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WHAT DETERMINES THE AVAILABILITY OF FORMAL AGRICULTURAL BANK CREDIT IN RURAL INDIA? A MACRO PERSPECTIVE

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Abstract

The central organising theme of this paper is the study of the factors that determine the availability of formal agricultural credit to rural households in India for the period 1991-92 to 2018-19. Grounded in economic theory, this work proposes a model of the determinants of the availability and access to formal agricultural bank credit in India by accounting for both the underlying demand and supply functions of the aggregate formal credit market of Indian agriculture. The study uses an Ordinary Least Squares framework to analyse the issue under consideration while carefully framing the estimated model in terms of the underlying theory, its econometric properties and the policy robustness of estimated results. The study finds that active policy interventions on the demand side of the agricultural credit market in India are the urgent need of the hour if the objectives of financial inclusion and inclusive development are to be achieved in spirit and action. This is the case because the availability of formal bank credit to agricultural borrowers is found to be largely driven by factors that directly affect the demand for credit rather than its supply. With an already well-regulated allocation and distribution environment for agricultural credit in India, it is now the demand-side forces that require active policy disruptions and innovations.

Keywords: Agricultural Credit, Agricultural Economics, Agricultural Productivity, Bank Credit, Financial Inclusion, Food Price, Rural Development.

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Introduction

The way credit manifests itself in the agricultural production process has transformed considerably since the initiation of economic reforms in India in the early 1990s. From the dominance of non-institutional sources to the emergence of organised and novel institutional channels of financing, the agricultural credit market has seen several well-structured policy-induced disruptions which have largely aimed at substituting the usurious informal credit with stable formal credit sources (Narayan, 2016). The modern day agriculture credit environment of India is largely driven by formal institutions with Scheduled Commercial Banks (SCBs) taking the lead (Reserve Bank of India, 2019). With the dominance of formal credit channels, the expectations from the policymakers of improving the penetration of formal credit have also increased as now the impulses of interventions could be much more easily transmitted to the grassroots levels via regulated institutions such as SCBs. However, while the demand for credit continued to grow due to rising agricultural output and other underlying structural factors, the supply of formal credit has been hesitant to meet the increased demand, especially for small and marginal farmers (Golait, 2007). This gave rise to a large penetration of informal sources in the rural sector. Not only the level of demand but also the nature of credit demand at the rural grassroots level was not optimally fulfilled by the formal credit institutions (Mohan, 2006; Golait, 2007). This has been a matter of concern, especially due to the simultaneous existence of indebtedness and excess credit demand.

Such a co-existence of excess demand for affordable credit on the one hand and high levels of indebtedness on the other may be termed as a paradox in the context of Indian agricultural credit market. (Sidhu & Gill, 2006). This has given rise to various debates on the quality of credit which is currently being supplied by formal institutions. Studies in the Indian context have given considerable attention to the reasons for the existence of such a paradox. An important agreement on this matter has been the recognition of the fact that access to formal credit is not uniform across the socio-economic groups and those at the bottom deciles of the rural income hierarchy still rely to a large extent on informal and often exploitative sources (Mehrotra & Nadhanael, 2016). Inequality in the landholding distribution too has been a critical factor nurturing this paradox in the Indian context. These observations raise an important question: what factors determine the extent of agricultural credit available to rural households? Given that the different income deciles in rural population have unequal access to the quantum and quality of agricultural credit, it is necessary to understand the underlying forces that determine the extent to which an average rural household is able to access agricultural credit in the first place. A deeper understanding of this dimension can help unveil the complexities surrounding the plight of farmers, their debt situation, farmer suicides, financial inclusion, economic inclusion, and especially the creation of a better life for those at the bottom of the income pyramid. Such a perspective is indeed macroeconomic and reveals the structural forces that shape the larger macro dynamics in the agricultural credit market. Literature has found that the shreds of evidence on the macroeconomic dynamics of agricultural credit in India are limited (Narayan, 2016). Inevitably, it implies abstracting away from micro-level individual household dynamics and rather provides a more policy-oriented perspective which demands a macro perspective before micro-level interventions can be designed.

Objectives and Hypotheses

An assessment of the factors that determine the extent to which rural households can access affordable credit presupposes a thorough understanding of the factors that can explain the observed level of credit available to the same. Availability and access, in operational terms, are thus quite close to each other. It might not be incorrect to assert that the availability of formal credit is a necessity, though not sufficient, condition

for ensuring rural access to formal credit. India's formal credit sector has been grappling with various challenges, one of which is to induce financial inclusion across rural households, especially for those who live in lower deciles of the income distribution. Literature has found that the wage-dependency of income and landholding distribution in the agriculture sector are negatively correlated (Chakravorty et al., 2019). This suggests that the vulnerability of the small and marginal farmers is much higher as their primary income is from non-wage sources, which are inherently volatile on account of the seasonal nature of such incomes. Enabling access to stable formal finance for these social strata can perhaps help in smoothing their incomes and possibly allow them to recover from the clutches of poverty. This paper is also motivated by the recent policy innovations such as the Kisan Credit Cards, Microfinance Institutions, and others which are forwarding the agenda of financial inclusion for rural households (Golait, 2007; Kumar et al., 2011). With rural inclusion as an important component of the larger development agenda of the current as well as past governments, a study of the factors that can robustly explain the economic rationale behind the observed level of credit available to the rural sector is imminently needed. This study is thus motivated to provide a macro-empirical and policy-driven perspective on the determinants of credit availability to the rural sector with the following underlying hypotheses.

The first hypothesis tested in this study is that the availability of banking services enhances access to agricultural credit. The mechanism through which this could occur may be found in the stabilisation of the seasonality of agricultural income through stable formal finance products (Gadgil, 1986; Nirgude et al., 2007). The second hypothesis is that inflation can either improve (Olanayi & Adeoye, 2016; Ajide, 2017) or worsen (Le et al., 2019) the access to formal finance. A major rationale for the worsening of financial inclusion through the inflation channel is hypothesised via increased poverty due to the contraction of real incomes of the rural poor (Park & Mercador Jr., 2016). This study thus allows both the possibilities. The third key hypothesis is that infrastructural development, particularly the consumption of key capital inputs such as energy, has a positive impact on access to institutional agricultural credit in rural India. Literature has found that increased access to energy sources allows improved productivity gains and increased incomes enable improved ability to qualify for and access formal credit (Cui et al., 2022). The fourth hypothesis argues that population pressure has a detrimental impact on access to agricultural credit, possibly due to the inability of the existing financial infrastructure to absorb the increasing potential participants in the formal financial system, especially when a large population in India already remains excluded (Garg & Agarwal, 2014). The fifth hypothesis incorporates the impact of input consumption on inclusivity in the agricultural sector. Input consumption at the sectoral level is proxied by the per capita fertilizer consumption in rural India and a positive impact of this variable is expected on the access to formal agricultural credit. Agricultural growth, and consequently agricultural income, is positively affected by the availability of higher inputs and by enabling stable production patterns and reducing the uncertainties associated with procuring high-quality inputs during the agricultural production process (D'souza, 2020). This, in turn, could allow a larger proportion of rural households to qualify for formal credit and get access to a stable source of finance. The sixth hypothesis argues that rainfall shocks reduce access to formal finance. This can occur through the uncertainty-inducing nature of abnormal rainfall variations, and more importantly, because rainfall shocks tend to increase the incidence of poverty (Abiona & Koppensteiner, 2020). We proxy rainfall shock by the coefficient of variation in the monthly rainfall levels as explained in Appendix 1. The use of variability in actual rainfall allows us to extract truly exogenous shocks and helps us incorporate instability in agro-climatic conditions through a continuous variable on the lines of Abiona and Koppensteiner (2020). The seventh hypothesis juxtaposes that improvements in lagged agricultural productivity should enable lesser dependency on formal credit by permitting such households to shift

to self-financing mechanisms or perhaps to other non-banking sources of credit. The rationale for including lagged productivity is to avoid the issue of endogeneity between productivity and credit growth. While improved inclusivity has been found to enhance productivity (Laha & Kuri, 2013), the flow of causality in the reverse direction is not very clear in the extant literature. Hence, this paper hypothesises that past productivity gains in agriculture should enable a lower need for formal credit by shifting the credit needs to non-banking sources. The eighth hypothesis is that adverse growth in the agricultural sector is detrimental to the availability of bank credit for the rural sector. This dimension is proxied by the dummy variable which takes the value of one for each year when growth rate in the real agricultural Gross Domestic Product was negative. In summary, the key issues that are adopted in this work reflect the major macroeconomic concerns from both the academic and policymaking angles. The empirical exercise in this study is derived from the pressing concerns of the times with regard to improving access to formal credit for the Indian agriculture sector while also extending the extant literature towards a macro framework on this matter.

Survey of Evidence

Studies in this context in India have largely focused on a case study-based approach wherein selected areas, villages, tehsils and taluks are surveyed regarding the debt situation and access to credit of a sample of households, often selected purposively. These studies are essentially microeconomic in nature and focus on a group of households within a particular agriculture-dominated geographical region such as Punjab or Haryana. Kumar et al. (2007) is a useful illustration in this regard. The insights derived are specific to the underlying population of interest, an empirical trend that seems to be prominent in the Indian context. Insights from the sample are at times not scientifically applied to the underlying population with limited justification of the representativeness of the chosen sample for the underlying population. Moreover, with a highly specific focus of analysis, a larger perspective that accounts for the heterogeneities in the availability of agricultural credit across different regions, States and villages cannot be inferred from such studies, except if a rigorous meta-analysis is undertaken. This too seems to be missing in the Indian scenario. However, some seminal studies focus on sectoral or all-India level assessment of the nature of agricultural credit and the factors determining the same. Such studies generally face the obvious constraint of being non-generalisable and many a time hide important macroeconomic differences in access to credit that are not specific to space or time but are an outcome of the complex inter-sectoral interactions in the economy. This gap in the extant literature motivates the macroeconomic focus adopted in the present study. The review of evidence below highlights some of the key works that have guided the theoretical motivations in this study.

A noteworthy exercise on the present theme was undertaken by Kumar et al. (2007) who investigated the choice of credit source by rural households using the unit-level data from the All India Debt and Investment Survey (AIDIS). The preliminary finding suggested that the initial structural shift in the composition of credit sources in the rural sector stagnated since 2002-03 with informal sources continuing their predominance in the credit basket of rural households. In terms of the determinants of the credit source, the authors utilised a multinomial logit regression approach. The authors found that key socio-economic characteristics of the borrowing member determined the choice of credit source with those borrowers having a higher age, being a male, possessing a larger landholding and being more educated preferring institutional sources.

Another important empirical exercise in the present context is contained in Kumar et al. (2010) who examined the level of access to institutional credit available for rural farm households in India and the factors determining the same. They found that the quantum of institutional credit in real terms has increased manifold since the economic reforms with the commercial banks emerging as the prime

movers of formal credit to the agriculture sector. However, they found that the share of investment credit in the total quantum of formal bank credit had declined during the sample period and this posed challenges for sustaining a healthy growth in agricultural production. They found that the socio-economic profiles of farmers played a critical role in shaping the availability of formal credit to these rural households.

Kumar et al. (2015) extended the analysis undertaken by Kumar et al. (2007) and updated the analysis with unit-level data from the newer versions of the AIDIS. Contrary to their earlier findings, they found that the stagnation of the expansion in the share of institutional credit for rural households regained momentum due to active efforts by the government. The key determinants of the choice of credit source were found to be education, caste affiliation, gender and asset ownership. Satyasai and Tiwari (2021) examined the nature of credit flow to the rural sector using an exploratory research design and found the persistence of disadvantages for small and marginal households in accessing formal credit in India.

Literature has also focused on the ability of debt relief initiatives to improve the level of rural financial inclusion and act as a substitute for formal credit through commercial banks. The primary finding on this account is that while debt relief programmes have had a significant impact on household balance sheets, they have failed to relax the liquidity constraints facing rural households sufficiently to encourage new investment (Kanz, 2016; Gine & Kanz 2016). Access to credit has been imperative for the rural sector to prevent unwarranted shocks to the production and consumption choices of households. High levels of rural debt, if not fine-tuned via prudent regulation, could cause productivity losses for the agricultural sector, and induce a positive shadow price for credit (Kumar et al., 2013) that may further aggravate accessibility to formal finance. Literature has focused on the role of State governments in reallocating the debt burden on rural small and marginal farmers to other sectors through additional revenue mobilisation measures or expenditure cuts via loan waivers. However, in a majority of the cases, it has been found that loan waivers by States adversely impacted their fiscal positions (Raghumanda et al., 2017). In other words, the loan waiver schemes have helped in reducing the rural indebtedness of small and marginal farmers to a great extent but the debt waivers to ameliorate the problems faced by farmers can provide only a temporary relief and not a lasting solution to rural indebtedness as there are possibilities of moral hazard in having repeated debt waivers (Raj & Edwin 2018). Indeed, debt relief improves the loan repayment behaviour of distressed borrowers, provided care is taken in the classification of distressed and non-distressed beneficiaries, otherwise, it may impose unforeseen costs on the programme (Mukherjee et al., 2017). This does not mean that debt relief programmes only produce adverse macroeconomic impacts; rather it implies that beyond a threshold, its costs may impose a significant toll, if implemented without taking into account the fiscal realities and budget constraints of the ex-chequer. These eminent works document a strong theoretical and empirical framework in the analysis of indebtedness and the policy initiatives thereof to lift the burden of indebtedness on rural households in India.

Data, Methodology and Variables

A set of macro-agricultural variables have been chosen and the process of this choice is elaborated in the next section. However, this section provides details about the various economic and data features of the chosen variables. Appendix 1 presents a systematic summary of the definition of each variable. Subsequently, Appendix 2 provides details about the measurement units and source of data for each of the selected variables. It must be noted that all the variables are secondary in nature and are obtained from official published sources. Despite various debates on the quality of the official statistical output in India (Barman, 2016, 2018), the available data is the best possible statistical input for the empirical exercise

undertaken herein. Another important aspect of these variables is that they have been deflated with appropriate deflators to derive their real magnitudes. This allows the analysis to be carried out in a theoretically sound manner. A partial adjustment framework is introduced by incorporating the lagged term of the dependent variable itself to test whether there exists a dynamic tendency in the credit expansion to adjust to a stable long-run level. This issue is addressed through the econometric frameworks proposed by Koyck (1954) and Nerlove (1958).

Furthermore, a linear time trend term is introduced for two major reasons. One is that the dependent variable showed evidence of trend stationarity. The second rationale was to ensure that the slightly trending behaviour of the dependent variable was not mistaken for a statistically significant partial adjustment process. This paper covers the period from 1991-92 to 2018-19. The choice of this period is directed by several considerations. Primarily, this period captures the post-economic reforms phase and is marked by substantial policy changes pertaining to agricultural credit as shown in Table 1. The variable PHAGDP shows the amount of agricultural output per hectare of the gross sown area, while PHACRD reflects the amount of agricultural credit per hectare of the gross sown area. Finally, ACRGDP signifies the penetration of agricultural credit in terms of the ratio of agricultural credit to agricultural output. Both PHAGDP and PHACRD are highly and positively correlated signifying that both the production and credit flow have followed similar developmental paths over time.

Table 1

Evolution of Agricultural Output and Credit Across Major Policy Shifts during the Study Period

Year	KEY POLICY CHANGES	PHAGDP (Rs. per hectare)	PHACRD (Rs. per hectare)	ACRGDP %
1991-92	Structural Economic Reforms	9932.84	1017.39	10.24
1992-93	SHG-Bank Linkage Programme	10936.94	1089.44	9.96
1995-96	Rural Infrastructure Development Fund	15727.64	1328.21	8.45
1998-99	Kisan Credit Card Scheme	22544.60	1836.59	8.15
2003-04	Ground Level Credit Policy	28830.09	4007.15	13.90
2004-05	Interest Subvention Scheme; BC and BF by R.B.I.; Joint Liability Groups by NABARD	29703.10	5028.70	16.93
2008-09	Agricultural Debt Waiver and Debt Relief Scheme; Global Financial Crisis	47401.20	14032.81	29.60
2009-10	Prompt Repayment Incentive	56346.50	16359.39	29.03
2012-13	Revisions in Priority Sector Lending	86248.36	28931.26	33.54
2015-16	Revisions in Priority Sector Lending	113041.76	45890.97	40.60
2018-19	-	153553.87	60789.58	39.59

Variables	Correlation Matrix		
	PHAGDP	PHACRD	ACRGDP
PHAGDP	n.a.	0.99	0.92
PHACRD	0.99	n.a.	0.91
ACRGDP	0.92	0.91	n.a.

Source: Authors' analysis using various economic surveys, RBI bulletins and Agricultural Statistics at Glance.

The fact that this correlation has persisted across the plethora of policy changes during the selected period highlights the positive impact of these policy interventions. Similarly, one can observe a strong positive correlation between the penetration of agricultural credit on the one hand, and per hectare agricultural output as well as agricultural credit on the other. The interlocked evolution of these variables suggests that output growth and credit flow have maintained strong linkages during this period (Das et al., 2009). Active policy developments as highlighted in Table 1 have given rise to a thriving agricultural credit market that has been expanding ever since the initiation of reforms to fulfil the growing needs of an expanding sector. Thus, this period provides an opportunity to investigate the factors shaping the expansion of agricultural credit at the macroeconomic level by incorporating a host of demand-side and supply-side factors as discussed earlier.

Results and Analysis

The choice of variables (as shown in Appendices 1 and 2) is undertaken by utilising the latest findings in this context and the underlying economic theory that is expected to shape the behaviour of observed movements in real per capita agricultural credit. The credit which is available to rural people is an embodiment of both the demand and supply of agricultural credit (Das et al., 2009). That is because the observed amount of credit is simultaneously demanded and supplied in the formal credit market. The separation of observed magnitudes of any quantity into its demand and supply dimensions has been a matter of rich debate in the literature on production theory in economics and management (Pandey & Baria, 2018). Hence, an analysis of the availability of agricultural credit should take into account both the demand-side and supply-side factors that may play a role in determining the equilibrium market-clearing amount of credit. The underlying theoretical model is proposed with this important aspect in mind. The theoretical framework of this study is broadly based on the works of Gadgil (1986), Nirgude et al. (2007), Ajide (2017), and Le et al. (2019) while appropriately modifying their proposed approaches to suit the objectives of this study by primarily focusing on the agricultural sector. The use of both the demand and supply-oriented factors in our theoretical model is on account of the a priori belief that agricultural credit is both demanded and supplied as factors of production mainly with an investment or productive use in mind even though its final utilisation may be dictated by other considerations such as personal use in marriage, repaying old debt, etc. Accordingly, the expectations for the chosen variables are shown in Table 2.

Table 2

Theoretical Expectations

S. No.	Variable	Expected Sign	Selected supporting references
1	TAC	+	Gadgil (1986), Nirgude et al. (2007)
2	AINF	- or +	Olanayi and Adeoye (2016), Ajide (2017), Le et al. (2019)
3	AENA	+	Cui et al. (2022)
4	RPOP	-	Garg and Agarwal (2014)
5	FERT	+	D'souza (2020)
6	RINST	– or +	Abiona and Koppensteiner (2020)
7	$APRD_{t-1}$	-	Laha and Kuri (2013)
8	DECO	-	N.A.
9	TIME	+ or -	N.A.
10	$ACRED_{t-1}$	- or +	Nerlove (1958)

Source: Authors' specification based on the Review of Literature.

Keeping these issues in mind, the theoretical model adopted in this study is elaborated below:

$$\begin{aligned} \text{logdACRED} = {} & \beta_0 + \beta_1 \text{logdTAC} + \beta_2 \text{logdAINF} + \beta_3 \text{logdAENA} \\ & + \beta_4 \text{logdRPOP} + \beta_5 \text{logdFERT} + \beta_6 \text{logdRINST} \\ & + \beta_7 \text{logdAPRD}_{t-1} + \beta_8 \text{logdDECO} + \beta_9 \text{TIME} \\ & + \beta_{10} \text{logdACRED}_{t-1} + \varepsilon \qquad \text{---------- (1)} \end{aligned}$$

Where, the variables are as defined in Appendix 1 and ε is the residual term with standard econometric assumptions.

Before delving into the estimation of the proposed model, an overview of the distributional characteristics of the chosen variables can be helpful. Table 3 shows the broad behaviour of chosen variables across the entire sample period of 1991-92 to 2018-19. One can immediately notice a good amount of differences in the variability across chosen variables. ACRED, AINF and TAC have considerably large variations across the period. The same insight can be corroborated by the distance between the minimum and maximum values of these variables. Higher temporal variability implies more complexity in the time-series data, and thus the use of such variables in their level form may be problematic. Unstable variables are difficult to model within a structural framework, and thus some kind of adjustment will be required for utilising these variables. Continuous policy interventions and market dynamism have probably induced high variability in these variables. There have been several important changes in the Indian agriculture sector since the beginning of the study period and these changes are reflected in the higher variability in these variables. RPOP shows lesser variability on account of it being a demographic variable which inevitably evolves slowly. Similarly, the level of aggregate Agricultural Output (AOUT) also shows a similar pattern, but in growth rate terms, the same has been quite volatile (not reported here). AENA also shows high variability but it is surprising that while AOUT is quite stable, AENA is not which is generally expected to be closely correlated to the level of output. Possibly, the growth rate dynamics of AOUT are more important in explaining the level of energy consumption in agricultural sector or there might be other factors determining this behaviour of AENA other than AOUT. The variable RINST has quite a low variability perhaps due to relatively stable agro-climatic conditions during the sample period. As explained in Appendix 1, this variable is measured as the Coefficient of Variation (CV) in the monthly actual rainfall levels across chosen years. APRD also has relatively lower variability possibly because productivity changes take time to unfold and changes in the same are slower but persistent.

With the above background, a comment on the correlation structure across the selected variables can provide useful indications of an underlying structure that corresponds to the theoretical beliefs laid down earlier. While the results of correlation analysis are not reported here due to lack of space, this exercise was carried out for three different forms of the selected variables, namely their level form, their percentage annual growth rate form and their log difference form. Most of the variables showed a negative correlation with RPOP in the level form, while hardly any degree of correlation was present in other forms. In level form, ACRED showed a strong correlation with most of the chosen variables while this was not the case in other forms, such as log difference form. Cross-correlations across variables seemed much weaker in growth rate and log difference forms than in level form. Hence, it was evident that the use of level form data, even without basic time-series checks, would pose problems in estimating the econometric model later. All variables were tested for non-stationarity using the Augmented Dickey-Fuller Test which showed that except TAC and RPOP, all other variables were stationary in log difference

Table 3

Key Descriptive Statistics

Statistic	Period: 1991-92 to 2018-19				
	RPOP	**AOUT**	**ACRED**	**FERT**	**AENA**
	Millions of people	Rs. per rural person	Rs. per rural person	Tonnes per rural person	Rs. per person
Min	627	6220	950.19	0.19	200.02
Mean	768	7846.91	4983.23	0.26	368.81
Max	889	9433.94	14843.13	0.34	765.67
SD	80	1011.59	4444.05	0.05	177.93
CV	10.38	12.89	89.18	18.73	48.24

Statistic	Period: 1991-92 to 2018-19			
	AINF	**TAC**	**RINST**	**APRD**
	%	Number of total bank accounts per person	%	Index Value
Min	-0.38	0.21	94.73	72.75
Mean	7.11	0.35	102.61	96.49
Max	17.75	0.86	109.47	123.7
SD	4.95	0.21	3.64	15.67
CV	69.59	59.61	3.54	16.24

Source: Authors' Estimation.

Notes: (1). Min refers to the Minimum Value; Max refers to the Maximum Value; SD refers to Standard Deviation; CV refers to Coefficient of Variation.

(2). Names of the Variables have been defined and explained in Appendix 1.

form at 10 per cent level of significance except AINF whose tau statistic was significant at 12 per cent level. The decision to use all variables in log difference form itself, including RPOP and TAC, was to maintain econometric consistency in the analysis. However, using RPOP and TAC in log difference form could result in econometric problems such as autocorrelation or even Heteroskedasticity. Hence, the final model was estimated using Heteroskedasticity and Autocorrelation Corrected (HAC) standard errors. This helps to avoid any such econometric problem in the estimated coefficients in advance and renders the final results more reliable.

Empirical Assessment

This section presents the estimated model which is shown in Equation 2. In terms of the signs of the coefficients, which are the focal issue of this exercise, the coefficients are largely as expected though there are some deviations. Table 4 exemplifies this point.

$$\begin{aligned} \text{logdACRED} = {} & 1.26 + 0.62\ \text{logdTAC} - 0.49\ \text{logdAINF} - 0.56\ \text{logdAENA} \\ & (5.344)^{***} \quad (2.494)^{**} \quad (-2.467)^{**} \quad (-2.360)^{**} \\ & - 59.38\ \text{logdRPOP} + 0.36\ \text{logdFERT} + 0.57\ \text{logdRINST} \\ & (-4.962)^{***} \quad (3.135)^{***} \quad (2.097)^{*} \\ & - 0.59\ \text{logdAPRDt-1} - 0.043\ \text{logdDECO} - 0.022\ \text{logdTIME} \\ & (-3.349)^{***} \quad (-1.040) \quad (-4.901)^{***} \\ & - 0.156\ \text{logdACREDt-1} \\ & (0.953) \end{aligned} \qquad \text{---------- (2)}$$

$R^2 = 0.64$ F-statistic = 11.79*** d.h.-statistic = –1.98

Notes:
1. ***, **, * represent significance level of 1%, 5% and 10%, respectively.
2. Values in the bracket represent t-values.
3. All the variables except DECO and TIME are in log difference form.
4. d.h. statistic is Durbin's h-statistic.
5. Equation two has been estimated using HAC (Heteroskedasticity and Autocorrelation Corrected) standard errors.
6. Definitions and measurement unit of each variable in Appendices 1 and 2.

Table 4 shows the expected and estimated signs and except AENA, all other variables seem to be corroborating the theoretical beliefs laid down earlier. The fact that all variables are in log difference form may have resulted in this deviation. Probably, growth rate dynamics between energy consumption and credit availability are different than their relationship in level form. A higher rate of expansion in agricultural energy consumption expenditure could dampen formal credit demand if energy as an input becomes costlier. Globally, this has inevitably been the case wherein increases in energy consumption have been accompanied by increases in the cost of energy (Cui et al., 2022). It appears that a similar pattern could be unfolding in the Indian scenario. Hence, increased rate of energy consumption might increase the cost of production faster than is bearable and possibly reduce the growth in credit demand. This could have a detrimental effect on the accessibility of institutional credit for the rural population. Higher costs of energy input could also result in higher defaults, and hence increased growth of the same might translate into a higher extent of non-performing assets. Thus, it may reduce the willingness of borrowers to increase their debt burden further. All other signs are as per the expectations, and thus the underlying theory behind this model seems properly suitable to the context under consideration. However, there is no evidence of a partial adjustment process in the growth of access to formal finance at the aggregate level. It seems that lagged growth in agricultural credit does not tend to persist, perhaps indicating considerable instability in the flow of bank credit to the agriculture sector. The decision to incorporate the linear trend element could be responsible for this finding. In summary, it appears that the

hypotheses laid down earlier are well-corroborated by the estimated results. The same can be further verified by the value of R2 which is quite good given that the temporal movements in the growth of variables are being interlinked here rather than their level forms. The overall model fits the data quite well with an F-statistic significant at 1 % level.

Table 4

Expected and Estimated Signs

S. No.	Variable	Expected Sign	Estimated Sign	Deviation
1	TAC	+	+	No
2	AINF	- or +	-	N.A.
3	AENA	+	-	Yes
4	RPOP	-	-	No
5	FERT	+	+	No
6	RINST	– or +	+	N.A.
7	$APRD_{t-1}$	-	-	No
8	DECO	-	-	No
9	TIME	+ or -	-	N.A.
10	$ACRED_{t-1}$	- or +	-	N.A.

Source: Authors' Estimation.

Note: N.A. implies Not Applicable.

Any empirical model is reliable for deriving policy insights only when it is econometrically sound and robust to alternative specifications. Both these issues were looked into in this paper. With reference to the diagnostic tests on the estimated results of this model, the residuals from equation 2 were found to be normally distributed as the value of the test statistic was insignificant at 10 % level. The Breusch-Godfrey test for autocorrelation up to three lags also showed that the results in Equation 2 were not marred by either positive or negative autocorrelation. The null of no autocorrelation could not be rejected even at 10 % level. In terms of the presence of high multicollinearity, except RPOP and TIME, all other variables had Variance Inflation Factors (VIFs) below four. RPOP and TIME have been largely used as control variables, and hence high multicollinearity in their case does not pose much of a problem for the econometric quality of other estimated coefficients. Furthermore, robustness checks for the estimated signs of the coefficients from equation two were also investigated. Accordingly, Table 5 shows the five alternative models that were estimated with different specifications of Equation 2 itself.

Table 5

Alternative Models for Robustness Checks

Alternative Model	Specification
1	Equation 2 without insignificant variables, HAC standard errors
2	Equation 2 without highly collinear regressors as per their VIF
3	Equation 2 without HAC standard errors
4	Equation 2 with Lagged value of RINST
5	Equation 2 without the Lagged value of the Dependent Variable

Table 6 presents the estimates of alternative specifications of Equation 2. The consistency of the signs of the coefficients is visibly clear from the estimated signs of coefficients across the specified models. While not all models fare equally well on basic econometric grounds, the signs of the coefficients are consistent irrespective of the model, though the statistical significance does suffer in the case of some models. However, given the theoretical model underlying these results and a broadly structural methodology adopted in this work, the consistency of estimated signs across alternative models provides a good amount of credence to the robustness of results contained in Equation 2. This also makes the results of Equation 2 meaningful for policy inferences.

Table 6

Alternative Models

S. No.	Variable	***Alternative Estimated Models for Assessing the Robustness of the Estimated Signs***				
		Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
	Constant	1.10***	0.13***	1.26***	1.17***	1.17***
1	TAC	0.50*	0.70***	0.62#	0.63***	0.55***
2	AINF	–0.39	–0.16	–0.49	–0.56***	–0.50**
3	AENA	–0.46***	–0.75***	–0.56*	–0.50**	–0.46**
4	RPOP	–52.66***	N.A.	–59.37***	–54.17***	–55.00***
5	FERT	0.29**	0.32#	0.36	0.18	0.28**
6	RINST/$RINST_{t-1}$	0.63**	0.44	0.57	–0.50#	0.51#
7	$APRD_{t-1}$	–0.62***	–0.69***	–0.59#	–0.29**	–0.52***
8	DECO	N.A.	–0.03	–0.04	–0.07	–0.05
9	TIME	–0.02***	N.A.	–0.02**	–0.02***	–0.02***
10	$ACRED_{t-1}$	N.A.	0.01	–0.16	–0.03	N.A.
	R^2	0.60	0.40	0.64	0.63	0.63
Statistic	F-statistic	14.60***	8.12***	2.68**	16.80***	10.22***
	d-w/d-h statistic	2.69	2.30	2.39	2.37	2.63

Notes: 1. **"#"** implies significant at 12 % level.
2. ***, **, * represent significance level of 1%, 5% and 10% respectively.
3. N.A. implies Not Applicable.
4. Each Alternative Model has been specified in Table 10.

Source: Authors' Estimation.

Limitations

Every empirical analysis is constrained by its choice of theoretical framework, data and econometric methodology. This study has provided several policy-driven insights and has also undertaken appropriate diagnostic and robustness checks to ensure that the estimated signs of the structural model are reliable. The analysis conducted in this paper focuses on the determinants of the aggregate bank credit flow to rural India. Hence, the use of more disaggregated data that could have allowed panel model estimation is not undertaken, primarily due to the objective of capturing sectoral credit flow dynamics rather than unit-level credit flow behaviour. While the choice of the variables is directed mainly by theoretical considerations rather than data mining, there can be alternative frameworks that might shed a different perspective on the phenomenon under consideration. Despite such a possibility, the estimated model is theoretically sound and econometrically robust. Hence, it does provide a good beginning point for a more advanced analysis of this issue. Lastly, the period of this study could be expanded retrospectively and the eras before the economic reforms could be accounted for. However, such an exercise would need to account for the large number of structural breaks in the Indian agricultural sector along with other policy regime changes experienced before the economic reforms. The changes in agricultural credit distribution and its determinants before and after the reforms could provide more insights into the policy successes and failures of the past as far as the formal credit market of Indian agriculture is concerned. It is hoped that future researchers will dig into the economic dynamics of this issue deeper with better data sets, especially in the era of the India-KLEMS database by the Reserve Bank of India, and with more sophisticated econometric methodologies.

Conclusions and Policy Implications

Derivation of policy implications from an econometric exercise is only feasible when the results are robust to alternative specifications. Having done the same as reported in Table 5, several important conclusions that can be useful for policymakers in India can be inferred from the analysis above.

First, it is quite evident that the major policy lever in enabling higher and better financial inclusion in rural regions is embodied in the demand-side dynamics of formal agricultural bank credit in India. The supply of agricultural funds has been quite stable and actively regulated by the Reserve Bank of India (RBI) as this sector falls under the priority sector. RBI has continuously evolved its priority sector lending regulations in concordance with the changing economic conditions in agriculture sector. Most of the factors that have shown significant impacts on credit availability in this study are essentially driven by demand-side considerations. Second, among all the factors modelled in this study, improvements in the availability of core banking services as captured by TAC, Fertilizer consumption (FERT) and variations in the level of instability of rainfall show a positive impact on the availability of formal agricultural bank credit. The stress on financial inclusion in the current rural development policy discourse in India can be better achieved if formal institutions are readily, easily and affordably available to provide core banking products to the rural population (Laha & Kuri, 2011; Reserve Bank of India, 2019). This can increase the degree of substitution from informal to formal sources and improve the ability of policymakers to induce targeted changes at the grassroots level. Fertilizers are an important input in the agricultural production process. It also seems to be an important component in the total demand for formal agricultural credit. The introduction of innovative credit products by the SCBs under the active guidance of the RBI, which makes it attractive for farmers to borrow formal credit for fertilizer usage, can improve the availability of credit to the rural population. Reduction of instability in rainfall is required because it results in higher indebtedness. Hence, stabilising the impact of rainfall variability through better irrigation projects, incentivising local irrigation technologies and methods, and promoting

local entrepreneurship in solving the water tables could help reduce excessive or suboptimal borrowings by the rural population and possibly allow them to use the borrowings for more productive investments in their agricultural businesses.

Third, agricultural inflation (AINF) and the occurrence of adverse years in agriculture sector need to be addressed so as to reduce their negative impact on the availability and use of formal credit. Inflation of primary commodities in India is a matter of concern and has been showing volatility in recent years, which is emerging particularly from the food market (Sekhar et al., 2018). Excessive and unstable rate of inflation in any sector causes distortions in the form of market failures and the same is the case with the formal agricultural credit market. Food price stabilisation policies seem to be working partially as far as the Public Distribution System is concerned. With domestic sources dominating as the major cause of agricultural inflation in India, reducing its rate via improving the price-discovering ability of the agricultural markets might help improve the demand and supply matching process in the formal credit market. Adverse economic conditions, as captured by DECO, need a holistic approach from the policy circles. Famines, droughts, bad rainfall, adverse weather and climatic conditions, impact of global warming, and international economic shocks, among others, are several persistent factors that result in unfavourable output growth in Indian agriculture.

Fourth, improved lagged productivity reduces the expansion of credit to the agriculture sector. As noted earlier, improved productivity reduces the need to assume debt to undertake capital investments and even repay older debts. It is the problem of indebtedness among India's rural population that requires urgent attention. Probably, improving agricultural productivity could help reduce the use of credit for unproductive purposes such as paying old debts and help improve the composition of total credit available in terms of its productive versus unproductive usages.

In summary, the analysis contained in this study has attempted to answer the central question of concern: what determines the availability of formal agricultural bank credit in India? The answer is quite clear - it is the active policy interventions on the demand side of the agricultural credit market, while maintaining the current efforts on the supply side, that can radically improve the availability, preference and access to formal bank credit for rural borrowers. Given that the world as well as the Indian economies are going through uncertain economic shocks created by the COVID-19 pandemic and a lurking world recession, policymakers need to prepare well in advance to help the agricultural sector in general, and the formal agricultural credit market in particular, to embrace the impact of the tough times ahead. The success of achieving financial inclusion now hinges upon how well the agricultural credit market absorbs the economic shocks that are on their way to India.

Author's Contribution:

Bhagirath Prakash Baria: Data Organization, Econometric analysis, Results and Analysis, Drafting of paper, and Revisions.

Sofia Devi Shamurailatpam: Review of Literature, Data Collection, Empirical analysis, and Revisions.

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Appendices

Appendix 1

Key Variables and Their Features

Name of the Variable	Description of the Variable	Definition
ACRED	Per Capita Availability of Agricultural Bank Credit	$\frac{\text{Real Agricultural Bank Credit (Rupees)}}{\text{Rural Population (Number of persons)}}$ - Agricultural Bank Credit disbursed by Scheduled Commercial Banks. - Wholesale Price Index for All Commodities with base 2011-12 used as deflator. - Rural Population Derived from Census Data through appropriate Interpolation.
TAC	Per Capita Availability of Core Banking Services	$\frac{\text{Total Rural Bank Accounts with Scheduled Banks (number of total accounts)}}{\text{Rural Population (in number of persons)}}$ - Total Rural Bank Accounts is the Sum of Total All-India Credit and Deposit Accounts with Scheduled Commercial Banks.
AINF	Agricultural Inflation	- Wholesale Price Index for Primary Commodities, with base year 2011-12.
AENA	Per Capita Energy Consumption in Agricultural Production	$\frac{\text{Energy Input Used in Agriculture Sector (rupees)}}{\text{Rural Population (in number of persons)}}$ - Energy Input Consumed in Agricultural and Allied Production (current prices) at All-India Level as per the India-KLEMS database, Reserve Bank of India. - Deflation of this series was done using the Wholesale Price Index for All Commodities, base year 2011-12.
RPOP	Total Rural Population	- Annual All-India Rural Population
FERT	Per Capita Consumption of Fertilizers in Agricultural Production	$\frac{\text{Annual Consumption of Fertilizers by Agricultural Sector (in tonnes)}}{\text{Rural Population (in number of persons)}}$ - Fertilizers include all three varieties, namely N+P+K, i.e. Nitrogen, Phosphorous and Potassium.

Contd...

Name of the Variable	Description of the Variable	Definition
RINST	Rainfall Instability and Climatic Uncertainty	- Coefficient of Variation of Monthly Actual Rainfall for each year, measured in percentage terms.
APRD	Agricultural Productivity	- Index of Yield per Hectare for All Agricultural Crops, with the base year of triennium ending 2007-08.
DECO	Dummy Variable for Adverse Economic Conditions in Agriculture Sector	- Dummy Variable has been defined as: 1 = For the year which saw a negative annual growth rate of Aggregate Agricultural Gross Domestic Product, 0 = Otherwise.

Appendix 2

Key Variables and Their Basic Features

Variable	Measurement Unit	Data Source
ACRED	Rs. Per Rural Person	Handbook of Agricultural Statistics, Ministry of Agriculture & Farmers Welfare, Government of India Basic Statistical Returns of the Scheduled Commercial Banks, Reserve Bank of India
TAC	Number of Total Bank Accounts Per Rural Person	Basic Statistical Returns of the Scheduled Commercial Banks, Reserve Bank of India
AINF	N.A.	Handbook of Statistics on Indian Economy, Reserve Bank of India
AENA	Rupees Per Rural Person	India-KLEMS database, Reserve Bank of India
RPOP	Number of Persons	Population Census Reports, Government of India
FERT	Tonnes Per Rural Person	Handbook of Agricultural Statistics, Ministry of Agriculture & Farmers Welfare, Government of India
RINST	Percentage	India Meteorological Department, Ministry of Earth Sciences, Government of India
APRD	N.A.	Handbook of Agricultural Statistics, Ministry of Agriculture & Farmers Welfare, Government of India
DECO	N.A.	Data on Agricultural Gross Domestic Product are obtained from Handbook of Agricultural Statistics, Ministry of Agriculture & Farmers Welfare, Government of India