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The Effect of Formal Credit on Output and Employment in Rural India

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and
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Improving credit in rural India greatly improves rural nonfarm employment and output. It has only a modest effect on crop output — more because of increased use of fertilizer than because of capital investments, which merely substitute for farm labor.

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Using a two-stage model to distinguish demand for formal credit from supply, Khandker and Binswanger conclude that increased formal credit has a positive effect on crop production, on the use of fertilizer, and on private investment in machines and livestock.

The effect of expanded credit on crop output is small, however. Crop output improves more because of increased use of fertilizer than because of capital investments, which merely substitute for labor.

Credit decreases farm employment, yet increases the real agricultural wage because of its overwhelmingly positive effect on rural nonfarm employment.

In short, improved financial intermediation in rural India greatly improves rural nonfarm employment and output, has a modest effect on crop output, and tends to substitute capital investment for farm labor.

This paper is a product of the Women in Development Division, Population and Human Resources Department. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Belinda Smith, room S9-125, extension 35108 (28 pages with tables).

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Introduction

Government financial intermediation in rural economies is geared to mobilize rural savings and foster agricultural output and investment via lending. There is a growing body of literature that has focused on the linkages between credit market development and economic growth, the role of financial institutions in savings mobilization and the effect of credit on agricultural investment and output (Braverman and Guasch, 1986; David and Meyer, 1980; Feder et al., 1988; Giovannini, 1985; Goldsmith, 1969; Gupta, 1987; Iqbal, 1986; Shaw, 1973; Von Pischke et al., 1983).

Credit can play an important role in agriculture. Because farmers often suffer from a cash-flow problem, their liquidity constraint produces sub-optimal inputs use and hence output. The role of credit, therefore, is to bring the sub-optimal outcome to "optimal" level and enhance farmer investment and output. Government credit institutions often grant larger volumes of credit for longer terms and at lower interest rates than the informal market. For examle, according to Reserve Bank of India (RBI), a sum of Rupees 101.3 billion was advanced to the rural sector of India by formal lending agencies in 1980/81, about 78 percent increase compared to the amount advanced in 1969/70. In subsidizing the growth of an institutional credit program for agriculture, the policy makers face the question: to what extent formal credit contributes to agricultural investment and output and consequently rural employment and wages.

This paper estimates the output, investment, employment and wage effect of institutional credit using district-level panel data from India. The central problem of estimating the causal relationships is how to disentangle the aggregate demand for credit from its supply. What we observe here is only a total amount of credit advanced by different government lending agencies. This amount represents both the demand for and supply of institutional credit. However, identification of the effects of exogenous increases in credit supply is critical. There is an additional simultaneity problem: credit demand, output supply, and farmer investment are jointly determined in the farmer's utility maximization.

In an earlier paper (Binswanger, Khandker and Rosenzweig, 1988) we circumvented the issue of simultaneity of credit demand and supply by estimating the effect of the number of rural commercial bank branches on agricultural output and investment rather than the effect of the volume of credit. Because the growth of rural commercial bank branches is controlled entirely by the banks and public policy, it is exogenous to the credit demand of farmers. Our findings suggested that commercial bank expansion had significant positive effects on farmer's fixed investment, fertilizer demand and output but the input effect is stronger than the output effects. Commercial banks also increase agricultural wage and helps reduce the incidence of rural poverty. However, because banks promote private capital investment in agriculture that replaces farm labor, the positive wage effect of improved financial intermediation is due to its strong (positive) effect on rural nonfarm employment and output (Khandker, 1989).

The commercial banks (CB) are, however, not the only agencies that advance credit to agriculture. Agencies such as the Primary Agricultural Co-operative Societies (PACS) and the Land Development Banks (LDBs) also provide credit to Indian farmers.[1] The earlier paper could not estimate the direct effect of the PACS and the LDBs on output and investment as the growth of PACS and LDBs, unlike CBs, does not measure the level of their operations. This is because in recent years while their lending has increased their numbers have been declining as smaller societies or branches have been merged. The question thus emerges: do our findings differ if we estimate the direct effect of total formal credit advanced to the rural sector?

This paper addresses this issue. To identify the credit supply from its demand, the number of rural branches of CBs, PACS, LDBs and Central Coperative branches (CCBs) are used as instruments to predict the volume of credit advanced. The predicted volume of credit is then used in the second stage of a two-stage procedure to estimate the effect of the volume of institutional credit on agricultural investment and output. Although the number of PACS may be negatively related to the volume of total lending, the purpose essentially here is to exploit the presence of correlation between the exogenous and the predicted variables.

The paper is structured in the following manner. Section two discusses the model framework and its estimation technique. Section three discusses the data. Section four reports the results. Finally, the results are summarized in the concluding section of the paper.

II. An Econometric Framework

Additional credit supply can raise output, input use, and hence investment, employment and wages when the farmer faces a credit constraint. This is the liquidity effect of credit. Credit has another role to play. In most developing countries where agriculture still remains a risky activity, better credit facilities, by enabling the smoothing of consumption, can increase the willingness of farmers to take risk and hence increase agricultural investment, output, employment and wages. This is the consumption smoothing effect of credit. Thus, better rural credit markets may lead to a volume of agricultural investment and output and consequently rural employment and wages which may not be attainable with a less developed or less efficient credit system.

The informal credit sector consisting of a large professional money lenders, commission agents, traders, relatives and friends plays an important role in rural India (Timberg and Aiyer, 1984). However, with the growth of formal credit market development, the importance of the private lending has reduced. According to All India Debt and Investment Survey, the proportion of farmers' cash debt from formal sources rose from 18 in 1961 to 32 percent in 1971. In contrast, the proportion of loan from rural money lenders has declined from 83 to 36 percent over this period. Although Indian official statistics provide district-level information on institutional credit advanced, the information on informal credit does not exist. Thus, without information on informal credit it is difficult to quantify to what extent this transition in farmer's source of credit from private to government has helped increase agricultural investment, output, rural employment and wages in India.

Nevertheless with data on formal credit it is possible to quantify its effect on agricultural output and investment. But, because money is fungible and farmers also get loan from the private lenders, the lack of information on informal credit may influence the effects of formal credit on output and investment. However, because the terms of credit in the formal system are better than from money lenders, farmers often try first to satisfy their credit demand by approaching the formal lending agencies. If they fail to satisfy their need for credit they then perhaps would approach the informal lenders at a higher rate of interest. This suggests that the absence of information regarding informal loans may not affect the estimates of the effects of institutional credit (Feder et. al., 1988).

The credit advanced by formal lending agencies is an outcome of both the supply of and demand for formal credit. The amount of formal credit available to farmer, his credit rations, enters into the output supply, input demand (e.g., fertilizer, employment) and wage functions as an independent argument.[2] We, therefore, need to disentangle the supply of formal credit from its demand. A two-stage procedure can solve this identification problem. Since financial institutions decide how many branches or offices a district should have, the number of offices is exogenous to farmer demand. In estimating the output or input effect of institutional credit, I first estimate a credit equation with credit advanced as the dependent variable with, among others, the number of branches of financial institutions as explanatory variables. This provides a predicted amount of credit supplied to each district by formal financial intermediaries which is then used in the second-stage estimation of output supply or input demand and wage equations.

Formal agricultural lending is not exogenously given or randomly distributed. As discussed in Binswanger, Khandker and Rosenzweig (1988), both the farmers and financial institutions are influenced by agricultural opportunities implied in the agroclimatic endowments of a district. That means, the lending agencies will lend more in areas where agricultural opportunities are better, risk is lower, and hence loan recovery is higher (Binswanger and Rosenzweig, 1986). An unobserved variable problem thus arises for the econometric estimation which can be overcome by the use of district-level panel data.

The system of equations to be estimated with the district-level time-series data are the following:

(1) $ICr_{jt} = ICr(X_{jt}, Z_{jt}, \mu_j t, \delta_j)$

(2) $Q_{jt} = Q_{jt}(X_{jt}, ICr_{jt}, \mu_j t, \delta_j)$

(3) $INp_{jt} = INp_{jt}(X_{jt}, ICr_{jt}, \mu_j t, \delta_j)$

(4) $INv_{jt} = INv_{jt}(X_{jt}, ICr_{jt}, INv_{j(t-1)}, \mu_j t, \delta_j)$

(5) $WAGE_{jt} = WAGE_{jt}(X_{jt}, ICr_{jt}, \mu_j t, \delta_j)$

where equation (1) is the district's prediction equation for institutional credit advanced to rural sector by the formal lenders; (2) is the output supply equation; (3) is the input demand equation; (4) is the investment equation and (5) is the wage equation. Here ICr stands for institutional credit advanced, X is a vector of exogenous explanatory variables (e.g., the output and input prices, government infrastructure, interaction terms between year and agroclimatic endowments, the rate of interest); Z is a vector of the number of formal lending agencies; Q is aggregate crop output; INp is the level of input (fertilizer and employment) utilized; INv stands for investment in pumps, draft animals, milk animals and small stocks; WAGE is daily wage of agricultural workers; μ is vector of observable district-specific permanent characteristics; δ is district-specific unobservable characteristics influencing investment and output; j stands for district and t stands for time. The interaction terms between year (t) and agroclimates (μ_j) allow for a district-specific time trend which, among other factors, allows for district-specific rate of technical change.

In order to estimate the causal relationships between, say, output growth and government infrastructure the simultaneity problem arising out of the response of both government and farmers to the heterogenous district endowments must be overcome. This is done by the use of panel data with either the fixed or random effects technique. If the unobserved endowments are time-invariant and specific to each district, then a fixed effects procedure is appropriate. The random effects procedure accounts for the existence of both time-invariant and time-varying error components. The random effects procedure, however, ignores any correlation between the persistent errors (endowment effects) and time-varying observed variables. We use Hausman-Wu specification test to determine whether the fixed or random effects model is appropriate for the given data and present results accordingly.

III. Data and Variable Description

The data used in this paper are drawn from 85 districts of India for a period of 9 years beginning from 1972/73 to 1980/81. The number of observations vary depending on the data available for particular dependent variable. Thus, 765 observations (9 years x 85 districts) are used for the output supply and wage equations, 738 (9 year x 82 districts) observations for the fertilizer equation, 228 (3 years x 76 districts) observations f the investment equations, and only 170 (2 years x 85 districts) observations for the farm and nonfarm employment equations. The investment data are computed fr livestock censuses of 1966, 1972, 1976 and 1982, while fertilizer, crop output, and wage data are from yearly fertilizer, wage, and agricultural statistics published by the Ministry of Agriculture of India. Crop output is the aggregate index of 20 crops using 1975/76 as the base year, fertilizer is measured in nutrient tons of nitrogen, phosphate and potash, and the wage rate is the daily wage rate of agricultural field workers. The investment variables are the net additions over each census interval to the stock of draft animals (male bullocks and male buffalos), milk animals (female bullocks and female buffalos), small stocks (sheep and goats) and pumps (both diseal and electric).[3] Employment data are drawn from the population censuses of 1970 and 1980 which are comparable with agricultural census years of 1971 and 1981. By employment we mean here the number of persons who were employed in farm or nonfarm activities for atleast 183 mandays in one year.

The government infrastructure variables include road length, regulated markets, primary school density, rural electrification and canal irrigation. All the infrastructure and dependent variables are normalized by the district's size. The price variables are the aggregate price index based on the international commodity prices, an all India price index of fertilizer, the district-level urban wage income, and the PACS rate of interest. The agroclimate variables include annual rainfall and permanent characteristics such as soil moisture capacity, length of rainy season, exceesive rainy months, irrigation potential, number of cold months and flood potentials. For a detailed discussion of these variables see Binswanger, Khandker and Rosenzweig, (1988).

The data for the CBs and the CCBs are published by the Reserve Bank of India in Banking Statistics. The National Bank for Agriculture and Rural Development (NABARD) of India has kindly provided unpublished data on the PACS and the LDBs which were collected by sending questionnaires to the State headquarters of these institutions.[4] Note that the CCBs primarily advance credit to agriculture via lending to the PACS and the LDBs. Thus, rural credit is defined in this paper as the amount of institutional credit advanced to the rural sector by the CBs and the credit advanced to agriculture by the PACS and the LDBs. Rural credit thus reflects both the subsidized agricultural credit advanced by the PACS, LDBs and CBs and non-subsidized nonagricultural credit advanced by the CBs. The variable such as subsidized agricultural credit cannot be constructed because district-level data on agricultural credit advanced by the CBs are not available. Since money is fungible, it is the effect of rural credit that is perhaps important to look at. However, I report the effects of credit advanced by the cooperative sector (i.e., PACS and LDBs) to compare with those of rural credit advanced by the banking system (i.e., PACS, LDBs and CBs). The mean and standard deviation of variables involved in this paper are presented in table 1.

IV. The Results

The estimates of the credit supply equation are shown in table 2. As the Hausman-Wu test suggests, the fixed effects procedure is appropriate to explain variations in the amount of rural credit advanced. The real urban wage has a negative effect on the amount of institutional credit advanced. An increase in urban wage which is correlated with the urban upswing may tend to divert credit from rural to urban sector. The roads improvement and regulated markets development have positive effects on the credit amount advanced by the lending agencies because of the induced demand effect via their positive infrastructural effects on agricultural output and investment. Rural electrification has a negative effect on the rural loan advanced by government agencies.

The number of branches generally have a positive effect on the volume of institutional credit advanced to rural households. The negative effect of PACS on credit supply is not surprising given the reduction in the PACS associated with consolidation of primary societies. Better agroclimates such as high irrigation potential and high soil moisture capacity lead to higher credit use. Lending is also higher in areas with low flood risk as measured by flood potential. In contrast, the credit volumes are lower in areas with longer rainy seasons.

Based on the estimates of table 2, we predict the amount of credit supplied to each district by formal lending agencies each year. Using this predicted credit amount as an explanatory variable, among others, we then estimate the fertilizer demand and aggregate output supply equations. These estimates are presented in table 3. The Hausman-Wu test suggests that the fixed effects procedure is appropriate for explaining variations in both the fertilizer demand and output supply over time.

The institutional credit has a positive effect on both the fertilizer demand and aggregate output. A 10 percent increase in the formal credit leads almost 3 percent increase in fertilizer consumption and only 0.2 percent in aggregate crop output. The output effect of credit is thus fairly low. If the fertilizer elasticity of crop output is, say, 0.01, it appears that fertilizer consumption increased by formal credit explains more than the increase in output due to credit. The fertilizer price has a negative effect on fertilizer demand indicating a negative own-price effect. However, the fertilizer price has a perverse positive effect on crop output. The urban wage has a positive effect on both the output and fertilizer, perhaps indicating a positive income effect induced by increased urban demand for farm goods. Regulated market and rural electrification have a positive effect on both the fertilizer demand and output supply, suggesting a positive induced infrastructural effect on agricultural production. Road length, however, has an unexpected negative effect on fertilizer demand. Canal irrigation increases fertilizer consumption. Better agroclimates such as higher rainfall, high irrigation potential and high soil moisture capacity have a positive effect on the growth in fertilizer demand and output supply. In contrast, poor agroclimatic conditions such as excess rain have a negative effect on the growth of fertilizer demand and hence crop output.

The investment effect of institutional credit on draft and milk animals, small stocks and irrigation pumps is shown in table 4. The Hausman-Wu test indicates that the random effects model is more appropriate than the fixed effects in explaining variations in the private investment over time. Institutional credit has an overwhelming positive effect on all types of private agricultural investment. A 10 percent increase in the amount of institutional credit advanced raises private investment in irrigation pumps by 4 percent, 6 percent in milk animals, about 5 percent in draft animals and almost 7 percent in sheep and goats. The credit effect of investment is thus much higher than its effect on fertilizer use and aggregate crop output.

The crop output price has an expected positive effect on investment in draft animals, small stocks and irrigation pumps, indicating a positive farm profit effect on the private investment. The fertilizer price has a negative effect on draft animals and small stocks, while a positive effect on milk animals. Real urban wage has a negative effect on investment in milk animals and small stock. Real urban wage has two possible effects: one is the opportunity cost effect of labor and the other is an income effect. The results suggest that the opportunity cost of human labor (negative) is outweighed by the positive income effect of urban wage for the private investment in draft animals and pumps. The road investment has a negative effect on investment in draft and milk animals, indicating that private investment in animals reduces as roads communication improves. Primary school expansion, rural electrification and regulated markets have expected positive effects on private investment in some capital goods.

The past stock has an expected negative effect on current investment, because of an adjustment process in an equilibrium regime. Private investment on pumps and small stocks increases over time in wheat producing areas where the mean temperature falls below 18 degree Farenheit. In contrast, irrigation potential reduces investment in small stocks over time. Better agroclimates such as the length of rainy season encourage private investment in milk animals over time, while the poor agroclimates such as excess rain discourage it.

The effect of formal credit on farm and nonfarm employment and agricultural real wage is shown in table 5. The Hausman-Wu test confirms that the random effect model is more appropriate than the fixed effect model in explaining variations in employment and wage over time. Institutional credit decreases agricultural employment by increasing private capital investment in agriculture that replaces farm labor, and yet increases agricultural real wage because of its strong positive effect on rural nonfarm employment. A 10 percent increase in institutional credit increases nonfarm employment by almost 18 percent, while reduces farm employment by only 0.4 percent and consequently increases agricultural real wage also by 0.4 percent. As can be seen from table 5, rural electrification like formal credit reallocates labor from agriculture to rural nonagricultural activities and thus helps increase agricultural real wage.

In contrast, the aggregate crop output price increases both the farm and rural nonfarm employment and hence agricultural real wage. Real urban wage has a negative effect on farm employment but a positive effect on agricultural real wage because of its demand-pull effect on the rural sector. Regulated market and primary school expansion have a negative effect on both the rural nonfarm employment and agricultural real wage, although they have a positive effect on farm employment. A 10 percent increase in the rural market regulation increases farm employment by only 6 percent, but decreases rural nonfarm employment by almost 10 percent and consequently agricultural real wage by about 6 percent.

Better agroclimates such as higher annual rainfall and irrigation potential increases agricultural real wage and employment.[5] In contrast, farm employment has declined over time in wheat producing areas where the number of cool months (i.e., when the mean temperature falls below 18 degree Farenheit) is higher.

The summary results of the effect of rural credit, cooperative credit and number of commercial bank branches on agricultural output, investment, wage and rural employment are presented in table 6. As this table suggests, the results do not differ substantially whether number of commercial bank branches or volume of rural lending or volume of cooperative lending is used. More bank branches and more credit (either agricultural or nonagricultural) increase agricultural output with an elasticity of about 0.02, and fertilizer use with an elasticity in the range of 0.1-0.3. They lead to higher investment in tractors, pumps, draft animals and small stocks, with investment elasticities of between 0.14 to 0.71. Although cooperative credit seems to have no significant effect on rural employment and wages, commercial bank branches and rural credit have significant impact on these outcomes. For example, they increase rural nonfarm employment with an elasticity of 0.2 to 0.3, while higher bank branches decrease agricultural employment with an elasticity of 0.07. Nevertheless banking expansion or formal credit expansion increase agricultural real wage with an elasticity in the range of 0.04 to 0.06.

V. Conclusions

This paper has estimated the effect of institutional credit on agricultural output, investment, fertilizer demand, farm-nonfarm employment and real wage using district-level panel data from India. In India special credit programs were launched after the nationalization of commercial banks in 1969 to support the country's green revolution in agriculture. An important policy question thus emerges: to what extent low-interest insitutional credit has helped increase private investment and output in Indian agriculture and consequently rural employment and wage.

A panel data analysis is used to estimate the output and input effect as well as wage effect of formal credit. The number of branches of lending agencies are determined by the financial intermediaries and thus exogenous to farmer demand for credit. They can, therefore, be used as instruments to identify the aggregate supply of formal credit from its demand. These instruments also help solve the simultaneity between the credit supply, output supply, input demand and wage equations. By using panel data we circumvent the unobserved variable problem that could otherwise produce inconsistent estimates in cross-section data analysis.

Econometric estimates suggest that formal credit plays an important role in fertilizer demand, private fixed investment, crop output, farm-nonfarm employment and agricultural real wage in India. A 10 percent increase in formal credit supply increases fertilizer use by almost 3 percent. A similar percentage increase in the supply of institutional credit spurs a 4 percent increase in private investment in irrigation pumps, 5 percent each in draft animals, 6 percent in milk animals, and about 7 percent in small stocks. In contrast, a 10 percent increase in formal credit supply increases aggregate crop output by only 0.2 percent. Compared to the credit effect of investment and fertilizer demand, the crop output effect appears fairly small. Since increased fertilizer consumption induced by formal credit can explain more than the credit effect of output, it appears, therefore, that additional capital investment has worked more for substituting agricultural labor than for increasing crop output. Thus, a 10 percent increase in the formal credit has reduced agricultural employment by 0.4 percent. However, institutional credit has a modest positive effect on agricultural real wage. This is because it has created more jobs in the rural nonfarm activities than it has substracted in agriculture. For example, a 10 percent increase in formal credit increases rural nonfarm employment by almost 18 percent and agricultural real wage by 0.4 percent. Formal credit expansion in rural India, therefore, has had a major effect on rural nonfarm sector and a modest effect in agriculture despite the considerable directed policy to increase formal credit supply for agriculture. Finally, the results do not vary substantially whether one uses the number of commercial bank branches or volume of lending (rural or agricultural) as a measure of growth of rural financial intermediation.

Footnotes

1 It is worth noting that the CBs who advance more rural credit than the PACS and the LDBs. For example, RBI reports that in 1981 the CBs advanced 776.3 billion rupees to the rural sector, while the coopearive sector (i.e., PACS and LDBs) advanced only 236.7 billion rupees, a third of what the CBs advanced.

2 Credit can enter into the output supply and hence input demand and investment or wage functions if credit is a binding constraint in rural household's input-output decision-making. Assume that a farmer maximizes output function, $Q = K^{\alpha}X^{\beta}$ (i)

subject to a liquidity constraint,

$$rX = \delta \quad \text{(ii)},$$

where Q is crop output, K is fixed capital such as livestock and irrigation pumps, r is the price of variable inputs (X) such as labor and fertilizer, δ is the total credit available to purchase variable inputs; and equation (i) is the familiar Cobb-Douglas production function. By simple manipulation, one can derive the input demand equation as

$$X^c = r^{-1}\delta \quad \text{(iii)}$$

and the output supply equation as

$$Q^c = K^{\delta}r^{-\beta}\delta^{\beta} \quad \text{(iv)}$$

where X^c and Q^c are, respectively, credit-constrained level of input use and crop output. If competitive labor market exists and equilibrium condition is satisfied, one can also show agricultural wage as a function of credit ration available to the farmers.

3 A second-stage equation for tractors could not be estimated because none of the explanatory variables has a significant effect on the tractors investment. Thus, the tractor variable was dropped.

4 Thanks to Dr. Gadgil of NABARD who has kindly opened the data base and personally organized the assembly of the unpublished banking data. This paper would not have been feasible without his kind help in collecting the banking data.

5 Since employment equations represent occupational status of rural households over the decade of 1970, the annual rainfall variable does not enter into these equations. This is, however, not the case with agricultural wage which comes from annual data.

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TABLE 1. DESCRIPTIVE STATISTICS

Dependent Variable	Number of Observations	Mean	Standard deviation
Aggregate crop output index	765	1.338	1.168
Fertilizer consumption, nutrient tons/ 10 sq. km.	738	23.784	30.997
Net investment in draft animals, number/ 10 sq. km.	228	6.755	17.102
Net investment in milk animals, number/ 10 sq. km.	228	17.974	27.691
Net investment in small stocks, number/ 10 sq. km.	228	5.948	15.426
Net investment in pumps, number/ 10 sq. km/	228	1.645	2.034
Credit advanced to rural sector, '000 Rs./ 10 sq. km.	765	283.991	421.445
Cooperative credit advanced to agriculture	765	93.615	203.583
Agricultural real wage (Rs./man day)	765	5.294	2.165
Agricultural employment, persons/10 sq. km	170	235.492	196.889
Nonagricultural employment, persons/10 sq. km	170	153.989	206.158
Independent Variable			
Aggregate real crop price index	765	0.851	0.328
Real price of fertilizer	765	3.459	0.493
Annual urban wage (real)	765	4373.277	1406.924
Canal irrigation, '000 ha/10 sq. km.	765	0.068	0.101
Number of regulated markets/ 10 sq. km.	765	0.019	0.025

Independent Variable	Number of Observations	Mean	Standard deviation
Number of villages with primary school/10 sq. km.	765	1.289	0.663
Number of villages with electricity/ 10 sq. km.	765	0.976	0.865
Total road length/10 sq. km.	765	5.369	4.986
Number of rural and semi-urban branches of commercial banks/10 sq. km.	765	0.101	0.132
Number of cooperative bank branches/ 10 sq. km.	765	0.031	0.026
Number of agricultural co-operative societies/10 sq. km.	765	0.436	0.277
Number of land development banks/ 10 sq. km.	765	0.010	0.006
Annual rainfall in mm	765	1120.059	964.609
Soil moisture capacity index	85	2.349	1.01
Length of rainy season, months	85	3.653	1.368
Excess rainy months, number	85	1.236	1.394
Number of cold months	85	0.935	1.313
Percentage of area liable to flooding	85	1.389	3.532
Percentage of area potential for irrigation	85	30.001	31.909

TABLE 2. DETERMINANTS OF INSTITUTIONAL CREDIT ADVANCE TO RURAL SECTOR

Explanatory variable	Institutional Credit (Fixed Effects)	
Aggregate real crop (real) price (lagged)[a]	-0.084	(-0.841)
Real price of fertilizer[a]	-0.249	(-1.003)
Real urban wage[a]	-0.323	(-2.323)*
Rainfall x 10^3	15.894	(0.724)
Roads[a]	2.489	(5.523)*
Regulated markets[a]	0.490	(3.254)*
Primary schools[a]	0.984	(1.328)
Rural electrification[a]	-0.353	(-1.925)*
Canal irrigation[a]	-0.278	(-1.385)
Commercial banks[a]	0.861	(9.185)*
Cooperative Banks[a]	0.259	(2.038)*
Primary cooperative societies[a]	-0.813	(-4.499)*
Land development banks[a]	-0.228	(-1.467)
Year	-0.003	(-0.027)
Year x irrigation potential	0.347	(2.873)*
Year x excess rain months	0.863	(0.265)
Year x length of rainy season	-5.942	(-2.563)*
Year x soil moisture capacity	7.029	(2.473)*
Year x flood potential	-1.954	(-1.990)*
Year x no. of cold months	-3.659	(-1.339)
F-Statistic	44.52	
Hausman-Wu (chi-square, 20 df.)	42.536	
Number of observations	765	

Note: t-statistics are in parentheses. Asterisk refers to significance level of 10 percent or better.
[a] coefficients are in elasticity form.

TABLE 3. EFFECT OF INSTITUTIONAL CREDIT ON FERTILIZER CONSUMPTION AND AGRICULTURAL OUTPUT

Explanatory Variable	Fertilizer Consumption	Aggregate Crop Output
Institutional credit (predicted)[a]	0.285	0.021
	(6.949)*	(1.344)§
Aggregate real output price index (lagged)[a]	0.058	0.012
	(1.123)	(0.414)
Real price of fertilizer[a]	-0.506	0.114
	(-4.041)*	(1.660)*
Real urban wage[a]	0.185	0.131
	(2.917)*	(3.124)*
Regulated market[a]	0.249	0.091
	(3.111)*	(2.223)*
Canal irrigation[a]	0.239	-0.076
	(2.445)*	(-1.389)
Rural electrification[a]	0.242	0.050
	(2.710)*	(1.031)
Road length[a]	-0.727	-0.140
	(-2.862)*	(-1.022)
Primary school[a]	0.583	0.219
	(1.526)	(1.065)
Annual rainfall x 10^3	1.008	1.078
	(1.081)	(3.778)*
Year	-2.951	-0.000
	(-4.496)*	(-0.021)
Year x irrigation potential	0.022	0.001
	(3.858)*	(5.618)*
Year x excess rain	-0.677	-0.006
	(-4.733)*	(-1.528)
Year x soil moisture capacity	0.563	0.008
	(4.087)*	(2.262)*
Year x length of rainy season	0.369	-0.008
	(2.566)*	(-2.810)*
Year x flood potential	-0.022	-0.001
	(-0.516)	(-0.988)
Year x no. of cold months	0.506	0.001
	(3.411)*	(0.142)
F-Statistic	60.446	19.99
Hausman-Wu (chi-square, 17 df.)	36.974	34.098
Number of observations	738	765

Note: t-statistics are in parentheses. Asterisk refers to significance level of 10 percent or better on a two-tail test.
[a] coefficients are in elasticity form.
§ refers to a 10 percent level of significance on a one-tail test.

TABLE 4. EFFECT OF INSTITUTIONAL CREDIT ON AGRICULTURAL INVESTMENT

(No. of Observations = 228)

Explanatory variable	Investment in: Draft animals	Milk animals	Small stocks	Pumps
Institutional credit (predicted)[a]	0.483	0.340	0.671	0.444
	(2.229)*	(5.169)*	(2.822)*	(3.906)*
Aggregate real crop output price, lagged a	2.344	0.017	1.432	0.395
	(3.233)*	(0.042)	(1.850)*	(1.742)*
Real fertilizer price a	-14.291	-11.953	-19.819	0.135
	(-5.004)*	(7.562)*	(-6.569)*	(0.093)
Real urban wage a	0.075	-1.052	-3.939	0.037
	(0.066)	(-1.718)*	(-6.568)*	(0.066)
Roads [a]	-1.621	-1.789	1.205	-0.265
	(-1.839)*	(-3.353)*	(1.165)	(-0.559)
Canal irrigation [a]	-0.579	-0.190	0.008	-0.312
	(-1.001)	(-0.517)	(0.011)	(-0.977)
Primary schools [a]	6.477	-0.670	0.489	0.121
	(3.706)*	(-0.639)	(0.242)	(0.132)
Electrification[a]	0.285	0.406	-0.754	0.231
	(0.727)	(1.826)*	(-1.774)*	(1.129)
Regulated markets[a]	-0.094	0.396	0.279	-0.023
	(-0.216)	(1.643)*	(0.589)	(-0.104)
Rainfall x 10^3	2.376	22.895	-5.965	0.732
	(0.477)	(2.800)*	(-1.138)	(1.097)
Past stock	-0.239	-0.041	-0.205	-0.100
	(-14.593)*	(-0.901)	(-14.260)*	(-9.543)*
Year	-0.499	2.971	1.367	0.002
	(-0.807)	(2.894)*	(2.061)*	(0.020)
Year x cool months	0.105	-0.137	0.485	0.025
	(1.434)	(-0.904)	(4.913)*	(2.319)*
Year x rainy season	0.091	0.691	0.119	0.003
	(0.965)	(3.709)*	(0.960)	(0.189)
Year x flood potential	-0.006	0.035	0.095	0.002
	(-0.193)	(0.569)	(2.315)*	(0.495)
Year x irrigation potential	0.005	0.002	-0.015	-0.001
	(1.424)	(0.216)	(-3.087)*	(-0.103)
Year x Soil moisture capacity	(-0.041)	-0.239	-0.116	-0.008
	(-0.460)	(-1.332)	(-0.967)	(-0.634)
Year x excess rain months	0.101	-0.419	-0.158	-0.005
	(1.273)	(-2.601)*	(-1.464)	(-0.390)
Constant	120.182	-75.226	106.845	0.426
	(3.173)*	(-1.286)	(2.896)*	(0.089)
F-Statistic	23.440	30.939	19.668	6.988
Hausman-Wu (Chi-square, 18 df)	14.195	17.891	20.576	13.888

Notes: t-Statistics are in parenthesis. Asterisk refers to significance level of 10 percent or better on a two-tail test.

[a] Coefficients of these variables are in elasticity form.

TABLE 5. EFFECT OF INSTITUTIONAL CREDIT ON FARM AND NONFARM EMPLOYMENT AND AGRICULTURAL WAGE

Explanatory Variable	Nonfarm employment	Farm employment	Agricultural wage
Institutional credit (predicted)[a]	0.175	-0.044	0.040
	(5.769)*	(-1.881)*	(2.709)*
Aggregate real crop output price index (lagged)[a]	0.141	0.114	0.038
	(1.331)§	(2.542)*	(1.624)*
Real price of fertilizer[a]	0.420	0.068	0.051
	(0.979)	(0.207)	(0.866)
Real urban wage[a]	-0.049	-0.206	0.394
	(-0.289)	(-1.589)	(11.738)*
Regulated market[a]	-0.098	0.057	-0.059
	(-2.091)*	(1.628)*	(-1.829)*
Canal irrigation[a]	0.054	-0.086	-0.046
	(0.661)	(-1.358)	(-1.105)
Rural electrification[a]	0.138	-0.058	0.061
	(3.428)*	(-1.966)*	(1.512)§
Road length[a]	0.153	0.063	-0.174
	(1.142)	(0.565)	(-1.889)*
Primary school[a]	-0.607	0.134	-0.261
	(-3.251)*	(0.933)	(-1.755)*
Annual rainfall x 10^3	-	-	0.272
	-	-	(2.817)*
Year	0.061	0.725	0.025
	(0.044)	(-0.411)	(0.679
Year x irrigation potential	0.001	0.044	0.001
	(0.059)	(3.163)*	(1.642)*
Year x excess rain months	0.866	-0.519	0.007
	(3.265)*	(-1.494)	(1.039)
Year x soil moisture capacity	-0.455	0.289	-0.008
	(-1.729)*	(0.841)	(-1.200)
Year x length of rainy season	0.316	0.853	0.003
	(1.020)	(2.104)*	(0.356)
Year x flood potential	0.021	0.154	-0.001
	(0.248)	(1.439)	(-0.285)
Year x no. of cold months	0.286	-0.676	0.004
	(1.211)	(-2.209)*	(0.683)
F-Statistic	29.586	10.945	26.822
Hausman-Wu (chi-square)	14.955	18.428	16.439
Number of observations	170	170	765

Note: t-statistics are in parentheses. Asterisk refers to significance level of 10 percent or better on a two-tail test.
[a] coefficients are in elasticity form.
§ refers to a 10 percent level of significance on a one-tail test.

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