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Forecasting Agricultural Financing by Commercial Banks in India: An Arima Approach

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ABSTRACT

This research paper explores the dynamics of agricultural financing by scheduled commercial banks in India from 2008 to 2022, employing econometric tools, specifically an ARIMA(0,2,1) model. The study aims to forecast future trends in agricultural credit, crucial for addressing national developmental goals such as food security, poverty alleviation, and rural employment. Through an extensive literature review, it synthesizes insights on the evolution of agricultural credit policies and their impact on sectoral growth. The findings highlight the significance of institutional credit in enhancing agricultural productivity and economic stability. Methodologically, the paper validates data normality and stationarity, selects the appropriate ARIMA model, and conducts diagnostic tests to ensure model reliability. The forecasted results indicate substantial growth in agricultural financing, projecting a notable increase by 2030-31. This study contributes to the understanding of financial inclusion strategies and policy implications for sustaining agricultural development amidst demographic shifts and economic aspirations in India.

INTRODUCTION

The post-independence era of India has been charecterised by the efforts on agriculture development from the grass root level. The Planning Commission of India introduced institutional arrangement towards upliftment through its policies. The 1st Five Year Plan 1951 based on the Harrod-Domar model entirely concentrated on the primary sector has achieved the growth rate of 3.6 per cent against the target 2.1 per cent (Revathi, 2022).

In spite of success of five year plan, banking sector was in the need of policy level change. The concentration of credit became a hurdle for financial inclusion which is key achieve national development. In the light of national interest the major 19 privately owned banks were nationalised by the Union Government in 1969. The nationalization of bank was inspired by the ambition of ensuring sufficient credit flow to the priority sectors in particularly agriculture sector. To boost the previous effort, after a couple of year the Reserve Bank of India(RBI) introduced Priority Sector Lending Norms in 1972 by fixing lending target for each heads under priority sector. Since then, the RBI has revising the lending target for commercial banks and made it mandatory. Agriculture being the crucial sector it accounts for lion share in total lending of commercial banks. Strengthening of agriculture can address problem of unemployment, ensure food security of growing population, earn foreign exchange and eradicate the poverty of rural India.

In this particular study the researchers obtained data of total agriculture advance from the non-food credit division by Indian commercial banks from 2008 to 2022 and used univariate time series model in building a model to forecast.

UNIVARIATE TIME SERIES MODEL- ECONOMETRICS

Time series data analysis is a popular tool in finance, economics and marketing field. In these discipline most of the data collected at successive point of time and by using historical data near future can be predicted. Under Univariate Time Series Analysis four models are popularin the model building namely

- **Auto Regressive (AR) Model**

  The future value of a variable can be estimated through its own past variable. AR Model uses past value of variable to predict the value of the next variable.

  $$\mathbf{Yt = \alpha + \beta_1 * y_{t-1} + \beta_2 * y_{t-2} + \beta_3 * y_{t-3} + \ldots\ldots\ldots + \beta_p * y_{t-p}}$$

  $$Yt = \alpha + \sum_{i=1} \beta p * Yt - p$$

Where,

α= Constant; β= Coefficient ; Y= Variable; t= Time; p= Lag order for the Variable

- **Moving Average(MA) Model**

  The future value of a variable can also be predicted by considering the past value of residuals or errors of the same variable. MA model uses past residuals of a variable to predict future.

$$Yt = \alpha + \beta 1\ \varepsilon t\text{-}_1 + \beta 2\ \varepsilon t\text{-}2 + \beta 3\ \varepsilon t\text{-}3 + \ldots\ldots\ldots + \beta q\ \varepsilon_t\text{-}q$$

$$Yt = \alpha + \sum \beta q * Ct - q$$

$$i=1$$

Where,

α= Constant; β= Coefficient; C= Residual; t= Time; p= Lag order for the Residual

- **Auto Regressive Moving Average (ARMA) Model**

  ARMA stands for Auto Regressive Moving Average. It is the combination of AR Model and MA Model. It uses both the value of past variable and residuals to forecast future.

$$Yt = \alpha + \beta_1 * y\text{-}_1 + \beta_2 * y_t\text{-}_2 + \beta_3 * y_t\text{-}_3 + \ldots\ldots\ldots\ldots + \beta p * y_t\text{-}p + \alpha + \beta 1\ \varepsilon t\text{-}_1 + \beta 2\ \varepsilon t\text{-}2 + \beta 3\ \varepsilon t\text{-}3 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + \beta q\ \varepsilon_t\text{-}q$$

$$Yt = \alpha + \sum \varphi i Yt - i + \sum \phi j Yt - j i=1$$

$$j=1$$

Where,

α = Constant; φ = Coefficient of Variable; ϕ= Coefficient of Residual; p= Lag order for Variable; q= Lag order for Residual; t= Time

- **Auto Regressive Integrated Moving Average (ARIMA)**

We can build model only if the data is stationary. ARIMA Model converts non- stationary data into stationary before building a model. This Model the term Integrated indicates the number of alteration made on non-stationary to convert it into stationary. If the data is stationary we should use ARMA Model and if data is non-stationary thenshould use ARIMA Model.

ARIMA(2,1,2) describes that the model uses two past variable and two residual and have taken first difference of original non-stationary data set to make it stationary.

REVIEW OF LITERATURE

Review of Literature enhances the fundamental understanding of the research area. In realtion to this study Researchers' reviewed various articles, few of them are included as follows,

Dogra & Sarjolta (2006) made a study to analyse the growth of agricultural sector advances by scheduled commercial banks in India in general and Himachal Pradesh in particular by using simple linear regression model. The research was based upon the secondary data obtained from RBI handbook of statistics, National Sample Survey Office (NSSO) and Economic Surveys by taking 2011-12 as base year. The authors concluded that the advances provided by the Scheduled Commercial Banks had a significant impact on agricultural gross state domestic product. It also found that despite of banking reforms the share of moneylenders are still high because banking procedures are complex and rural farmers are pounded difficult to handle it. One more study conducted by Golait (2007) on the current issue in agricultural credit in India by using secondary data since 1951 to 2006 concluded that the cooperative structure is to be improved thereby improving rural credit. The agricultural sector receiving inadequate credit since the beginning and all the efforts to revamp are not so desirable. The banks are still hesitant to advance loans to marginal farmers.The study on the inequality in supply of loan undertaken by Kumar et al. (2010) examine the performance of agricultural credit including the issues of inequalities in disbursement and identifying the factors that responsible for increasing the use of institutional credit at household level by using secondary data from 1972 to 2009. The researchers claim that the flow of credit is increasing in the past four decades. The commercial banks are the major source of institutional credit to agricultural sector. Regional disparity and inequality in distribution of credit are the area of concern. The choice of institution and amount are subjected to number of socio-demographic factors. Quality building in farmers though imparting of training and educating and simplifying the procedure or need of the hour. Further The SC, ST and OBC or rely upon informal institution for agricultural credit, this could curtail their economic growth. The existing scheme should be implemented properly for the marginal sectors of the society. The study highlighted the role of institutional credit agriculture particularly in rural areas. Bashir et al. (2013) conducted a study on institutional credit to agricultural sector in India with the aim of assessing the quantum of loan issued and outstanding by institutional agencies in the country and to identify the programme of Scheduled Commercial Banks in supplying agricultural credit in India. The research was based on secondary data that is loan issued by commercial banks, RRBs and Co-operative societies from 2000-01 to 2011-12 by applying time series model. The analysis found that the amount of advances to agriculture in sector by these institutions are increased. The bank should take an effort to reduce the quantum of outstanding loans if it is so the further extension of agricultural advances are possible. Regarding policy implementation Hoda & Terway (2015) have undertook the research with the objectives of evaluating various policies and programmes of central government and Reserve Bank of India to enhance credit flow to agriculture. The authors studied the trends in agriculture from 1951 to

2013 and have noticed that generalised waiver is an unscientific method and has an adverse impact on economy. The government should Monitor the merits of farmers to waiving the loan. Rekha et al. (2016) made the research entitled as Agricultural Credit in India into 2000s Growth and Distribution Linkage Productivity with the objective of identifying the relationship between agricultural credit and agri-productivity. Investigated that the priority sector lending policy by union government made a positive impact on agricultural production. The agricultural sector deserves direct lending for the sustainable growth. Hence, to achieve higher growth the direct lending needs to be encouraged. The quatum of institutional lending impcats the growth of agriculture. While comparing contributions of public and private sector banks to agriculture Kumar & Kumar (2016) claims that the prescribed target of lending to agricultural sector not achieved by both Public and Private Sector Banks and this is the area of concern. It is also found that the disparities in disbursement to agriculture is found to be higher in the private sector as compare to public sector banks, immediate measures are to be taken to achieve the prescribed target of lending.

From the review of various research works it has been identified that existing studies focused on understanding trends, impacts, and disparities in agricultural credit disbursement by scheduled commercial banks in India. Thus, no studies have been undertaken to forecast the agriculture finance by scheduled commercial banks in India up to the year 2030.

OBJECTIVES OF THE STUDY

The objectives of the study are,

1. To build a model on agriculture financing by scheduled commercial banks.
2. To forecast the agriculture financing by Commercial banks by the end of this decade.

RESEARCH METHODOLOGY

This exploratory study depends upon the total agriculture credit from the non-food credit division by the Indian Commercial Banks from 2008-09 to 2022-23. The data and information for the study has been reffered from RBI Handbook of Statistics on Indian Economy 2022-23, Journal articles and other government publications.

Tools for Analysis

The researchers used Gretl Statistical Software in the analysis of data. ARIMA Model is used for building model to forecast.

Model Building for Forecasting

Econometrics model building process to be done according established steps. The researchers applied the following steps to data for building a valid model for forecasting,

Step 1: Check for Data Normality

Normal distribution of data is mandatory to build a model. For checking normality Jarque-Bera Test is widely used test. The Test Statistics for normal distribution is given under the Table.1

Null Hypothesis: Data is normally distributed

Table 2: Augmented Dickey Fuller Test

Augmented Dickey-Fuller Test (Lag_1)			
Data Set	**Asymptomatic P-value (With Constant)**	**Asymptomatic P-value (With Constant and Trend)**	**Interpretation**
Actual Data Series	1	0.9993	Non-stationary
First Difference (d)	0.47	0.2827	Non-stationary
Second Difference (d_d)	9.431e06	0.0001476	Stationary

Source:Researchers' Calculation

To make data stationary, researchers extracted second difference of the given data series. So, in the second difference data set with 95 per cent confidence and 5 per cent Margin of Error the P Value obtained are with constant (9.431e06) and with constant and trend (0.0001476) are lower than level of significance(0.05). Hence, the null hypothesis that is data is non-staioray should be rejected and it validate the stationarity of data.

Step 3: Model Selection

The effectiveness of model is depends on the selection of model. An appropriate model can forecast reliable data. The researchers applied Akaike Criterion for selection of the best model for forecasting. The test summary Akaike Criterion for model selection is given below. Table 3 depicts the summary of Akaike test for various combination of values and residuals.

Table 3: Summary Statistics on Akaike criterion

AR/MA	0	1	2	3	4
0	329.6860	327.5352	329.2161	330.7810	331.2384
1	328.8961	329.1515	331.1392	331.8249	333.1967
2	330.8514	331.1055	332.8742	332.9846	334.1593
3	331.3040	333.1053	332.8702	334.9734	337.0291
4	332.8702	334.1672	334.8543	336.5716	337.3180

Source: Researchers' Calculation

From the Table.3 researchers summarised various combinations of AR and MA between given combinations. The ARMA (0,1) contains the least Akaike value. The research used two differences to achieve data stationarity so the model ARIMA (0,2,1) would be the best model for building the model for forecasting.

Step 4: Build the Model

Based on the Akaike criterion information the researcher identified the model ARIMA(0,2,1) and the summary of the model is presented in the Table 5.

ARIMA, using observations 2010-2022 (T = 13)

Estimated using AS 197 (exact ML)

Dependent variable: (1-L)^2 Agriculture_CreditStandard errors based on Hessian

Table 5 ARIMA (0,2,1) Model on Agriculture Financing by Commercial Banks

	Coefficient	Std.Error	Z	P- Value
Const	11298.7	3404.06	3.319	0.0009 ***
theta_1	−1.00000	0.312244	−3.203	0.0014 ***

Mean dependent var	16955.00	S.D. dependent var	69387.98
Mean of innovations	−1987.763	S.D. of innovations	51343.80
R-squared	0.407749	Adjusted R-squared	0.407749
Log-likelihood	−160.7676	Akaike criterion	327.5352
Schwarz criterion	329.2301	Hannan-Quinn	327.1869

Source: Source: Researchers' Calculation

The Table.5 contains the model ARIMA(0,2,1) is the best model for forecasting agriculture financing by the scheduled commercial banks. The P value of test indicates that the model with 99 per cent confidence and is significant at 0.01 level. The R- Squared value 0.407749 depictsmodel is fit.

Equation for the Model ARIMA (0,2,1) is

$$\mathbf{Yt= 11298.7+ 0.813973e_{t-1}}$$

Step 5: Diagnostic Testing

Diagnostic test validate the model built forecast. If the model fulfills every applicable condition then only it should be used for forecasting. Three applicable diagnostic test for the Univariate Time Series data are summarised in the Table 6.

Table 6 Diagnostic Tests for ARIMA(0,2,1) Model

Diagnostic Tests	Null Hypothesis	Test- Statistics	P-Value	Interpretation
Normality of Residuals (Lag_1)	Error is normally distributed	Chi-square(2) = 3.0718	0.21526	Residuals are Normally Distributed
Test for Auto-Correlation (Lag_7)	No autocorrelation presents between residuals	Chi-square(1) = 0.168908	0.6811	No Autocorrelation presents
Test for ARCH Effect (Lag_1)	No ARCH effect presents	LM = 0.0268641	0.869808	No ARCH effect Present
Level of Confidence= 95 per cent			Level of Significance= 0.05	

Source: Researchers' Calculation

With 95 per cent confidence and 5 per cent Margin of Error the test for normality of residuals has given the Chi-square value 3.0718 with the corresponding P- value 0.21526 which is more than level of significance (0.05). Hence, there no evidence to reject null hypothesis so that errors are normally distributed.

Test for autocorrelation with 95 of confidence and 5 per cent of significance exhibit the Chi-squared value 0.168908 with corresponding P- value 0.6811. So the Null Hypothesis of no autocorrelation is cannot be rejected.

The null hypothesis of no ARCH effect is present in the model has been tested with 95 per cent of confidence and 5 per cent of significance. The test yielded LM value 0.0268641with corresponding P-value 0.869808. Hence there is no evidence to reject Null Hypothesis and model is free from ARCH effect.

Step 6: Forecast the Future

The researcher by using ARIMA(0,2,1) Model have predicted the amount of agriculture financing for the upcoming seven years. Table.7 depicts the actual and forecasted figures.

Table.7 Prediction of Agriculture Financing by Commercial Banks

(Rs. in Crores)

Year	Actual Agriculture Financing	Predicted Value
2008-09	160690	-
2009-10	188253	-
2010-11	222792	-

2011-12	312877	-
2012-13	484499	-
2013-14	527506	-
2014-15	604376	-
2015-16	642954	-
2016-17	799781	-
2017-18	871080	-
2018-19	954823	-
2019-20	1070036	-
2020-21	1194704	-
2021-22	1415964	-
2022-23	1663942	-
2023-24	-	1853522.42
2024-25	-	2054401.57
2025-26	-	2266579.47
2026-27	-	2490056.10
2027-28	-	2724831.47
2028-29	-	2970905.58
2029-30	-	3228278.43
2030-31	-	3496950.02

Source: Compiled from RBI Handbook of Statistics on Indian Economy 2022

The Table.7 depicts the credit extended by the commercial banks of India up to the year 2030-31. The model predict that there will be a notable increment in agriculture lending in the country, the agriculture credit will reach Rs. 3496950.02 crores by 2030-31 which is 110.16 per cent increment over existing disbursement. According to The Chief Economic Adviser Mr. V Anantha Nageswaran, India's Gross Domestic Product (GDP) will shoot up to Seven Trillion Dollar by the year 2030 (Sharma, 2023) which is the 100 percent increment over current GDP. As per the latest report of United Nations' India became the highest populous country in the world by surpassing China, out of which youth population accounts for 68 per cent of the total population (Roy, 2023). It is clear that there will be high demand for food grains and employment by the end of this decade. However, this Econometrics Model founds that Agriculture finance to GDP value will be leading by 10 per cent with in next seven years and suggest to

maintain the flow of finance to agriculture at current rate in order to boost the primary sector of the economy.

CONCLUSION

The growing population has two fold impacts with agriculture financing. Firstly, it creates additional demand for food grains. Secondly, in the labor intensive country agriculture generates more employment that can cater the employment needs of the population. Finally the study concludes that extending of direct lending and the capital expenditure in agriculture can address present and potential fundamental challenges of the country.

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