	0.0489	Ho: Rejected
Case 2	LOG(PCF) does not Granger Cause LOG(IDC)	2	1.12993	0.3005	Ho: Accepted

Source: Author's Own Calculation

The table above presents pair-wise Granger causality results of indirect credit and private capital formation. As the F-statistics estimate is significant at a five percent significance level, the Null hypothesis: indirect credit does not granger cause private capital formation is rejected. Furthermore, the Null hypothesis: private capital formation does not granger cause indirect credit is accepted because the F-value is statistically insignificant. The causality between indirect credit and private capital formation is unidirectional, according to the results. Causality flows from indirect credit to private capital formation. Thus, indirect credit provided to the agricultural sector by commercial banks raises private capital formation in India.

MODEL: 7.28

$$TCF_t = \sum_{i=1}^{n} a_i PVAGR_{t-i} + \sum_{j=1}^{m} b_j TCF_{t-j} + \mu_{1t} \text{ -------(1)}$$

$$PVAGR_t = \sum_{i=1}^{n} c_i TCF_{t-i} + \sum_{j=1}^{m} d_j PVAGR_{t-j} + \mu_{2t} \text{ ----------(2)}$$

Where:
TCF= Total Capital Formation
PVAGR = Agricultural Advances by Private Commercial Banks
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.28: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(TCF) does not Granger Cause LOG(PVAGR)	2	0.15542	0.6976	Ho: Accepted
Case 2	LOG(PVAGR) does not Granger Cause LOG(TCF)	2	5.87003	0.0250	Ho: Rejected

Source: Author's Own Calculation

As shown in the above table, a Granger causality analysis is conducted on total capital formation and agricultural credit by private commercial banks. Since the F-statistics estimate is insignificant, therefore the Null hypothesis: total capital formation does not granger cause agricultural credit by private commercial banks is accepted. The Null hypothesis: agricultural credit by private commercial banks does not granger cause total capital formation is rejected because the F-value is statistically significant. The causality between total capital formation and agricultural credit by private commercial banks is unidirectional. The direction of causality runs from agricultural credit by private commercial banks to total capital formation. In this way, credit by private sector commercial banks to the agriculture sector contributes to the growth of total capital formation in India.

MODEL: 7.29

$$PCF_t = \sum_{i=1}^{n} a_i PVAGR_{t-i} + \sum_{j=1}^{m} b_j PCF_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$PVAGR_t = \sum_{i=1}^{n} c_i PCF_{t-i} + \sum_{j=1}^{m} d_j PVAGR_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
PCF= Private Capital Formation
PVAGR = Agricultural Advances by Private Commercial Banks
a,b,c,d = *Sensitivity coefficient,*

U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.29: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(PCF) does not Granger Cause LOG(PVAGR)	2	0.35038	0.5605	Ho: Accepted
Case 2	LOG(PVAGR) does not Granger Cause LOG(PCF)	2	5.12503	0.0349	Ho: Rejected

Source: Author's Own Calculation

The above table shows a Granger causality analysis conducted on private capital formation and agricultural credit lent by private sector commercial banks. As the F-statistic is insignificant in case 1, therefore, the Null hypothesis: private capital formation does not granger cause agricultural credit by private commercial banks is accepted. In case 2, the Null hypothesis: agricultural credit by private commercial banks does not granger cause private capital formation is rejected because the F-value is statistically significant. Based on the results, the causality between private capital formation and agricultural credit by private commercial banks is one way. Causality runs from agricultural credit by private commercial banks to private capital formation. As a result, the extension of credit from private sector commercial banks to the agriculture sector facilitates the growth of private capital formation in India.

MODEL: 7.30

$$TCF_t = \sum_{i=1}^{n} a_i PBAGR_{t-i} + \sum_{j=1}^{m} b_j TCF_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$PBAGR_t = \sum_{i=1}^{n} c_i TCF_{t-i} + \sum_{j=1}^{m} d_j PBAGR_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
TCF= Total Capital Formation
PBAGR = Agricultural Advances by Public Commercial Banks
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.30: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(TCF) does not Granger Cause LOG(PBAGR)	2	0.32926	0.5725	Ho: Accepted
Case 2	LOG(PBAGR) does not Granger Cause LOG(TCF)	2	10.5232	0.0041	Ho: Rejected

Source: Author's Own Calculation

The above table demonstrates the causal relationship between total capital formation and agricultural credit by public sector commercial banks. As the F-statistic is insignificant, therefore, the Null hypothesis: total capital formation does not granger cause agricultural credit by public sector commercial banks is accepted. The Null hypothesis: agricultural credit by public sector commercial banks does not granger cause total capital formation is rejected because the F-value is statistically significant. Results indicate that there is one way causality between capital formation and agricultural credit by public sector commercial banks. Causality runs from agricultural credit by public sector commercial banks to total capital formation. As a result, credit extensions from public sector commercial banks to the agriculture sector help to expand total capital formation in the agriculture sector in India.

MODEL: 7.31

$$PCF_t = \sum_{i=1}^{n} a_i PBAGR_{t-i} + \sum_{j=1}^{m} b_j PCF_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$PBAGR_t = \sum_{i=1}^{n} c_i PCF_{t-i} + \sum_{j=1}^{m} d_j PBAGR_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
PCF= Private Capital Formation
PBAGR = Agricultural Advances by Public Commercial Banks
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.31: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision

Case 1	LOG(PCF) does not Granger Cause LOG(PBAGR)	2	1.90929	0.1823	Ho: Accepted
Case 2	LOG(PBAGR) does not Granger Cause LOG(PCF)	2	7.86053	0.0110	Ho: Rejected

Source: Author's Own Calculation

The table above shows the causal relationship between private capital formation and agricultural credit by public sector commercial banks. As the F-statistic is insignificant, therefore, the Null hypothesis: private capital formation does not granger cause agricultural credit by public sector commercial banks is accepted. On the other hand, the Null hypothesis: agricultural credit by public sector commercial banks does not granger cause private capital formation is rejected because the F-value is statistically significant. The results indicate that there is one way relationship between private capital formation and agricultural credit by public sector commercial banks. It indicates that an increase in agricultural advances by public sector commercial banks leads to higher rate of private capital formation in agriculture sector. Causality runs from agricultural credit by public sector commercial banks to private capital formation.

MODEL: 7.32

$$\boldsymbol{PCF_t} = \sum_{i=1}^{n} a_i SCBTA_{t-i} + \sum_{j=1}^{m} b_j PCF_{t-j} + \boldsymbol{\mu_{1t}} \quad \textbf{-------(1)}$$

$$\boldsymbol{SCBTA_t} = \sum_{i=1}^{n} c_i PCF_{t-i} + \sum_{j=1}^{m} d_j SCBTA_{t-j} + \boldsymbol{\mu_{2t}} \quad \textbf{----------(2)}$$

Where:
PCF= Private Capital Formation
SCBTA = Total Agricultural Advances by Scheduled Commercial Banks
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.32: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(PCF) does not Granger Cause LOG(SCBTA)	2	2.09604	0.1632	Ho: Accepted

Case 2	LOG(SCBTA) does not Granger Cause LOG(PCF)	2	7.65095	0.0119	Ho: Rejected

Source: Author's Own Calculation

The above table depicts the causal relationship between private capital formation and scheduled commercial banks' total advances. As a result of a insignificant F-statistic, the Null hypothesis: private capital formation does not granger cause scheduled commercial banks total advances is accepted. Because the F-value is statistically significant, the Null hypothesis: scheduled commercial banks total advances does not granger cause private capital formation is rejected. The results indicate that there is unidirectional causality between private capital formation and scheduled commercial banks total advances. Direction of causality runs from scheduled commercial banks total advances to private capital formation. Increasing agricultural advances by scheduled commercial banks causes the private capital formation to increase in the agriculture sector.

MODEL: 7.33

$$TCF_t = \sum_{i=1}^{n} a_i SCBTA_{t-i} + \sum_{j=1}^{m} b_j TCF_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$SCBTA_t = \sum_{i=1}^{n} c_i TCF_{t-i} + \sum_{j=1}^{m} d_j SCBTA_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
TCF= Total Capital Formation
SCBTA = Total Agricultural Advances by Scheduled Commercial Banks
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.33: Granger-Causality Test

Case	**Null Hypothesis**	**Lag**	**F-Statistic**	**Prob.**	**Decision**
Case 1	LOG(TCF) does not Granger Cause LOG(SCBTA)	2	0.25166	0.6214	Ho: Accepted
Case 2	LOG(SCBTA) does not Granger Cause LOG(TCF)	2	9.99369	0.0049	Ho: Rejected

Source: Author's Own Calculation

The table above illustrates the causal relationship between total capital formation and scheduled commercial banks' total advances. Due to the insignificant F-statistic, the Null hypothesis: total capital formation does not granger cause scheduled commercial banks total advances is accepted. Because the F-value is statistically significant, the Null hypothesis: scheduled commercial banks total advances does not granger cause total capital formation is rejected. The results indicate that there is unidirectional causality between total capital formation and scheduled commercial banks total advances. Direction of causality runs from scheduled commercial banks total advances to total capital formation. It indicates that an increase in agricultural advances by scheduled commercial banks leads to higher rate of total capital formation in agriculture sector.

MODEL: 7.34

$$AGDP_t = \sum_{i=1}^{n} a_i SCBTA_{t-i} + \sum_{j=1}^{m} b_j AGDP_{t-j} + \mu_{1t} \quad \text{-------(1)}$$

$$SCBTA_t = \sum_{i=1}^{n} c_i AGDP_{t-i} + \sum_{j=1}^{m} d_j SCBTA_{t-j} + \mu_{2t} \quad \text{----------(2)}$$

Where:
AGDP= Agricultural Gross Domestic Product
SCBTA = Total Agricultural Advances by Scheduled Commercial Banks
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.34: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(AGDP) does not Granger Cause LOG(SCBTA)	2	1.00847	0.3273	Ho: Accepted
Case 2	LOG(SCBTA) does not Granger Cause LOG(AGDP)	2	12.7308	0.0019	Ho: Rejected

Source: Author's Own Calculation

The above table shows the pair wise granger causality results between agricultural GDP and scheduled commercial banks' total advances. As the F-statistic is insignificant in case 1, the Null hypothesis: agricultural GDP does not granger cause scheduled commercial banks total

advances is accepted. Here in case 2, F-value is statistically significant, t the Null hypothesis: scheduled commercial banks total advances does not granger cause agricultural GDP is rejected. According to the results, agricultural GDP and scheduled commercial banks' total advances are causally linked in a unidirectional manner. The direction of causality runs from the total advances of commercial banks to agricultural GDP. It indicates that an increase in agricultural advances by scheduled commercial banks lead to the higher rate of agricultural GDP.

MODEL: 7.35

$$AGDP_t = \sum_{i=1}^{n} a_i TCF_{t-i} + \sum_{j=1}^{m} b_j AGDP_{t-j} + \mu_{1t} \text{ -------(1)}$$

$$TCF_t = \sum_{i=1}^{n} c_i AGDP_{t-i} + \sum_{j=1}^{m} d_j TCF_{t-j} + \mu_{2t} \text{ ----------(2)}$$

Where:
AGDP= Agricultural Gross Domestic Product
TCF = Total Capital Formation
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.35: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(AGDP) does not Granger Cause LOG(TCF)	2	3.76003	0.0667	Ho: Accepted
Case 2	LOG(TCF) does not Granger Cause LOG(AGDP)	2	6.08825	0.0309	Ho: Rejected

Source: Author's Own Calculation

In the above table, the pair wise granger causality results between agricultural GDP and total capital formation are presented. The Null hypothesis: agricultural GDP does not granger cause total capital formation is accepted because estimated F-statistics is insignificant at five percent significance level. On the other hand, the Null hypothesis: total capital formation does not granger cause agricultural GDP is rejected, because the F-value is also statistically significant. The result indicates that there exists unidirectional Granger causality between

agricultural GDP and total capital formation, the causality runs from total capital formation to agricultural GDP.

MODEL: 7.36

$$\boldsymbol{AGDP_t} = \sum_{i=1}^{n} a_i PBCF_{t-i} + \sum_{j=1}^{m} b_j AGDP_{t-j} + \boldsymbol{\mu_{1t}} \quad \textbf{-------(1)}$$

$$\boldsymbol{PBCF_t} = \sum_{i=1}^{n} c_i AGDP_{t-i} + \sum_{j=1}^{m} d_j PBCF_{t-j} + \boldsymbol{\mu_{2t}} \quad \textbf{----------(2)}$$

Where:
AGDP= Agricultural Gross Domestic Product
PBCF = Public Capital Formation
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.36: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(AGDP) does not Granger Cause LOG(PBCF)	2	1.59062	0.2218	Ho: Accepted
Case 2	LOG(PBCF) does not Granger Cause LOG(AGDP)	2	4.90783	0.0385	Ho: Rejected

Source: Author's Own Calculation

By using granger causality test it is confirmed from the results that there is one way causal relationship between agricultural GDP and public capital formation, causality run from public capital formation to agricultural GDP. There is no reverse causality from agricultural GDP to public capital formation. The analysis implies that an increase in public capital formation in agriculture would lead to a higher growth of agricultural GDP.

MODEL: 7.37

$$\boldsymbol{AGDP_t} = \sum_{i=1}^{n} a_i PCF_{t-i} + \sum_{j=1}^{m} b_j AGDP_{t-j} + \boldsymbol{\mu_{1t}} \quad \textbf{-------(1)}$$

$$\boldsymbol{PCF_t} = \sum_{i=1}^{n} c_i AGDP_{t-i} + \sum_{j=1}^{m} d_j PCF_{t-j} + \boldsymbol{\mu_{2t}} \quad \textbf{----------(2)}$$

Where:

AGDP= Agricultural Gross Domestic Product
PCF = Private Capital Formation
a,b,c,d = *Sensitivity coefficient,*
U = *Residual component,*
t = *Period of analysis*
i = *Number of variable delays*

Table 7.37: Granger-Causality Test

Case	Null Hypothesis	Lag	F-Statistic	Prob.	Decision
Case 1	LOG(AGDP) does not Granger Cause LOG(PCF)	2	0.49970	0.4878	Ho: Accepted
Case 2	LOG(PCF) does not Granger Cause LOG(AGDP)	2	4.83726	0.0342	Ho: Rejected

Source: Author's Own Calculation

The Granger causality test confirms that there is a one-way causal relationship between agricultural GDP and private capital formation, the causality runs from private capital formation to agricultural GDP. Based on the analysis, a boost in private capital formation in agriculture sector would contribute to a higher agricultural growth.

Summary of Results

Growth rate (Percentage)

Variable	1991-2000	2000-2010	1991-2014
PCF	4.28	10.28	6.49
PBCF	-0.376	6.14	2.73
TCF	3.12	7.52	5.70
LDC	12.64	28.70	19.74
SDC	18.08	27.85	23.34
TDC	15.68	28.17	21.88

Source: Author's Own Calculation

Impact of Independent variable on dependent variable

Dependent Variable	Independent Variable	Degree of Impact
PCF	LDC	0.323
TDC	SDC	0.599
TCF	PCF	0.789
TCF	PBCF	0.212
PCF	LDC	0.321
PCF	PBCF(I YEAR LAG)	0.011

Source: Author's Own Calculation

Summary of Causal Relationship

Sr. No.	Pair Wise Granger Causality	Direction
1	LOG(TDC) does not Granger Cause LOG(TCF)	Unidirectional
2	LOG(TCF) does not Granger Cause LOG(TDC)	TDC ⟶ TCF
3	LOG(IDC) does not Granger Cause LOG(TCF)	Unidirectional
4	LOG(TCF) does not Granger Cause LOG(IDC)	IDC ⟶ TCF
5	LOG(PCF) does not Granger Cause LOG(TDC)	Unidirectional
6	LOG(TDC) does not Granger Cause LOG(PCF)	TDC ⟶ PCF
7	LOG(PBCF) does not Granger Cause LOG(PCF)	Unidirectional
8	LOG(PCF) does not Granger Cause LOG(PBCF)	PBCF ⟶ PCF
9	LOG(IDC) does not Granger Cause LOG(PCF)	Unidirectional
10	LOG(PCF) does not Granger Cause LOG(IDC)	IDC ⟶ PCF

11	LOG(TCF) does not Granger Cause LOG(PVAGR)	Unidirectional
12	LOG(PVAGR) does not Granger Cause LOG(TCF)	PVAGR ⟶ TCF
13	LOG(PCF) does not Granger Cause LOG(PVAGR)	Unidirectional
14	LOG(PVAGR) does not Granger Cause LOG(PCF)	PVAGR ⟶ PCF
15	LOG(TCF) does not Granger Cause LOG(PBAGR)	Unidirectional
16	LOG(PBAGR) does not Granger Cause LOG(TCF)	PBAGR ⟶ TCF
17	LOG(PCF) does not Granger Cause LOG(PBAGR)	Unidirectional
18	LOG(PBAGR) does not Granger Cause LOG(PCF)	PBAGR ⟶ PCF
19	LOG(PCF) does not Granger Cause LOG(SCBTA)	Unidirectional
20	LOG(SCBTA) does not Granger Cause LOG(PCF)	SCBTA ⟶ PCF
21	LOG(TCF) does not Granger Cause LOG(SCBTA)	Unidirectional
22	LOG(SCBTA) does not Granger Cause LOG(TCF)	SCBTA ⟶ TCF
23	LOG(AGDP) does not Granger Cause LOG(SCBTA)	Unidirectional
24	LOG(SCBTA) does not Granger Cause LOG(AGDP)	SCBTA ⟶ AGDP
25	LOG(AGDP) does not Granger Cause LOG(TCF)	Unidirectional
26	LOG(TCF) does not Granger Cause LOG(AGDP)	TCF ⟶ AGDP
27	LOG(AGDP) does not Granger Cause LOG(PBCF)	Unidirectional
28	LOG(PBCF) does not Granger Cause LOG(AGDP)	PBCF ⟶ AGDP

29	LOG(AGDP) does not Granger Cause LOG(PCF)	Unidirectional
30	LOG(PCF) does not Granger Cause LOG(AGDP)	PCF ⟶ AGDP

Source: Author's Own Calculation