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Impact of Agricultural Credit on Agriculture Production: An Empirical Analysis in India

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Available data suggest that agricultural credit has been rising in recent years as a share of both the value of inputs and the value of output. There are wide regional disparities in the disbursement of agricultural credit by scheduled commercial banks. At the same time the share of agricultural GDP in total GDP is falling. In this context, this paper examines the role of direct and indirect agriculture credit in the agriculture production taking care of the regional disparities in agriculture, credit disbursement and agriculture production in an econometric framework using Dynamic Panel Data Analysis with Instrumental Variables using Arellano-Bond Regression. The analysis suggests that the direct agriculture credit amount has a positive and statistically significant impact on agriculture output and its effect is immediate. The number of accounts of the indirect agriculture credit also has a positive significant impact on agriculture output, but with a year lag. These results reveal that even though there are several gaps in the present institutional credit delivery system like inadequate provision of credit to small and marginal farmers, paucity of medium and long-term lending and limited deposit mobilisation and heavy dependence on borrowed funds by major agricultural credit purveyors, agriculture credit is still playing a critical role in supporting agriculture production in India.

JEL Classification : Q14, C23

Keywords : Agriculture Credit, Panel Data, Generalised Method of Moments

Introduction

A large proportion of the population in India is rural based and depends on agriculture for a living. Enhanced and stable growth of the agriculture sector is important as it plays a vital role not only in generating purchasing power among the rural population by creating

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on-farm and off-farm employment opportunities but also through its contribution to price stability. In India, although the share of agriculture in real GDP has declined below one-fifth, it continues to be an important sector as it employs 52 per cent of the workforce. The growing adult population in India demand large and incessant rise in agricultural production. But per capita availability of food, particularly cereals and pulses, in recent years has fallen significantly. As a result, slackening growth of agriculture during last decade has been a major policy concern.

Three main factors that contribute to agricultural growth are increased use of agricultural inputs, technological change and technical efficiency. With savings being negligible among the small farmers, agricultural credit appears to be an essential input along with modern technology for higher productivity. An important aspect that has emerged in last three decades is that the credit is not only obtained by the small and marginal farmers for survival but also by the large farmers for enhancing their income. Hence, since independence, credit has been occupying an important place in the strategy for development of agriculture. The agricultural credit system of India consists of informal and formal sources of credit supply. The informal sources include friends, relatives, commission agents, traders, private moneylenders, etc. Three major channels for disbursement of formal credit include commercial banks, cooperatives and micro-finance institutions (MFI) covering the whole length and breadth of the country. The overall thrust of the current policy regime assumes that credit is a critical input that affects agricultural/ rural productivity and is important enough to establish causality with productivity. Therefore, impulses in the agricultural operations are sought through intervention in credit.

In order to improve the flow of credit to the agricultural sector, the Reserve Bank had advised public sector banks to prepare Special Agricultural Credit Plans (SACP) in 1994-95. Under the SACP, the banks are required to fix self-set targets for achievement during the year (April-March). The targets are generally fixed by the banks about 20 to 25 per cent higher over the disbursements made in the previous year. With the introduction of SACP, the flow of credit to agricultural sector has increased significantly from Rs.8,255 crore in 1994-95 to Rs.1,22,443 crore in 2006-07 which were higher than the projection of Rs.1,18,160 crore. As against the target of Rs.1,52,133 crore for the financial year 2007-08, disbursements to agriculture by public sector banks under the plan were Rs.1,11,543 crore (provisional). As recommended by the Advisory Committee on Flow of Credit to Agriculture and Related Activities from the Banking System (Chairman: Shri V.S. Vyas), the Mid-Term Review of Annual Policy of RBI for 2004-05 made the SACP mechanism applicable to private sector banks from the year 2005-06. Disbursements to agriculture by private sector banks under SACP during 2006-07 aggregated to Rs.44, 093 crore against the target of Rs.40,656 crore. As against the target of Rs.41,427 crore for the financial year 2007-08, disbursements to agriculture by private sector banks aggregated to Rs.45,905 crore (provisional).

From the Government side, with a view to doubling credit flow to agriculture within a period of three years and to provide some relief to farmers affected by natural calamities within the limits of financial prudence, the Union Finance Minister announced several measures on June 18, 2004. Accordingly, the Reserve Bank and NABARD issued necessary operational guidelines to banks. From the very beginning, the actual disbursements exceeded the targets for each of the last four years. As against the target of Rs.2,25,000 crore for 2007-08, all banks disbursed Rs.2,25,348 crore (provisional). During 2007-08, 7.29 million new farmers were financed by commercial banks and RRBs as against the target of 5 million farmers fixed by the Union Finance Minister for the year. The Finance Minister, in his Budget Speech for the year 2008-09, urged the banks to increase the level of credit to Rs.2,80,000 crore during the year 2008-09.

Such efforts have, however, not been transmitted to the growth in agriculture output. Since the mid-1990s, the growth of the agricultural sector has been low as well as volatile; the growth decelerated from an annual average of 4.7 per cent per annum during 1980s to 3.1 per cent during the 1990s and further to 2.2 per cent during the Tenth Plan period. Growth in agricultural production has decelerated during 2006-07 with the agriculture sector characterised by stagnation in output of major food grains. Per capita annual production of cereals declined from 192 kilogram (kg) during 1991-95 to 174 kg during 2004-07 and that of pulses from 15 kg to 12 kg over the same period. Per capita availability of food grains has, thus, fallen close to the levels prevailing during the 1970s.

Volatility in agricultural production has not only affected overall growth but also exerted persistence pressure on maintaining low and stable inflation. Demand-supply gaps were reflected in higher domestic food prices in recent years. All these evidences apparently point to the fact that higher credit to agriculture is not translated into commensurate increase in agricultural output. In this paper, we examine this basic premise empirically using both macro- and micro level data.

The rest of the paper is organized as follows. Section I presents a brief review of recent literature on the broader issue of bank credit and agriculture output. Section II makes an assessment of progress in agriculture credit in India. Econometric methodology of dynamic panel data regression, including some description on the economic framework of the proposed model is given in Section III. Section IV presents the empirical results. Concluding remarks follow in Section V.

Section I. Literature Review

India has systematically pursued a supply leading approach to increase agricultural credit. The objectives have been to replace moneylenders, relieve farmers of indebtedness and to achieve higher levels of agricultural credit, investment and agricultural output. Among earlier studies, Binswanger and Khandker (1992) found that the output and employment effect of expanded rural finance has been much smaller than in the nonfarm sector. The effect on crop output is not large, despite the fact that credit to agriculture has strongly increased fertilizer use and private investment in machines and livestock. High impact on inputs and modest impact on output clearly mean that the additional capital investment has been more important in substituting for agricultural labor than in increasing crop output.

Between bank nationalization in 1969 and the onset of financial liberalization in 1990 bank branches were opened in over 30,000 rural locations which had no prior presence of commercial banks (called un-banked locations). Alongside, the share of bank credit and savings which was accounted for by rural branches raised from 1.5 and 3 percent respectively to 15 percent each (Burgess and Pande, 2005). This branch expansion was an integral part of India's social banking experiment which sought to improve the access of the rural poor to cheap formal credit. The estimates suggested that a one percent increase in the number of rural banked locations reduced rural poverty by roughly 0.4 percent and increased total output by 0.30 percent. The output effects are solely accounted for by increases in non-agricultural output – a finding which suggests that increased financial intermediation in rural India aided output and employment diversification out of agriculture.

In a detailed paper, Mohan (2006) examined the overall growth of agriculture and the role of institutional credit. Agreeing that the overall supply of credit to agriculture as a percentage of total disbursal of credit is going down, he argued that this should not be a cause for worry as the share of formal credit as a part of the agricultural GDP is growing. This establishes that while credit is increasing, it has not really made an impact on value of output figures which points out the limitations of credit. In another study, Golait (2007) attempted to analyse the issues in agricultural credit in India. The analysis revealed that the credit delivery to the agriculture sector continues to be inadequate. It appeared that the banking system is still hesitant on various grounds to purvey credit to small and marginal farmers. It was suggested that concerted efforts were required to augment the flow of credit to agriculture, alongside exploring new innovations in product design and methods of delivery, through better use of technology and related processes. Facilitating credit through processors, input dealers, NGOs, etc., that were vertically integrated with the farmers, including through contract farming, for providing them critical inputs or processing their produce, could increase the credit flow to agriculture significantly.

In general, it is difficult to establish a causal relationship between agriculture credit and production due to the existence of critical endogeneity problem. However, Sreeram (2007) concluded that increased supply and administered pricing of credit help in the increase in agricultural productivity and the well being of agriculturists as credit is a sub-component of the total investments made in agriculture. Borrowings could in fact be from multiple sources in the formal and informal space. Borrowing from formal sources is a part of this sub-component. With data being available largely from the formal sources of credit disbursal and indications that the formal credit as a proportion of total indebtedness is going down, it becomes much more difficult to establish the causality. He also stated that the diversity in cropping patterns, holding sizes, productivity, regional variations make it difficult to establish such a causality for agriculture or rural sector as a whole, even if one had data. Finally, he argued that mere increase in supply of credit is not going to address the problem of productivity, unless it is accompanied by investments in other support services. In the present study, we take a re-look at the problem by quantitatively assessing the impact of institutional credit expansion on agriculture.

Section II. Assessment of Progress in Agricultural Credit in India

In India, the share of agriculture in the gross domestic product has registered a steady decline from 36.4 per cent in 1982-83 to 18.5 per cent in 2006-07. Agriculture growth has remained lower than the growth rates witnessed in the industrial and services sectors. The gap between the growth of agriculture and non-agriculture sector began to widen since 1981-82, and more particularly since 1996-97, because of acceleration in the growth of industry and services sectors (Table 1). Even though the share of agriculture in GDP has declined over the years, the number of people dependent on agriculture for their food and livelihood has remained unchanged. Therefore, a number of measures were taken by the Reserve Bank and the Government of India for facilitating increased credit flows to the agriculture sector. With a view to doubling credit flow to agriculture within a period of three years, several measures have been announced. From the very beginning, the actual disbursements exceeded the targets for each of the last four years (Table 2).

Table 1: Average GDP growth rates of agriculture and other sectors at 1999-2000 prices

(Per cent)

Period		Total Economy	Agriculture & allied	Crops & livestock	Non-agriculture
1	2	3	4	5	6
Pre-Green Revolution	1951-52 to 1967-68	3.7	2.5	2.7	4.9
Green Revolution period	1968-69 to 1980-81	3.5	2.4	2.7	4.4
Wider technology dissemination period	1981-82-1990-91	5.4	3.5	3.7	6.4
Early Reform Period	1991-92 to 1996-97	5.7	3.7	3.7	6.6
Ninth and Tenth Plan	1997-98 to 2006-07	6.6	2.5	2.5	7.9
	2005-06 to 2006-07	9.5	4.8	5.0	10.7

Source: Economic Survey (2007-08).

The increased credit flow to agriculture has not resulted in the commensurate increase in production. The average rate of growth of foodgrains production decelerated to 1.2 per cent during 1990-2007, lower than annual rate of growth of population, averaging 1.9 per cent. The per capita availability of cereals and pulses has witnessed a decline during this period. The consumption of cereals declined from a peak of 468 grams per capita per day in 1990-91 to 412 grams per capita per day in 2005-06, indicating a decline of 13 per cent during this period. The

Table 2: Targets and actual disbursement to agriculture by banks

(Rs. crore)

Agency	(2004-05)		(2005-06)		(2006-07)		(2007-08)*	
	Target	Disbursement	Target	Disbursement	Target	Disbursement	Target	Disbursement
1	2	3	4	5	6	7	8	9
Comm. Banks	57,000	81,481	87,200	1,25,477	1,19,000	16,64,486	1,50,000	1,56,850
Coop. Banks	39,000	31,231	38,600	39,786	41,000	42,480	52,000	43,684
RRBs	8,500	12,404	15,200	15,223	15,000	20,435	23,000	24,814
Other Agencies		193						
Total	**1,05,000**	**1,25,309**	**1,41,000**	**1,80,486**	**1,75,000**	**2,29,401**	**2,25,000**	**2,25,348**

Source: NABARD; *: Provisional; RRBs:Regional Rural Banks.

consumption of pulses declined from 42 grams per capita per day (72 grams in 1956-57) to 33 grams per capita per day during the same period. The overall production of food grains was estimated at 217.3 million tonnes in 2006-07, an increase of 4.2 per cent over 2005-06. Compared to the target set for 2006-07, it was, however, lower by 2.7 million tonnes (1.2 per cent). Over a medium term, there has generally been a shortfall in the achievement of target of foodgrains, pulses and oilseeds during 2000-01 to 2006-07. The actual production of foodgrains on an average was 93 per cent of the target (Table 3). Actual production, however, was only 87.7 per cent of target for pulses and 85.3 per cent of target for oilseeds.

The production of agriculture crops, besides the weather-induced fluctuations, significantly depends on the availability of inputs like fertilizers, irrigation, certified seeds, credit support and appropriate price signals. Minimum support prices indicated upfront and before the sowing seasons act as effective incentives for acreage response of the agricultural crops. Deviations in foodgrains and agricultural output from their long-term trends are determined, among other factors, by variations in monsoon around its long-term trend and the area under irrigation.

Table 3: Actual production relative to targets

(Per cent)

Crop	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	Average (2001-07)
1	2	3	4	5	6	7	8
Rice	101.5	77.2	95.2	88.9	104.5	100.6	94.7
Wheat	93.3	84.3	92.5	86.3	91.8	100.4	91.4
Coarse cereals	101.1	79	110.6	90.9	93.3	92.9	94.6
Pulses	89.1	69.6	99.4	85.8	88.4	93.7	87.7
Foodgrains	**97.6**	**79.4**	**96.9**	**88.1**	**97**	**98.8**	**93**
Oilseeds	**37.8**	**55**	**102**	**93**	**105.2**	**82.6**	**85.3**
Sugarcane	91.4	89.8	73.1	87.8	118.4	131.7	98.7
Cotton	68.9	57.5	91.5	109.5	112.1	122.3	93.7
Jute & Mesta	106.2	94	93.1	87.1	96.1	99.9	96.1

Source: Economic Survey (2007-08).

Table 4: Rate of growth of production for major crops

(Per cent)

Year	Rice	Wheat	Pulses	Food grains	Cotton	Oilseeds	Sugarcane
1	2	3	4	5	6	7	8
1989-90 to 2006-07	1.17	1.9	-0.03	1.18	2.04	1.25	1.13
1992-93 to 1996-97	1.73	3.6	0.66	1.88	4.88	3.57	3.74
1997-98 to 2001-02	1.13	1.26	-2.52	0.67	5.79	-4.68	1.23
2002-03 to 2005-06	1.75	0.42	3.27	1.61	20.22	9.81	-1.23

Source: Economic Survey (2007-08).

On the productivity front, India is not only low relative to other countries in crop production, there are considerable inter-state variations. The productivity of wheat in 2005-06 varied from a low of 1,393 kg per ha in Maharashtra to a high of 4,179 kg in Punjab. The Steering Committee on Agriculture for the Eleventh Five Year Plan has observed that not only the yields differed across the States, there was a significant gap between the performance and potential as revealed by actual yield and yield with improved practices adopted by farmers (Table 5).

Table 5: Interstate Variation in Actual yield and yield with improved practices

State	Improved practice(I)	Farmer practice(F)	Actual yield 2003-04(A)	Gap (per cent)	
				I and F	I and A
1	2	3	4	5	6
Wheat (Yield : Kg/ha – 2002-03 to 2004-05)					
Bihar	3651	2905	1783	25.7	104.8
Madhya Pradesh	3297	2472	1789	33.4	84.3
Uttar Pradesh	4206	3324	2794	26.5	50.5
Rice (irrigated) (Yield : Kg/ha - 2003-04 to 2004-05)					
Uttar Pradesh	7050	5200	2187	35.6	222.4
Bihar	4883	4158	1516	17.4	222.1
Chhattisgarh	3919	3137	1455	24.9	169.4
Sugarcane					
Maharashtra	127440	99520	51297	28.1	148.4
Karnataka	147390	128000	66667	15.1	121.2
Bihar	74420	49440	40990	50.5	81.6

Source: Economic Survey (2007-08).

The above mentioned facts clearly underline the need to analyze the effect of institutionalized agriculture credit on agriculture output in an econometric framework. Considering the diverse nature of agriculture activities and agriculture credit distribution across the country, the Arellano-Bond (1991) dynamic panel estimation at district level is most suitable as it is designed for situations with 1) "small T, large N" panels, meaning few time periods and many individuals; 2) a linear functional relationship; 3) a single left-hand-side variable that is dynamic, depending on its own past realizations; 4) independent variables that are not strictly exogenous, meaning correlated with past and possibly current realizations of the error; 5) fixed individual effects; and 6) heteroskedasticity and autocorrelation within individuals, but not across them. Arellano-Bond estimation starts by transforming all regressors, usually by differencing, and uses the Generalised Method of Moments, and so is called "difference GMM" (Hansen 1982). The technical discussion of the methodology is given in the next section.

Section III
Methodology for estimating the effect of agricultural credit on production: A dynamic panel regression approach

III.1. Economic framework

When the farmer faces a credit constraint, additional credit supply can raise input use, investment, and hence output. This is the liquidity effect of credit. But credit has another role to play. In most developing countries where agriculture still remains a risky activity, better credit facilities can help farmers smooth out consumption and, therefore, increase the willingness of risk-averse farmers to take risks and make agricultural investments. This is the consumption smoothing effect of credit. Therefore, specification of an appropriate model of agricultural credit and output is fraught with several econometric difficulties. First, time series data on informal credit do not exist. If expansion of formal credit causes a reduction in informal credit, a regression of output on formal credit will measure the effect of expansion of credit net of the effect of reduced informal credit. The second econometric problem is the joint dependence of output and credit on other variables such as the weather, prices, or technology. Credit advanced by formal lending agencies such as banks is an outcome of both the supply of and demand for formal credit. The amount of formal credit available to the farmer, his credit ration, enters into his decision to make investments, and to finance and use variable inputs such as fertilizer and labor. There is, therefore, a joint dependence between the observed levels of credit used and aggregate output. A two-stage instrument variable (IV) procedure can solve this identification problem. The third econometric problem arises because formal agriculture lending is not exogenously given or randomly distributed across space. That means, the banks will lend more in areas where agricultural opportunities are better, risk is lower, and hence, chances for loan recovery are higher. An unobserved variable problem thus arises for the econometric estimation and is associated with unmeasured or immeasurable region, say district characteristics. This problem can be overcome by the use of district-level panel data. The credit delivery to agriculture will have differential impacts over different regions in India. Even various districts in same state may be responding in a different manner to the change in credit delivery. Therefore, any methodology where data are pooled together will not be appropriate. Again, assuming exogeneity in the independent variables may lead to wrong results as the variables like area under cultivation may depend on last periods' output. For example, an increase (decrease) in output in a particular district at any particular year leads to the chances of more (less) area of showing in the next year which increases (decreases) the likelihood of higher production in the subsequent year. This led us analyzing the data using a dynamic panel data analysis with instrumental variables using Arellano-Bond Regression. Using some select states, district level panel data is obtained and analyzed allowing district level unobserved heterogeneity.

III.2. Panel data methodology

Panel data is widely used to estimate dynamic econometric models. Its disadvantage over cross-section data is that we cannot estimate dynamic models from observations at a single point in time, and it is rare for single cross section surveys to provide sufficient information about earlier time periods for dynamic relationships to be investigated. Its advantages over aggregate time series data include the possibility that underlying microeconomic dynamics may be obscured by aggregation biases, and the scope that panel data offers to investigate heterogeneity in adjustment dynamics between different panels. A single equation, autoregressive-distributed lag model can be estimated from panels with a large number of cross-section units, each observed for a small number of time periods. This situation is typical of micro panel data and calls for estimation methods that do not require the time dimension to become large in order to obtain consistent parameter estimates. Assumptions about the properties of initial conditions also play an important role in this setting, since the influence of the initial observations on each subsequent observation cannot safely be ignored when the time dimension is short. In case of absence of strictly exogenous explanatory variables or instruments as strict exogeneity rules out any feedback from current or past shocks to current values of the variable, which is often not a natural restriction in the context of economic models relating several jointly determined outcomes (Bond, 2002). Identification then depends on limited serial correlation in the error term of the equation, which leads to a convenient and widely used class of Generalised Method of Moments (GMM) estimators for this type of dynamic panel data model.

Consider a simple AR(1) model,

$$y_{it} = \alpha y_{i,t-1} + \eta_i + v_{it}\,; \; |\alpha| < 1 \qquad (3.1)$$
$$i = 1......N$$
$$t = 2,3,....T$$

where y_{it} is an observation on some series for individual i in period t, $y_{i,t-1}$ is the observation on the same series for the same individual in the previous period, η_i is an unobserved individual-specific time-invariant effect which allows for heterogeneity in the means of the y_{it} series across individuals, and v_{it} is a disturbance term. A key assumption that is maintained throughout is that the disturbances v_{it} are independent across individuals. The number of individuals for which data is available (N) is assumed to be large whilst the number of time periods for which data is available (T) is assumed to be small, and asymptotic properties are considered as N becomes large with T fixed.

The individual effects (η_i) are treated as being stochastic, which implies that they are necessarily correlated with the lagged dependent variable $y_{i,t-1}$ unless the distribution of the η_i is degenerate. Initially it is further assumed that the disturbances (v_{it}) are serially uncorrelated. These jointly imply that the Ordinary Least Squares (OLS) estimator of α in the levels equations (3.1) is inconsistent, since the explanatory variable $y_{i,t-1}$ is positively correlated with the error term ($\eta_i + v_{it}$) due to the presence of the individual effects, and this correlation does not vanish as the number of individuals in the sample gets larger. The within groups estimator eliminates this source of inconsistency by transforming the equation to eliminate η_i. Although within groups estimator is biased, in large samples, it is biased downwards. In specifying the model (3.1) no restriction to the process that generates these initial conditions is made, and a wide variety of alternative processes could be considered (Bond, 2002).

Instrumental variables estimators, which require much weaker assumptions about the initial conditions, have therefore been attractive in this context. Additional instruments are available when the panel has more than 3 time series observations. Whilst y_{i1} is the only instrument that can be used in the first differenced equation for period t = 3, both y_{i1} and yi_2 can be used in the first differenced equation for period t = 4, and the vector ($y_{i1}, y_{i2}, \ldots, y_{i,T-2}$) can be used in the first-differenced equation for period t = T. Since the model is over identified with T > 3, and the first-differenced error term Δv_{it} has a first-order moving average form of serial correlation if the maintained assumption that the v_{it} are serially uncorrelated is correct, 2SLS is not asymptotically efficient even if the complete set of available instruments is used for each equation and the disturbances v_{it} are homoskedastic. The Generalised Method of Moments (GMM), developed by Hansen (1982), provides a convenient framework for obtaining asymptotically efficient estimators in this context, and first-differenced GMM estimators for the AR(1) panel data model are developed by Holtz-Eakin, Newey and Rosen (1988) and Arellano and Bond (1991).

Essentially these use an instrument matrix of the form

$$Z_i = \begin{bmatrix} y_{i1} & 0 & 0 & . & 0.... & 0 \\ 0 & y_{i1} & y_{i2} & . & 0.... & 0 \\ . & . & . & . & ..... & . \\ 0 & 0 & 0 & y_{i1} & ..... & y_{iT-2} \end{bmatrix} \quad (3.2)$$

where rows correspond to the first-differenced equations for periods t=3, 4, . . . ,T for individual i, and exploit the moment conditions

$$E\left[Z_i^{'}\Delta v_i\right] = 0 \qquad \text{for i=1,2....N} \tag{3.3}$$

where $\Delta v_i = (\Delta v_{i3}, \Delta v_{i4,} ....\Delta v_{iT})^{'}$

In general, the asymptotically efficient GMM estimator based on this set of moment conditions minimises the criterion

$$J_N = \left(\frac{1}{N}\sum_{i=1}^{N}\Delta v_i^{'} Z_i\right) W_N \left(\frac{1}{N}\sum_{i=1}^{N} Z_i^{'}\Delta v_i\right) \tag{3.4}$$

using the weight matrix

$$W_N = \left[\frac{1}{N}\sum_{i=1}^{N}\left(Z_i^{'}\Delta\hat{v}_i\Delta\hat{v}_i^{'}Z_i\right)\right]^{-1} \tag{3.5}$$

where the Δv_i are consistent estimates of the first-differenced residuals obtained from a preliminary consistent estimator. Hence this is known as a two-step GMM estimator. Under homoskedasticity of the v_{it} disturbances, the particular structure of the first-differenced model implies that an asymptotically equivalent GMM estimator can be obtained in one-step, using instead the weight matrix

$$W_{1N} = \left[\frac{1}{N}\sum_{i=1}^{N}\left(Z_i^{'}HZ_i\right)\right]^{-1} \tag{3.6}$$

where H is a (T − 2) square matrix with 2's on the main diagonal, -1's on the first off-diagonals and zeros elsewhere. Notice that W_{1N} does not depend on any estimated parameters.

At a minimum this suggests that the one-step estimator using W_{1N} is a reasonable choice for the initial consistent estimator used to compute the optimal weight matrix W_N and hence to compute the two-step estimator. In fact a lot of applied work using these GMM estimators has focused on results for the one-step estimator rather than the two-step estimator. This is partly because simulation studies have suggested very modest efficiency gains from using the two-step version, even in the presence of considerable heteroskedasticity, but more importantly because the dependence of the two-step weight matrix on estimated parameters makes the usual asymptotic distribution approximations less reliable for the two-step estimator. Simulation studies have shown that the asymptotic standard errors tend to be much too small, or the asymptotic t-ratios much too big, for the two-step estimator, in sample sizes where the equivalent tests based on the one-step estimator are quite accurate (Bond, 2002).

In general, autoregressive-distributed lag models of the form

$$y_{it} = \Sigma_j (\alpha_j y_{i,t-j}) + \beta x_{it} + (\eta_i + v_{it}); \; \mathrm{i} = 1, 2, \ldots, \mathrm{N};$$

$$\mathrm{j}=1,2 \; \mathrm{T} \; ; \; \mathrm{t} = (\mathrm{T\text{-}j}), (\mathrm{T\text{-}j\text{-}1}) \ldots, \mathrm{T} \qquad (3.7)$$

where y_{it} is the vector of dependant variable. x_{it} can be a vector of current and lagged values of additional explanatory variables.

Maintaining also that the v_{it} disturbances are serially uncorrelated, the x_{it} series may be endogenous in the sense that x_{it} is correlated with v_{it} and earlier shocks, but x_{it} is uncorrelated with $v_{i,t+1}$ and subsequent shocks; predetermined in the sense that x_{it} and v_{it} are also uncorrelated, but x_{it} may still be correlated with $v_{i,t-1}$ and earlier shocks; or strictly exogenous in the sense that x_{it} is uncorrelated with all past, present and future realisations of v_is. If x_{it} is assumed to be endogenous then it is treated symmetrically with the dependent variable y_{it}. In this case the lagged values $x_{i,t-2}$, $x_{i,t-3}$ and longer lags (when observed) will be valid instrumental variables in the first-differenced equations for periods t = 3, 4, . . . , T . Maintaining also that the initial conditions y_{i1} are predetermined, the complete set of moment conditions available has the form of (3), in which the vector $(y_{i1}, \ldots, y_{i,t-2})$ is replaced by the vector $(y_{i1}, \ldots, y_{i,t-2}, x_{i1}, \ldots, x_{i,t-2})$ in forming each row of the instrument matrix Z_i. If we make the stronger assumption that there is no contemporaneous correlation and the x_{it} series is predetermined, then $x_{i,t-1}$ is additionally available as a valid instrument in the first-differenced equation for period t. In this case $(y_{i1}, \ldots, y_{i,t-2})$ is replaced by the vector $(y_{i1}, \ldots, y_{i,t-2}, x_{i1}, \ldots, x_{i,t-2}, xi_{,t-1})$ to form the instrument matrix Zi. If we make the much stronger assumption that x_{it} is strictly exogenous, then the complete time series $x_i = (x_{i1}, x_{i2}, \ldots, x_{iT})$ will be valid instrumental variables in each of the first-differenced equations. In this case $(y_{i1}, \ldots,$

$y_{i,t-2}$) is replaced by the vector ($y_{i1}, \ldots, y_{i,t-2}, x\_i$) to form the instrument matrix (Bond, 2002).

The only assumption required on the initial conditions y_{i1} is that they are uncorrelated with the subsequent disturbances v_{it} for t = 2, 3. . . T in, which case the initial conditions are said to be predetermined. The correlation between y_{i1} and the individual effects η_i is left unrestricted, and there is no requirement for any stationarity condition to be satisfied. Together with the previous assumption that the disturbances v_{it} are serially uncorrelated, predetermined initial conditions imply that the lagged level $y_{i,t-2}$ will be uncorrelated with Δv_{it} and thus available as an instrumental variable for the first-differenced equations. The resulting 2SLS estimator is consistent in large N, fixed T panels, and identifies the autoregressive parameter α provided at least 3 time series observations are available ($T \geq 3$).

When $T > 3$ and the model is overidentified, the validity of the assumptions used to obtain (3.3) can be tested using the standard GMM test of overidentifying restrictions, or Sargan test. In particular $N{*}J_N$ in (3.4) has an asymptotic $\chi 2$ distribution under the null that these moment conditions are valid (Sargan, 1958, 1988; Hansen, 1982). In this context the key identifying assumption that there is no serial correlation in the v_{it} disturbances can also be tested by testing for no second-order serial correlation in the first-differenced residuals (Arellano and Bond, 1991).

Section IV. Empirical Analysis

Before explaining the results of the regression model as indicated in the earlier section, association in terms of correlation between agriculture credit and output based on the district level data for 2007 is assessed. Then, we discuss the empirical results of the dynamic panel regression using state-level data and finally results of the same based on districts level data of select states are presented.

IV.1. Association between agriculture credit and output: some empirical assessment

Indicus Analytics, a private sector organization, came out with district GDP data, classified by agriculture, industry and others for the year 2007.[1] With a view to analyze the association between agriculture credit and output, the data district GDP from agriculture data (DGDP_AG) of major states are juxtaposed with district-level agricultural credit data (as per place of utilization) as available in Basic Statistical Returns of all scheduled commercial banks (BSR 1, March 2007). In addition to the credit amount outstanding (AG_C), the number of credit accounts to agriculture (N_AG_C) is also used. The (Pearson's) correlation coefficients for districts within the states have been derived to indicate the direction and extent of relationship between GDP and credit. The elasticity of bank credit on GDP has been chosen to measure the responsiveness of the relationship to changes in bank credit to the GDP (Table 6).

The correlation coefficients of GDP and bank credit in respect of agriculture for the states Andhra Pradesh, Chattisgargh, Jharkhand, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttranchal and West Bengal were positive and statistically significant at 1 per cent level. The correlation coefficients were significant for Assam, Bihar, Maharashtra, Meghalaya, Sikkim at 5 per cent level. However, the correlation coefficients were not found significant for the states like Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh and Punjab. The log elasticity of bank credit to GDP of agriculture were highly significant for the states Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and Uttaranchal at one per cent level. Extension of formal credit to agriculture may play a significant role on the agriculture output in these states. On the other hand, bank credit does not seem to play a major role on the agriculture output in Haryana, Jammu & Kashmir, Karnataka and Kerala. The flow of credit for agriculture in the states of Uttar Pradesh, Andhra Pradesh, Maharashtra, West Bengal, Rajasthan, Tamil Nadu, Bihar, Orissa, Assam, Chhattisgarh, Jharkhand, Uttaranchal, etc., are very important as these states contributes significantly towards agriculture GDP and the elasticity of credit to GDP is also significantly high. Interestingly, when agriculture credit is extended to more people, as demonstrated by the number of agricultural credit account, it has translated to higher

Table 6: Correlation of District GDP and Bank Credit at District Level: 2007

State	No. of districts	Correlation (DGDP_AG, AG_C)	Log-Elasticity (DGDP_AG, AG_C)	Rank Correlation (DGDP_AG, N_AG_C)	Average DGDP_AG (Rs. lakh)	Average AG_C (Rs. lakh)
1	2	3	4	5	6	7
Andhra Pradesh	22	0.77*	0.66*	0.67*	248234	87346
Assam	23	0.42**	0.70*	0.52**	71483	4386
Bihar	37	0.50**	0.58*	0.60*	69559	17897
Chhattisgarh	16	0.70*	0.67*	0.79*	58961	11783
Gujarat	25	0.19	0.42**	0.50**	152787	48758
Haryana	19	0.12	0.05	0.72*	119075	51571
Himachal Pradesh	12	0.06	0.47**	0.54***	44403	10530
Jammu & Kashmir	14	0.43	0.66	0.77*	56967	7826
Jharkhand	18	0.59*	0.60	0.56**	40816	6420
Karnataka	27	0.12	0.05	0.65*	109415	75980
Kerala	14	-0.19	-0.03	0.42	127711	60785
Madhya Pradesh	45	0.21	0.47*	0.56*	72148	22951
Maharashtra	33	0.37**	0.50*	0.72*	157593	36207
Orissa	30	0.60*	0.46*	0.72*	74577	12722
Punjab	17	0.26	0.36**	0.67*	205346	74078
Rajasthan	32	0.74*	1.02 *	0.67*	106739	40342
Tamil Nadu	27	0.53*	0.64 *	0.62*	96348	64578
Uttar Pradesh	69	0.69*	0.65 *	0.83*	127330	33806
Uttaranchal	13	0.78*	0.49 *	0.70*	41327	10797
West Bengal	17	0.81*	0.55 *	0.70*	276601	28430
Total	**510**	**0.53***	**0.51 ***	**0.70***	**113195**	**35658**

*, ** and *** indicate statistical significance at 1%, 5% and 10%, respectively.
DGDP_AG= District domestic product from agriculture.
AG_C = District level bank credit to agriculture.
N_AG_C = District level bank credit account to agriculture.

output. This is true for most of the states, except Kerala. Therefore, empirical association clearly indicates that financial inclusion of farmers in the organized financial system boosts agriculture output.

With the objective identifying the role of bank credit in agriculture growth, the dynamic panel data regression with instrumental variables is performed with agriculture output as the dependant variable and total outstanding agriculture credit amount, total outstanding agriculture credit accounts, total agriculture area and rainfall as the regressors. Here analysis is done in two parts. First, an all India level analysis is undertaken involving all the variables for which data are available at state level, in a panel setup, which allows state level unobserved heterogeneity in the model. Secondly, using data of some select states, district level panel data model is estimated and analyzed allowing district level unobserved heterogeneity.

IV.2 Aggregate analysis using State-level panel data

In this section, 20 major states in India are included in the analysis for a period from 2001 to 2006.[2] The period of study is confined to the above mentioned time period mainly due the restricted data availability. The state-wise agriculture output is obtained from the 'State wise estimates of value of output from agriculture and allied activities (Base: 1999-2000)', Central Statistical Organisation, Ministry of Statistics and Programme Implementation, Government of India. The total rainfall in the monsoon season (June to September) is used to obtain the excess/deficit rainfall in different subdivisions for different years. The state level data on total credit outstanding and total number of credit accounts for the scheduled commercial banks are available in the 'Basic Statistical Returns of Scheduled Commercial Banks in India', Reserve Bank of India. This data source is utilised to obtain the credit amount outstanding and total number of agriculture accounts for direct, indirect and total agriculture credit of schedule commercial banks in India. All the variables except rainfall is standardized using population size of the state obtained from the projected data of 2001 population census. The variables used in the study are mentioned below as follows.

pcagout	Per capita agriculture output in rupees
pctacam	Per capita total agriculture credit amount outstanding in rupees

pctacn	Per capita total number of agriculture credit accounts outstanding per one lakh population
pcagar	Total agriculture area in square meter standardized by population
rain	Absolute deviation from normal rain.
pcdacam	Per capita agriculture direct credit amount outstanding in rupees
pcidacam	Per capita agriculture indirect credit amount outstanding in rupees
pcdacn	Per capita number of direct agriculture credit accounts outstanding per one lakh population
pcidacn	Per capita number of indirect agriculture credit accounts outstanding per one lakh population

A dynamic panel regression model is estimated with per capita agriculture output as the dependent endogenous variable. The per capita direct agriculture credit amount outstanding, per capita direct agriculture credit number of accounts, pre capita indirect agriculture credit amount outstanding, pre capita indirect agriculture credit number of accounts and agriculture area are used as predetermined regressors, while rainfall is treated as a strictly exogenous variable. The lagged values of the endogenous and predetermined variables; and exogenous variable are used as instrumental variables. All variables except rainfall used in this equation and subsequent equations are in their first difference form. As described in the above section a difference GMM is used to obtain the parameter estimates. The results obtained from one-step are reported because of downward bias in the computed standard errors in two-steps. The validity of the instruments is verified using Sargan test for over identifying restrictions and is found to be satisfactory (*Note* in Table 7). The difference residuals exhibited significant first order serial correlation and no second order serial correlation (*Note* in Table 7). Therefore it satisfies another essential assumption for the consistency of the system GMM estimator *i.e.* no serial correlation in the error terms.

The results from Table 7 reveal that only agriculture area is significant in explaining the variation in agriculture output, even after

Table 7: GMM estimates for the all India level regression equation

Variable	GMM estimates	Robust Std. Err.	z	Prob.	[95% Conf. Interval]	
Δpcagout (-1)	1.0724	0.1176	9.1200	0.0000	0.8420	1.3029
Δpcdacam	-0.0166	0.0276	-0.6000	0.5480	-0.0708	0.0375
Δpcdacam(-1)	0.0172	0.0335	0.5100	0.6080	-0.0485	0.0829
Δpcdacn	-0.0155	0.0102	-1.5200	0.1280	-0.0354	0.0045
Δpcdacn(-1)	0.0164	0.0132	1.2400	0.2140	-0.0095	0.0422
Δpcidacam	0.1148	0.0589	1.9500	0.0510	-0.0007	0.2302
Δpcidacam (-1)	-0.0579	0.0398	-1.4600	0.1450	-0.1359	0.0200
Δpcidacam (-2)	-0.0728	0.0582	-1.2500	0.2110	-0.1868	0.0412
Δpcidan	0.2434	0.1713	1.4200	0.1550	-0.0923	0.5792
Δpcidan (-1)	-0.2793	0.2355	-1.1900	0.2360	-0.7408	0.1822
Δpcidan (-2)	0.2371	0.1518	1.5600	0.1180	-0.0604	0.5346
Δpcagar	0.0234	0.0051	4.6000	0.0000	0.0134	0.0333
Rain	-0.1800	0.2412	-0.7500	0.4560	-0.6528	0.2928

Note:
GMM results are one-step estimates with heteroskedasticity-consistent standard errors and test statistics.
Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
H0: no autocorrelation z = -2.00 Pr > z = 0.0454
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
H0: no autocorrelation z = 0.95 Pr > z = 0.3404
Sargan test of over-identifying restrictions: chi2(25) = 6.64 Prob > chi2 = 0.99
(Sargan is a test of the over identifying restrictions for the GMM estimators, asymptotically $\chi 2$. This test uses the minimised value of the corresponding two-step GMM estimators.)

adjustment of heteroskedasticity-consistent standard errors. Thus, the credit-output relationship of agriculture is difficult to establish at the state level. Agriculture is typically a localized regional economic activity and, therefore, its aggregation over states may hide the spatial heterogeneity. In order to establish a clear picture of the impact of agriculture credit on agriculture output, we examined further by drilling down to district level and the results are discussed in the section below.

IV.3 State Level Analysis with Districts as the Panel

As the agriculture activities tend to perform rather different across districts, a district level panel data is obtained and analyzed allowing district level unobserved heterogeneity. The data of the variables mentioned in the previous subsection are not available for all the districts in India. Therefore, the analysis is performed for districts of select states namely Maharashtra, Andhra Pradesh, Punjab and West Bengal. The period of study is from 2001 to 2006. The district level agriculture output is not available as such in public domain. But district wise production and farm harvest prices of various agriculture commodities are available with Directorate of Economic and Statistics, Department of Agriculture and Corporation, Ministry of Agriculture, Government of India.[3] This information is utilised to estimate the district level agriculture output. For compilation of this only main agriculture commodities are selected.[4] The cultivated area of different agriculture crops is also available from the same source and this information is utilised to obtain the area under cultivation for different districts. The subdivision wise normal and actual rainfall is published on a regular basis by Indian Metrological Department. The total rainfall in the monsoon season (June to September) is used to obtain the excess/deficit rainfall in different subdivisions for different years. The district level data on total credit outstanding and total number of credit accounts for the schedule commercial banks are available in Basic Statistical Returns of Scheduled Commercial Banks, Reserve Bank of India. This source of data also provide the information on credit amount outstanding and total number of agriculture accounts for direct, indirect and total agriculture credit of schedule commercial banks in India.[5] All the variables expect rainfall is standardized using population size of the district obtained from 2001 population census.

The first model identifies the effect of per capita direct agriculture credit amount outstanding and per capita indirect agriculture credit amount outstanding on per capita agriculture output (Table 8). This model is estimated with per capita agriculture output as the dependent endogenous variable. The per capita direct agriculture credit amount outstanding, per capita indirect agriculture credit amount outstanding and agriculture area are used as predetermined regressors, while rainfall is treated as a strictly exogenous variable. The lagged values of the endogenous and predetermined variables and exogenous variables are used as instrumental variables. All variables except rainfall used in this equation and subsequent equations are in their first difference form. As described in the above section a difference GMM is used to obtain the parameter estimates. Again, the results obtained from one-step are reported because of downward bias in the computed standard errors in two-step. The validity of the instruments is verified using Sargan test for over identifying restrictions and is found to be satisfactory (*Note* in Table 8). The difference residuals exhibited significant first order serial correlation and no second order serial correlation (*Note* in Table 8). Therefore it satisfies the essential assumption for the consistency of the system GMM estimator *i.e.* the assumption of no serial correlation in the error terms.

The results presented in Table 8 indicate that agriculture area is having a significant positive impact and rainfall (measured as deviation from normal) is negatively affecting the agriculture output and is significant, which is consistent with the general beliefs. It can be noted from Table 8 that indirect agriculture credit amount and its first lag are insignificant in describing the variation in the

Table 8: GMM estimates for the second regression equation

Variable	**GMM estimates**	**Robust Std. Err.**	**z**	**Prob.**	**[95% Conf. Interval]**	
1	2	3	4	5	6	7
Δpcagout (-1)	0.0605	0.1531	0.3900	0.6930	-0.2396	0.3605
Δpcdacam	0.1100	0.0317	3.4700	0.0010	0.0479	0.1722
Δpcidacam	0.1683	0.1739	0.9700	0.3330	-0.1726	0.5093
Δpcidacam (-1)	0.0980	0.1026	0.9600	0.3390	-0.1030	0.2990
Δpcagar	0.5268	0.1501	3.5100	0.0000	0.2326	0.8211
Rain	-0.8378	0.3039	-2.7600	0.0060	-1.4334	-0.2421

Note:

GMM results are one-step estimates with heteroskedasticity-consistent standard errors and test statistics.

Arellano-Bond test that average auto covariance in residuals of order 1 is 0:

H0: no autocorrelation z = -2.17 Pr > z = 0.0298

Arellano-Bond test that average auto covariance in residuals of order 2 is 0:

H0: no autocorrelation z = 1.09 Pr > z = 0.2753

chi2(11) = 19.52 Prob > chi2 = 0.0529

(Sargan is a test of the over identifying restrictions for the GMM estimators, asymptotically $\chi 2$. This test uses the minimised value of the corresponding two-step GMM estimators.)

agriculture output. On the other hand, the intervention through direct agriculture credit has significant positive impact on agriculture output. In particular, change in per capita agriculture direct credit (amount outstanding) by one per cent will lead to increase in per capita agriculture output by 0.11 per cent. This effect is, however, more stronger from the area under cultivation; an increase in per capita agriculture area by one per cent has the potential of raising the per capita agriculture output by more than 0.5 per cent. The output effect of rainfall on agriculture in India is still very severe; the deviation of rainfall from normal by one per cent could adversely affect agriculture output growth by 0.8 per cent.

The above defined regression equation is further modified by including number of accounts of direct agriculture credit and number of indirect agriculture credit accounts. The parameters are estimated using difference GMM (Table 9). The lagged values of the endogenous and predetermined variables and exogenous variables are used as instrumental variables. The validity of the instruments and assumption of no serial correlation in the error terms are tested using Sargan test for over identifying restrictions and Arellano-Bond test (*Note* in Table 9) and are found to be satisfactory.

The results from Table 9 reveal that the direct agriculture credit amount is significant and positively explains the variation described in the agriculture output. While the number of indirect agriculture credit accounts is significant at 10 per cent level and positive at first lag. That is more people benefited from the indirect finance to agriculture current year may lead to higher output next year. As in the case of earlier models agriculture area is having a significant positive impact and rainfall (measured as deviation from normal) is negatively affecting the agriculture output. However, the effect of rainfall deviation from normality to agriculture output got substantially reduced once we control for the financial inclusion indicator like number of people covered under agricultural loan facilities from the formal institutional mechanism. The indirect agriculture amount outstanding and direct number of agriculture accounts is found to be insignificant in explaining the variation in agriculture output.

Table 9: GMM estimates for the second regression equation

Variable	GMM estimates	Robust Std. Err.	Z	Prob.	[95% Conf. Interval]	
1	2	3	4	5	6	7
Δpcagout (-1)	0.1292	0.1040	1.2400	0.2140	-0.0745	0.3329
Δpcdacam	0.1050	0.0259	4.0500	0.0000	0.0542	0.1558
Δpcdacn	-0.0121	0.0101	-1.2000	0.2320	-0.0318	0.0077
Δpcidacam	-0.1215	0.1017	-1.1900	0.2320	-0.3208	0.0779
Δpcidacam (-1)	-0.0132	0.0252	-0.5200	0.6010	-0.0625	0.0361
Δpcidan	0.1926	0.1461	1.3200	0.1870	-0.0938	0.4791
Δpcidan (-1)	0.2330	0.1251	1.8600	0.0630	-0.0122	0.4783
Δpcagar	0.6321	0.1470	4.3000	0.0000	0.3441	0.9202
Rain	-0.2447	0.2947	-0.8300	0.4060	-0.8223	0.3330

Note:
GMM results are one-step estimates with heteroskedasticity-consistent standard errors and test statistics.
Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
H0: no autocorrelation z = -4.48 Pr > z = 0.0000
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
H0: no autocorrelation z = 1.61 Pr > z = 0.1082
Sargan test of over-identifying restrictions: chi2(46) = 62.74 Prob > chi2 = 0.051
(Sargan is a test of the over identifying restrictions for the GMM estimators, asymptotically $\chi 2$. This test uses the minimised value of the corresponding two-step GMM estimators.)

Section V. Concluding Remarks

Over the years there has been a significant increase in the access of rural cultivators to institutional credit and, simultaneously, the role of informal agencies, including moneylenders, as a source of credit has declined. Available data suggest that agricultural credit has been rising in recent years as a share of both the value of inputs and the value of output. Among the striking features of the agricultural credit scene in India are the wide regional disparities in the disbursement of agricultural credit by scheduled commercial banks. At the same time the share of agricultural GDP is falling in total GDP. In this context this paper examines the role of direct and indirect agriculture credit in the agriculture production taking care of the regional disparities in agriculture credit disbursement and agriculture production in an econometric framework. This is done using Dynamic Panel Data Analysis with Instrumental Variables using Arellano-Bond Regression using district level data from four select states namely Maharashtra, Andhra Pradesh, Punjab and West Bengal belonging to four different regions in India. Using Arellano-Bond Regression this paper tries to address two econometric problems namely joint dependence of output and credit and unmeasured or immeasurable district characteristics.

The analysis suggests the direct agriculture credit amount has a positive and statistically significant impact on agriculture output and its effect is immediate. The number of accounts of the indirect agriculture credit also has a positive significant impact on agriculture output, but with a year lag. These results reveal that even though there are several gaps in the present institutional credit delivery system like inadequate provision of credit to small and marginal farmers, paucity of medium and long-term lending and limited deposit mobilisation and heavy dependence on borrowed funds by major agricultural credit purveyors, agriculture credit is still playing a critical role in supporting agriculture production in India. As suggested by Mohan (2006), its role can be further enhanced by much greater financial inclusion by involving of region-specific market participants, and of private sector suppliers in all these activities, and credit suppliers ranging from public sector banks, co-operative banks, the new private sector banks and micro-credit suppliers, especially self-help groups.

Notes:

[1] **District GDP of India, 2006-07 - Methodology :** At the first step, Gross State Domestic Product, 2006-07 for each Sector has been estimated for the year 2006-07 using CSO's time series GSDP figures at factor cost and at current prices for 1999-00 to 2005-06. Secondly, in order to distribute these state GDP numbers across districts, variables/indicators have been identified that have the most significant impact on GDP for that specific sector with the help of a detailed econometric analysis. Third, based on these variables an index is created separately for each sector and this index proportion is used to distribute the state level GDP figures obtained across districts within a state. Fourth, district level GDP obtained as above have been crosschecked with already published Government figures for districts from three states-Andhra & Arunachal Pradesh, Karnataka and Jammu & Kashmir for 2000-2001 so as to maintain consistency. Since GDP is estimated for all districts in the country, same methodology is adopted for all states. This obviously puts certain limitations on data that could be used, given the divergence in data availability across time and across states. The main data sources used for the analysis are NAS, CSO, RBI, Census (2001), National Sample Survey Organization's, NDSSPI etc.

[2] States included are: Andhra Pradhesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradhesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradhesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradhesh, Uttarakhand and West Bengal.

[3] The data is available in the Ministry's website *http://www.dacnet.nic.in/eands/APY_96_To_06.htm*

[4] List of these commodities include Arhar (Tur), Bajra, Cotton (lint), Gram, Groundnut, Jowar, Maize, Rapeseed & Mustard, Rice, Soyabean, Sugarcane and Wheat.

[5] At present, scheduled commercial banks (excluding RRBs) are expected to ensure that priority sector advances constitute 40 per cent of net bank credit and within the overall lending target of 40 per cent, 18 per cent of net bank credit goes to the agricultural sector. To ensure that the focus of banks on direct agricultural advances does not get diluted, lending under indirect finance should not exceed one-fourth of the agricultural sub-target of 18 per cent, i e, 4.5 per cent of net bank credit. The classification of direct and indirect agriculture loans by scheduled commercial banks in India are given in Annex 2.

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Annex 1 AGRICULTURE

	DIRECT FINANCE		**INDIRECT FINANCE**		
1	2	3	4	5	6
1.1	Finance to individual farmers [including Self Help Groups (SHGs) or Joint Liability Groups (JLGs), i.e. groups of individual farmers, provided banks maintain disaggregated data on such finance] for Agriculture and Allied Activities (dairy, fishery, piggery, poultry, bee-keeping, etc.)	1.3	Finance for Agriculture and Allied Activities	1.3.11	Advances to Custom Service Units managed by individuals, institutions or organisations who maintain a fleet of tractors, bulldozers, well-boring equipment, threshers, combines, etc., and undertake work for farmers on contract basis.
1.1.1	Short-term loans for raising crops, i.e. for crop loans. This will include traditional/non-traditional plantations and horticulture.	1.3.1	Two-third of loans to entities covered under 1.2 above in excess of Rs. one crore in aggregate per borrower for agriculture and allied activities.	1.3.12	Finance extended to dealers in drip irrigation/ sprinkler irrigation system/agricultural machinery, irrespective of their location, subject to the following conditions: The dealer should be dealing exclusively in such items or if dealing in other products, should be maintaining separate and distinct records in respect of such items. A ceiling of up to Rs. 30 lakh per dealer should be observed.
1.1.2	Advances up to Rs. 10 lakh against pledge/hypothecation of agricultural produce (including warehouse receipts) for a period not exceeding 12 months, irrespective of whether the farmers were given crop loans for raising the produce or not.	1.3.2	Loans to food and agro-based processing units with investments in plant and machinery up to Rs. 10 crore, undertaken by those other than 1.1.6 above.	1.3.13	Loans to *Arthias* (commission agents in rural/ semi-urban areas functioning in markets/ *mandies*) for extending credit to farmers, for supply of inputs as also for buying the output from the individual farmers/ SHGs/ JLGs.

Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.1.3	Working capital and term loans for financing production and investment requirements for agriculture and allied activities.	1.3.3	Credit for purchase and distribution of fertilizers, pesticides, seeds, etc. Loans up to Rs. 40 lakh granted for purchase and distribution of inputs for the allied activities such as cattle feed, poultry feed, etc.	1.3.14	Fifty per cent of the credit outstanding under loans for general purposes under General Credit Cards (GCC).
1.1.4	Loans to small and marginal farmers for purchase of land for agricultural purposes.	1.3.4	Finance for setting up of Agriclinics and Agribusiness Centres.	1.3.15	The deposits placed in RIDF with NABARD by banks on account of non-achievement of priority sector lending targets/sub-targets and **outstanding** as on the date of this circular would be eligible for classification as indirect finance to agriculture sector till the date of maturity of such deposits or March 31, 2010, whichever is earlier.

Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.1.5	Loans to distressed farmers indebted to non-institutional lenders, against appropriate collateral or group security.	1.3.5	Finance for hire-purchase schemes for distribution of agricultural machinery and implements.	1.3.16	Loans already disbursed and outstanding as on the date of this circular to State Electricity Boards (SEBs) and power distribution corporations/companies, emerging out of bifurcation/restructuring of SEBs, for reimbursing the expenditure already incurred by them for providing low tension connection from step-down point to individual farmers for energising their wells and for Systems Improvement Scheme under Special Project Agriculture (SI-SPA), are eligible for classification as indirect finance till the dates of their maturity/repayment or March 31, 2010, whichever is earlier. Fresh advances will, however, not be eligible for classification as indirect finance to agriculture.
1.1.6	Loans granted for pre-harvest and post-harvest activities such as spraying, weeding, harvesting, grading, sorting, processing and transporting undertaken by individuals, SHGs and cooperatives in rural areas.	1.3.6	Loans to farmers through Primary Agricultural Credit Societies (PACS), Farmers' Service Societies (FSS) and Large-sized Adivasi Multi Purpose Societies (LAMPS).	1.3.17	Loans to National Co-operative Development Corporation (NCDC) for on-lending to the co-operative sector for purposes coming under the priority sector will be treated as indirect finance to agriculture till March 31, 2010.

Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.2	Finance to others [such as corporates, partnership firms and institutions] for Agriculture and Allied Activities (dairy, fishery, piggery, poultry, bee-keeping, etc.)	1.3.7	Loans to cooperative societies of farmers for disposing of the produce of members.	1.3.18	Loans to Non-Banking Financial Companies (NBFCs) for on lending to individual farmers or their SHGs/JLGs.
1.2.1	Loans granted for pre-harvest and post harvest activities such as spraying, weeding, harvesting, grading, sorting and transporting.	1.3.8	Financing the farmers indirectly through the co-operative system (otherwise than by subscription to bonds and debenture issues).	1.3.19	Loans granted to NGOs/MFIs for on-lending to individual farmers or their SHGs/JLGs.
1.2.2	Finance up to an aggregate amount of Rs. one crore per borrower for the purposes listed at 1.1.1, 1.1.2, 1.1.3 and 1.2.1 above.	1.3.9	Existing investments as on March 31, 2007, made by banks in special bonds issued by NABARD with the objective of financing exclusively agriculture/allied activities may be classified as indirect finance to agriculture till the date of maturity of such bonds or March 31, 2010, whichever is earlier. Fresh investments in such special bonds made subsequent to March 31, 2007 will, however, not be eligible for such classification.		

Annex 1 AGRICULTURE

	DIRECT FINANCE		INDIRECT FINANCE		
1	2	3	4	5	6
1.2.3	One-third of loans in excess of Rs. one crore in aggregate per borrower for agriculture and allied activities.	1.3.10	Loans for construction and running of storage facilities (warehouse, market yards, godowns, and silos), including cold storage units designed to store agriculture produce/ products, irrespective of their location. If the storage unit is registered as SSI unit/micro or small enterprise, the loans granted to such units may be classified under advances to Small Enterprises sector.		