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Internship Report

On

‘Analysing the Effect of Macroeconomic Stress on Non-Performing Assets of Karnataka State Cooperative Bank’

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February, 2021

Certificate

This internship report titled “*Analysing the Effect of Macroeconomic Stress on Non-Performing Assets of Karnataka State Cooperative Bank*” is a report on the study taken up at the Fiscal Policy Institute (FPI) in 2020-21.

The internship report is prepared by Aniket Chatterjee studying at University of Hyderabad, Hyderabad under the mentorship of Sri. Manjunath Hegde, Adviser (Trg) & Faculty, Fiscal Policy Institute.

All opinion and conclusions expressed in the internship report are of the Intern and usual disclaimer applies.



Sujit Kumar Chowdhury

Director, FPI



LETTER OF TRANSMITTAL

Shri. Sujit Kumar Chowdhury,

The Director,

Fiscal Policy Institute, Bangalore.

Respected sir,

I am pleased to submit the report “*Analysing the Effect of Macroeconomic Stress on Non Performing Assets of Karnataka State Cooperative bank*” as part of the online summer internship 2020 at the esteemed Fiscal Policy Institute, Bangalore. I hereby declare that this is an original work done by me and the work has not been previously submitted for any publication.

Kindly feel free to revert to me with any questions and/or comments regarding this report.

Sincerely,

Aniket Chatterjee

Online Summer Intern

Fiscal Policy Institute

Bangalore

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Aniket Chatterjee

Online Summer Intern

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Abstract

Risk management has been one of the most challenging tasks for any policy maker. The viable and robust economic health of an organisation is a key to its improved performance. Cooperative banks play a significant role in the Indian economy, especially in catering to the economic needs of the rural population. Hence, dynamic financial (risk) management is essential to keep the institution strong.

Credit risk, in any lending institution, is one of the inherent issues that needs special care and notice. Credit risk may arise from a multitude of directions. One prominent source of credit risk is the macroeconomic conditions prevailing in the economy. Macroeconomic volatilities can push a financial institution into a severe crisis if not properly managed.

As for cooperative banks which primarily deal with the volatile agricultural credit sector, they demand proper estimation and analysis of risk arising from macroeconomic stresses. This study aims at explaining the impact of macroeconomic stress on the non-performing assets, which is the primary consideration for the credit risk of the Karnataka State Cooperative bank. The study tries to find out a set of macroeconomic variables directly affecting NPAs in the cooperative domain. This is followed by an estimation of the range in NPAs arising out of fluctuations in the macroeconomic variables identified before. The paper also analyses the performance of the cooperative bank empirically looking at different data on the bank's performance based on operations, advances and spread.

Finally, the conclusion is derived consisting of a brief discussion on the possible solutions to the NPA crisis faced by the cooperatives and the way ahead for mitigation of the same.

Keywords: Non Performing Assets, Value added, Cooperatives, Agriculture, State Domestic Product, Linear Regression

List of abbreviations

ACSF	Agricultural Credit Stabilisation Fund
Agri	Agriculture
DCCB	District Central Cooperative Bank
MSP	Minimum Support Price
MT	Medium Term
NABARD	National Bank for Agriculture and Rural Development
NAFSCOB	National Federation of State Cooperative Banks Ltd
NPA	Non-Performing Asset
NPL	Non-Performing Loans
NSDP	Net State Domestic Product
NVA	Net Value Added
SDP	State Domestic Product
ST	Short Term
StCB	State Cooperative Bank
UCB	Urban Cooperative Bank

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1. Introduction

A challenge of paramount stature that policy makers of India often face is the diversity and demography of this vast country. Achieving social welfare in this country demands significant importance and consideration of this fact. The concept of financial inclusion also requires the same. Financial inclusion is considered as one of the core factors behind inclusive economic growth and an overall development in the standard of living. Access to formal finance can boost job creation, reduce susceptibility to economic shocks and increase investments in human capital. Absence of formal financial channels marginalises a section of the society in accessing the credit facilities from informal sources, often coupled with hefty interest rates and thereby putting a cloud of doubt of insolvency and bankruptcy.

The idea of financial inclusion has taken a driving seat in the Indian financial system. However, the vastness and diversity in terms of demography, economy, literacy, culture and socio-political structures have posed a serious question before the policy makers in the domain of accessibility of cheap credit. Heavy transaction costs often bring hurdles in the process of providing cheap loans. Under such circumstances, the eco-system of cooperative banks gains much importance. These institutions play a crucial role in last-mile credit delivery and in extending financial services across the length and breadth of the country through their geographic and demographic outreach.

Cooperatives are well known in the Indian banking system. Cooperatives are the nurturing incubators for individuals with limited resources. They voluntarily join the structure to fulfil a common economic need through the formation of a democratically managed organisation making equitable contributions to the capital requirements and accepting a fair share of the risks and rewards of the undertaking.

Cooperative banks face different types of risks like any other financial organisations. Owing to the significant role of cooperative banks, it requires an independent risk management and mitigation framework to thrive and serve as the key instrument for inclusion. Financial risks can arise from a multitude of directions and hence rigorous analysis and estimation are required to achieve a higher utility from the operations of the cooperative banks.

This study is broadly divided into three parts. The first part includes the literature review and research objectives. The second part consists of explanation of the scenario of cooperatives and

risk management. The third and final part brings out the research carried out, the results observed and the conclusion arrived at.

A brief note on macroeconomic risks and its importance in the cooperative ecosystem:

Before delving into the idea of macroeconomic risks, the difference between risk and uncertainty is summarised. Knight (1921), in defining risk and uncertainty, made an explicit distinction between the two terms. Knight has defined risk as a decision-making situation in which all potential outcomes are identified and their respective probabilities of occurrence are known. Knight has characterised uncertainty as a situation in which either the possible decision outcomes or the specific probabilities associated with such outcomes are unknown to the decision-maker. Decision-makers are in the domain of risk, if their decision is known to lead to a certain outcome with certain probability and they are in the realm of uncertainty, if the probabilities associated with the outcomes are either unknown or meaningless. Hence, we are concerned with macroeconomic risks and not uncertainties in the following study.

Macroeconomic risks refer to those risks that arise from the fluctuations in variables that generally indicate the overall condition of the economy and not any specific part of it. Macro risks affect all asset classes that are exposed to a particular country or region. Macroeconomic risks are considered external to any particular institution because they do not have the authority or power to influence the variables. Therefore, any type of risk that arises and cannot be influenced individually can be considered as macroeconomic risk. As a result of this definition, there can be a broad set of risks that can be attributed under macroeconomic risks. Also, a particular risk that is external to an institution can be internal for another.

As far as cooperative banks are concerned, the governance structure and its domain of action make it vulnerable to these kinds of risks. Cooperatives mainly cater to the credit needs of the rural sector whose resilience to shocks is not as healthy as that of any urban commercial bank. Hence, efficient management of the financial health plays a crucial role for cooperatives.

2. Literature Review

- **Louzis, Vouldis, and Metaxas (2012) and Abid, Ouertani and Ghorbel (2014)** used a dynamic panel data model to study the factors influencing non-performing loans (NPLs) in the Greek and Tunisian banking sector respectively. Louzis, Vouldis, and Metaxas (2012) studied separately Non-Performing Assets (NPAs) for consumer credit, corporate credit, and secured loans. Both the studies are based on the hypothesis that both macroeconomic and bank-specific variables increase NPAs. The results

demonstrate that NPLs can be explained mainly by macroeconomic variables, which include GDP, unemployment, interest rates, public debt and by management quality.

- **Swamy (2012)** examined the impact of macroeconomic and endogenous factors on Non-Performing Assets (NPAs). Using panel data, he has shown that lending rates do not affect NPAs significantly. Further, his study suggests that private banks and foreign banks have advantages in terms of their efficiencies in better credit management that contain Non-Performing Assets. It indicates that bank privatisation can lead to better management of default risk. Kauko (2012) tests the significance of current account deficits to the banking crisis.
- According to **Kauko (2012), Louzis, Vouldis, and Metaxas (2012) and Abid**, factors affecting the same can be broadly classified into two parts – macroeconomic and bank specific. Macroeconomic factors include GDP per capita, inflation, interest rates, business cycles etc.
- **Ouertani and Ghorbel (2014)**. It has been found that Gross Domestic Product growth has a negative effect on NPAs, since because of increasing income levels businesses repay their debts and NPAs will decline. Rate of unemployment is also another macroeconomic variable, affecting NPAs (Rinaldi and Sanchis Arellano (2006)). Research has also proved that there is a direct relationship between the inflation rate and default rate as well.
- **Das and Sen (2015)** have analysed the performance of urban cooperative banks by estimating the ratings of 31 state cooperative banks operating in India by applying the Data Envelopment Analysis (DEA) to find out the relationship between the efficiency score of the banks and other independent variables. They concluded that in order to improve the efficiency of the banks, the inefficient banks have to reduce the amount of capital and number of employees. The findings suggest that technical efficiency of a cooperative bank, which has been reflected by 'efficiency score', is positively associated with equity to total assets, bank size, ROA, non-interest income and negatively related to market power, loans intensity, loan loss provisions to total liabilities, non-interested expenses to total assets.

3. Research gap and objective

The aforementioned literature mainly focuses on the risk management of private and public banks. As far as state cooperative banks are concerned, there have been comparative trend analysis and studies on NPA and performance but there has been no study based on the stress of the cooperative banks. Introducing macroeconomic stress in the framework requires the consideration of shocks to estimate the stress faced by the institution, which is considered in this study.

Secondly, stress analysis based on scenarios on the State Cooperative Bank of Karnataka is not undertaken in any past literature. Hence, this study tries to focus on the performance of the Karnataka State Cooperative Bank. In this project, macroeconomic phenomena and variables such as gross domestic product per capita, net value added, minimum support price and agricultural domestic product are taken into the picture to explain the incidence of Non-Performing Assets in the State Cooperative Bank. This is followed by considering shocks in the explanatory variable to estimate its impact on the NPAs.

The ultimate objective of this study is to comment on the health of the State Cooperative Bank in case of macroeconomic shocks. An estimation of the prospective upper and lower bounds is done based on a specific degree of shock in the macroeconomic explanatory variables. This, in turn, will help the policy makers and regulators to better understand the NPA crisis with respect to the macroeconomic changes that are not in hands of the banking sector regulators.

4. A brief note on Non-Performing Assets (NPAs)

Before we move on to the analysis of NPA, a brief exposure on the core features are mentioned. These are specified by the Reserve Bank of India in their master circular on NPA dated July, 2015.

Non-Performing Assets: An asset, including a leased asset, becomes non-performing when it ceases to generate income for the bank. A Non-Performing Asset (NPA) is a loan or an advance where;

- i. interest and/ or instalment of principal remain overdue for a period of more than 90 days in respect of a term loan,
- ii. the account remains 'out of order' in respect of an Overdraft/Cash Credit (OD/CC),
- iii. the bill remains overdue for a period of more than 90 days in the case of bills purchased and discounted,

- iv. the instalment of principal or interest thereon remains overdue for two crop seasons for short duration crops,
- v. the instalment of principal or interest thereon remains overdue for one crop season for long duration crops,
- vi. the amount of liquidity facility remains outstanding for more than 90 days, in respect of a securitisation transaction undertaken in terms of guidelines on securitisation dated February 1, 2006.
- vii. in respect of derivative transactions, the overdue receivables representing positive mark-to-market value of a derivative contract, if these remain unpaid for a period of 90 days from the specified due date for payment.

Banks should classify an account as NPA only if the interest due and charged during any quarter is not serviced fully within 90 days from the end of the quarter.

(i) NPA in agricultural advances can be further explained in the following points (September 2004)

- a) A loan granted for short duration crops will be treated as NPA, if the instalment of principal or interest thereon remains overdue for two crop seasons.
- b) A loan granted for long duration crops will be treated as NPA, if the instalment of principal or interest thereon remains overdue for one crop season.

The duration (short/long) is categorised in the following way:

(ii) "long duration" crops would be crops with crop season longer than one year and crops, which are not "long duration" crops would be treated as "short duration" crops.

(iii) The crop season for each crop, which means the period up to harvesting of the crops raised, would be as determined by the State Level Bankers' Committee in each state.

(v) Banks should ensure that while granting loans and advances, realistic repayment schedules are fixed based on cash flows / fluidity with the borrowers.

In case of natural calamities affecting agricultural outputs, the borrower is provided the option to convert the short-term production loan into a term loan or re-schedule the repayment period, and sanction fresh short-term loans.

In such cases of conversion or re-schedulement, the term loan as well as fresh short-term loan may be treated as current dues and need not be classified as Non-Performing Asset (NPA). The asset classification of these loans would, therefore, be governed by the revised terms and conditions and these would be treated as NPA under the extant norms applicable for classifying agricultural advances as NPAs.

5. Analysing the performance of Karnataka State Cooperative Bank

State Co-operative Bank (StCB) means the principal cooperative body in a state, which is registered or deemed to be registered under the Co-operative Societies Act, 1912, or any other law for the time being in force in India related to co-operative societies. StCBs are formed by federating all District Central Co-Operative Banks (DCCBs) in a particular state. If there is no such society in a state, the state government may declare one or more co-operative societies carrying on business in that state to be a state co-operative bank (or banks).

The StCB is also called the Apex Bank, which stands at the top of the agriculture credit structure in each state and provides agriculture finance to the central co-operative banks in order to enable them to help in promoting the lending activities of the primary agriculture credit societies. Thus, StCBs serve as the final link between the money market and the co-operative sector. The StCBs not only finance but also control and regulate the working of central co-operative banks in each state. The StCB is interested in helping the co-operative credit movement, also in promoting other co-operative ventures and in extending the principles of co-operation. In the absence of DCCBs in a state, a StCB may give direct financial assistance to the primary agriculture credit societies. The main features of StCBs include their service as the balancing centre in the state, organising provision of credit for credit worthy farmers, carrying out banking business, and leading the co-operative movement as a leader of the co-operatives in the state.



Figure 1: The hierarchy of cooperative ecosystem

The performance metric¹ of Karnataka State Cooperative Bank can be summarised by the following charts:

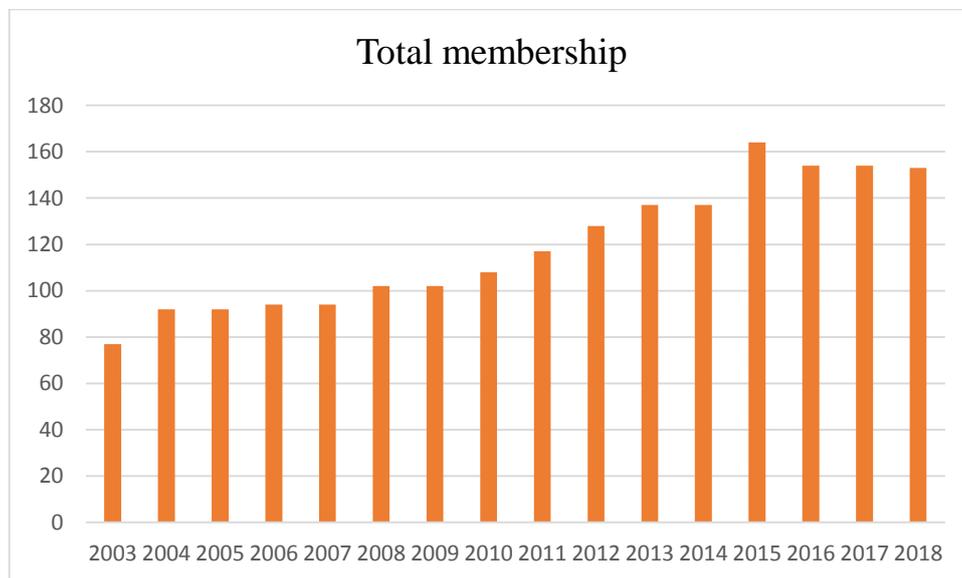


Figure 2: Total membership of Karnataka State Cooperative Bank Source: (NAFSCOB)

Total membership which includes cooperative societies, individuals and government bodies, has shown an increase in the previous fifteen-year period before 2018. However, there has been

¹Values in lakhs unless otherwise mentioned.

a fall in the total membership after 2015, which could be a result of a shift from cooperatives to private and public banks and non-banking financial institutions.



Figure 3: Share of membership with total members nationwide. Source: (NAFSCOB)

Though there has been a weak increasing trend in total membership, the share of total membership with respect to the nationwide total membership value has shown a decreasing trend as seen from the trend line.

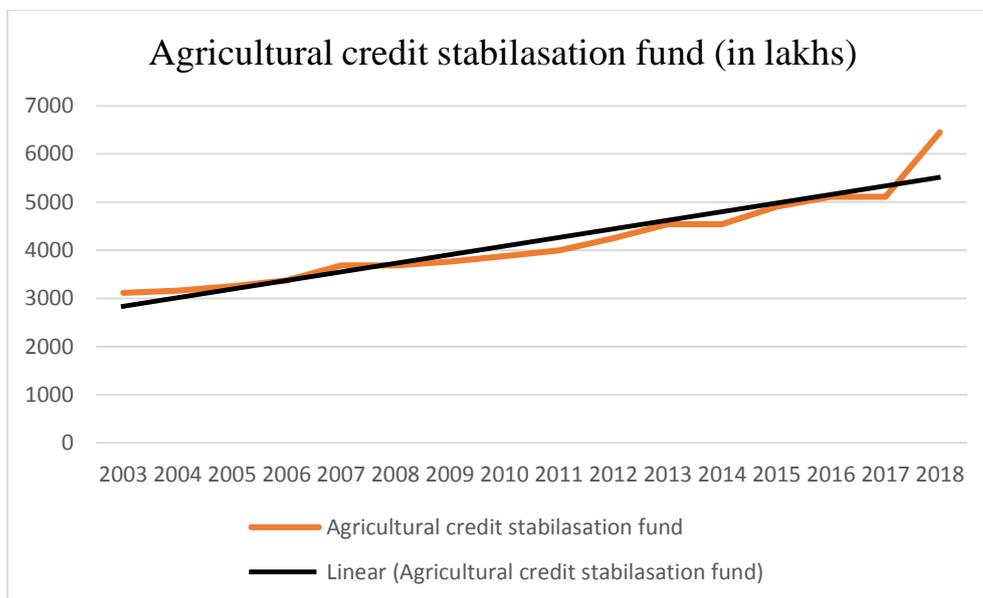


Figure 4: Amount of ACSF. Source: (NAFSCOB)

This Agriculture Stabilisation Fund was created under the National Bank for Agriculture and Rural Development Act, 1981. These funds include the sum of money central and state

governments may contribute from time to time. It shall also take the amount received from the Reserve Bank of India into account. Loans forwarded from this fund come under Section 22 of the Act. The amount of funds in this section shows a significant increase during the time.

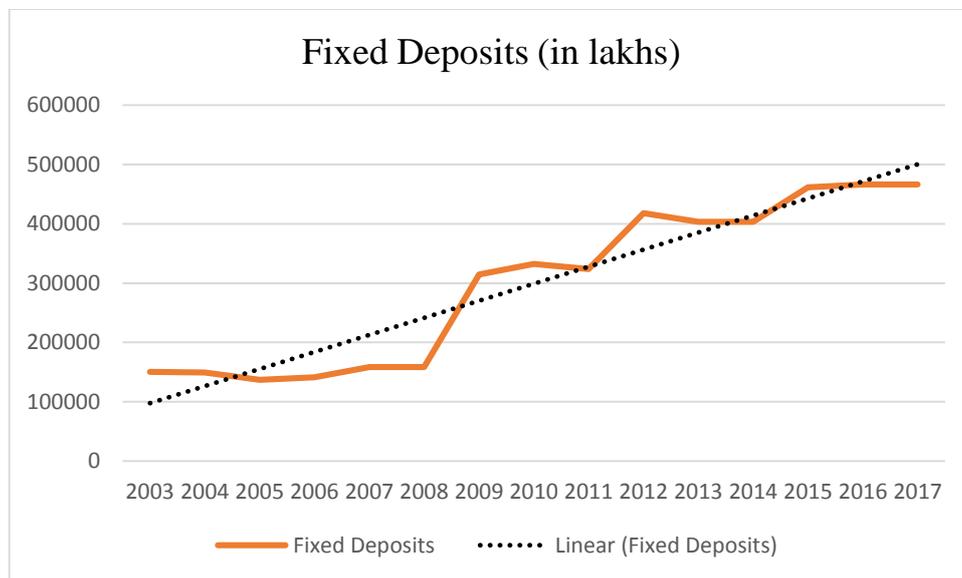


Figure 5: Amount of fixed deposits. Source: (NAFSCOB)

The level of fixed deposits has varied year on year but has shown an increasing trend, highlighting the increased spread of state cooperatives in the financial sector of the state.

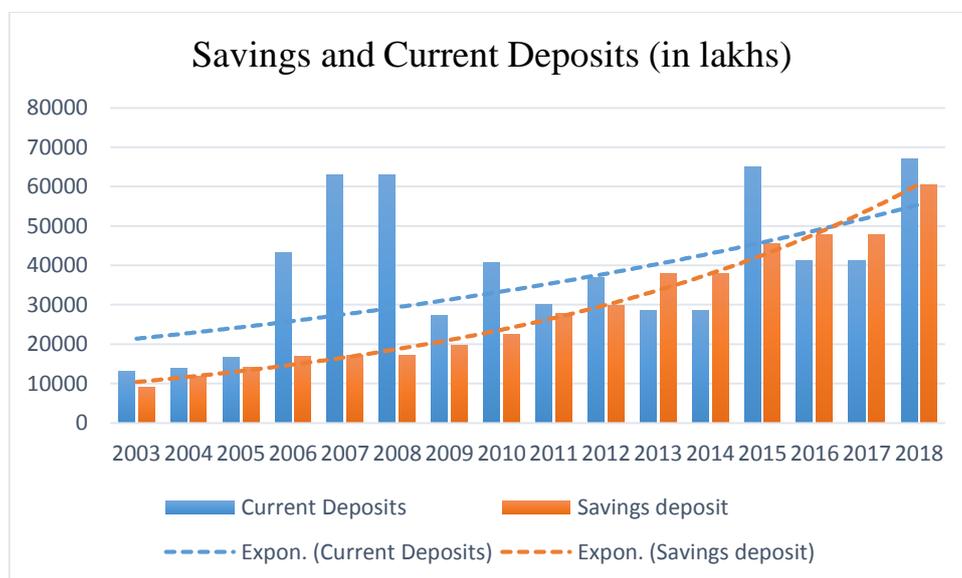


Figure 6: Amount of savings and current deposits. Source: (NAFSCOB)

The significant fact that can be derived from this graph relates to the exponential increase in savings in the last fifteen years. One important ambition of cooperative banks is to provide saving opportunities to the rural sector. This trend points towards the success of the target.

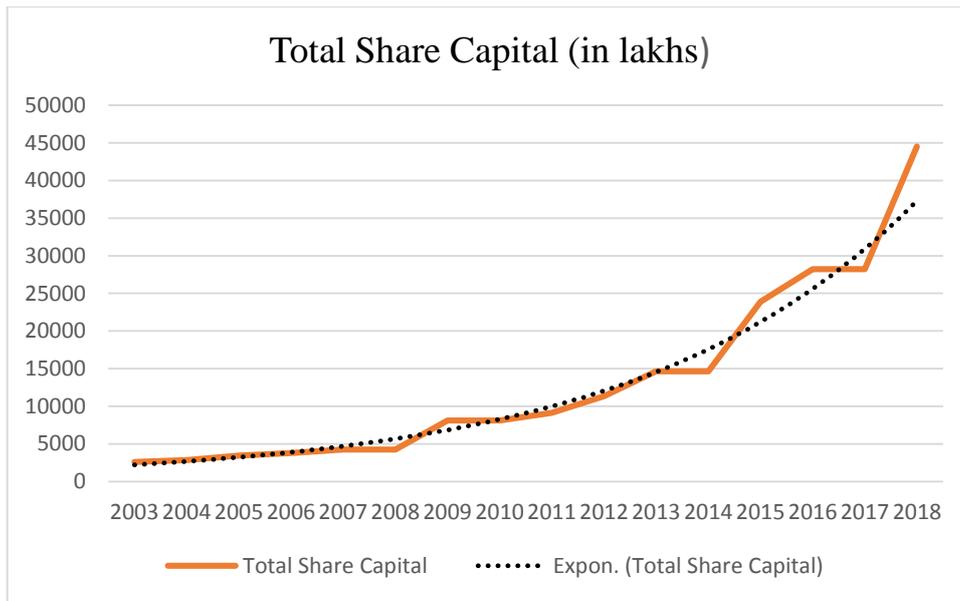


Figure 7: Amount of share capital. Source: (NAFSCOB)

This graph denotes the funds generated by issuing stocks and shares. Share capital has increased almost exponentially during the time period. This highlights the financial viability which the cooperatives have gained in the last decade.

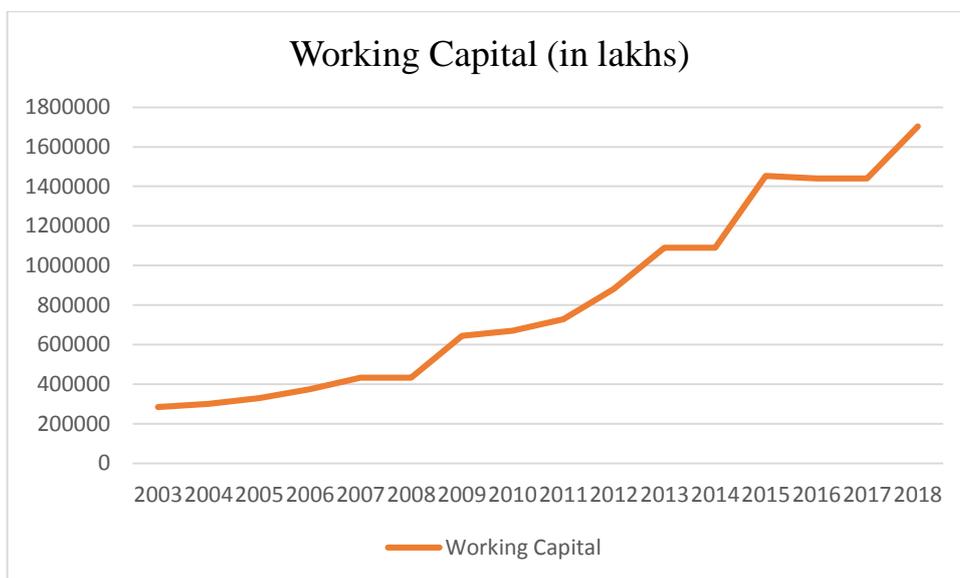


Figure 8: Amount of working capital. Source: (NAFSCOB)

Working capital indicates the liquidity that the organisation possesses to ensure daily operations. This amount is a proxy for the daily activities that the organisation undertakes. As we see from the graph, the amount of working capital has shown a substantial increase, thereby indicating the financial health of the institution.

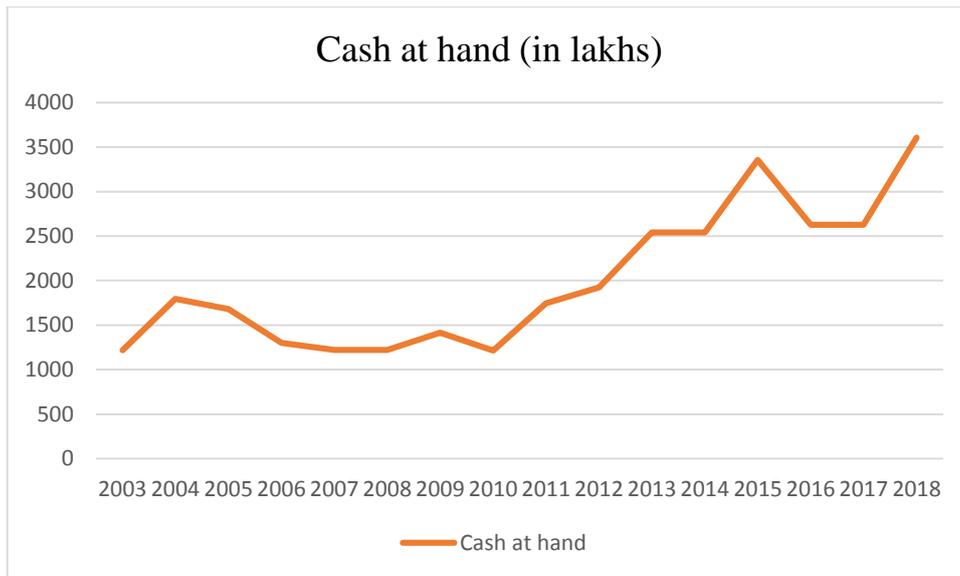


Figure 9: Cash at hand with Karnataka StCB. Source: (NAFSCOB)

Similarly, cash at hand also indicates the financial health as it is the most liquid asset that the bank holds. As far as the Karnataka StCB is concerned, cash at hand shows a dual trend where it falls first and then rises after 2010.

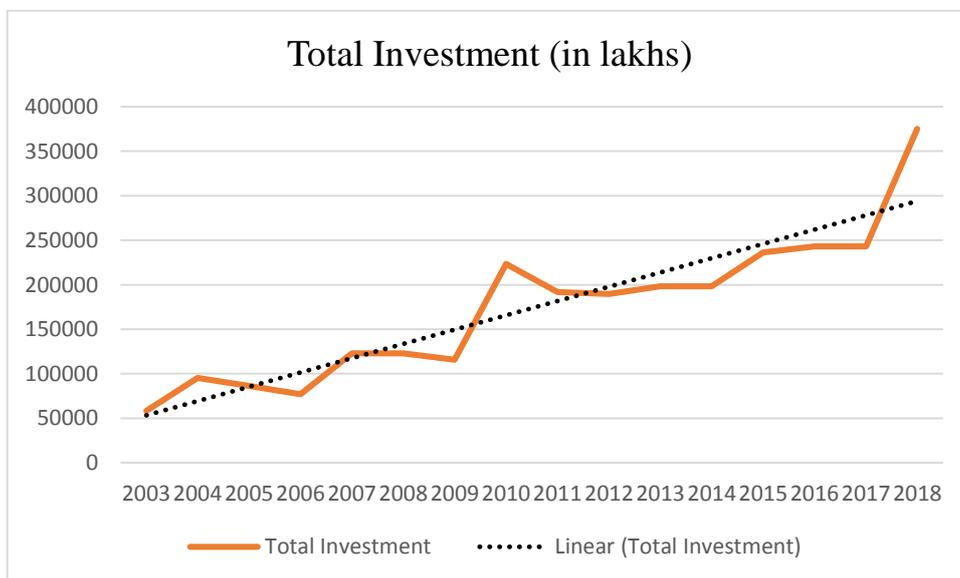


Figure 10: Total investments by Karnataka StCB. Source: (NAFSCOB)

Total investments made by the State Cooperative Bank in government securities, debentures and fixed deposits with other agencies show a steady increase. This also points to the financial health of the institution.

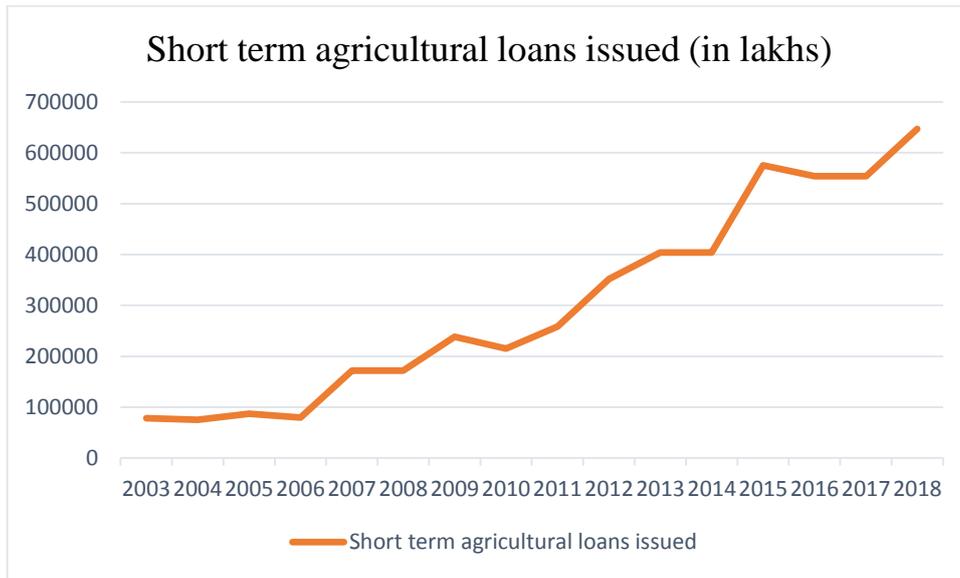


Figure 11: Short term agricultural loans issued. Source: (NAFSCOB)

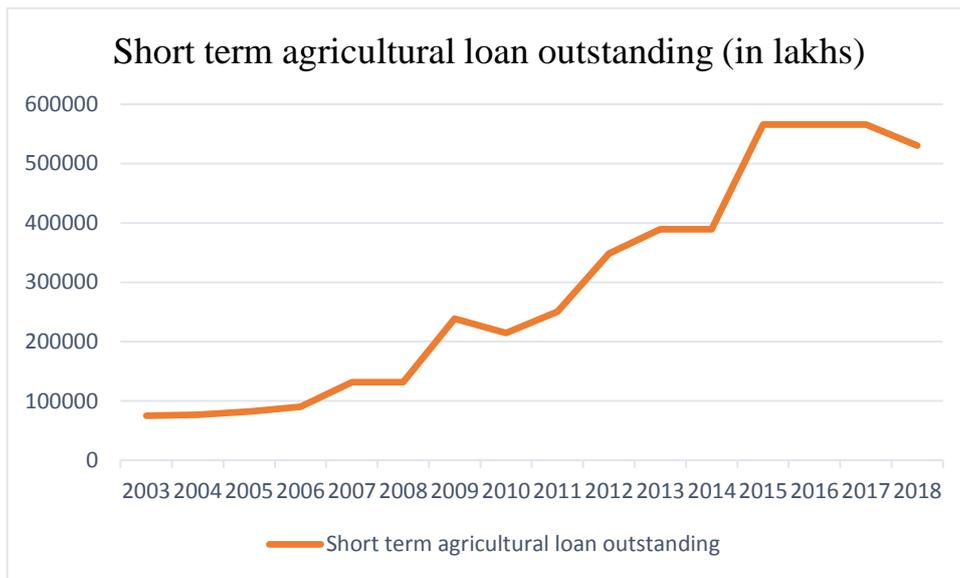


Figure 12: Short term agricultural loans outstanding. Source: (NAFSCOB)

The above two charts bring out an important factor regarding NPAs. NPA is highly correlated with the amount of loan advanced, which is evident from the pattern from the above graphs.

After 2015, borrowing has relatively declined and outstandings have relatively increased, probably indicating the risk management approach of the cooperatives.

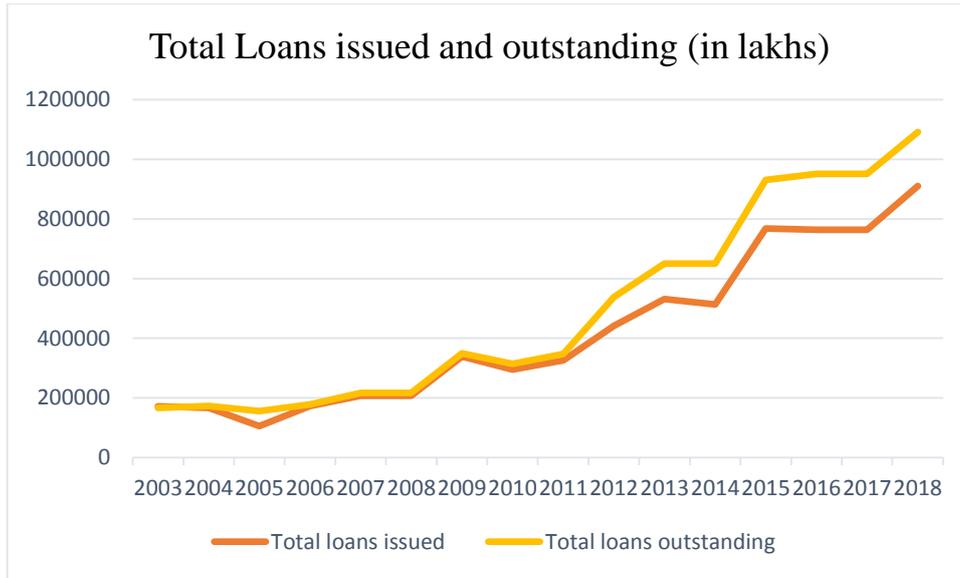


Figure 13: Total loans issued and outstanding. Source: (NAFSCOB)

Total loans include short and medium term loans for both agricultural and non-agricultural purposes. This graph is probably the most important in the context of NPA. Total loans issued by the State Cooperative Bank and the total loan outstanding show an identical trend. The correlation coefficient between them is 0.99, which indicates a high positive linear correlation. This is vital as it indicates that risk management is an irreplaceable part of the operations.

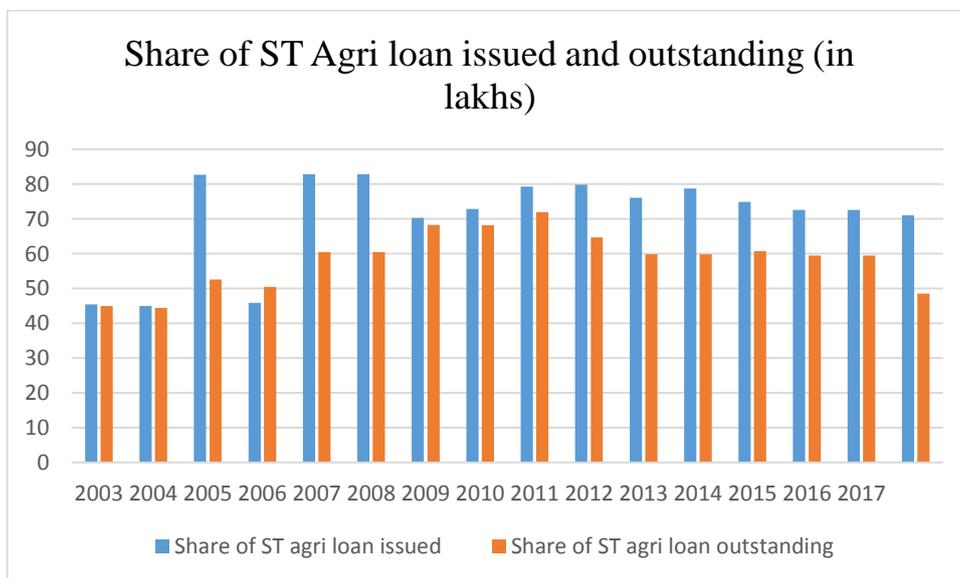


Figure 14: Share of short term agricultural loans issued and outstanding out of total advances

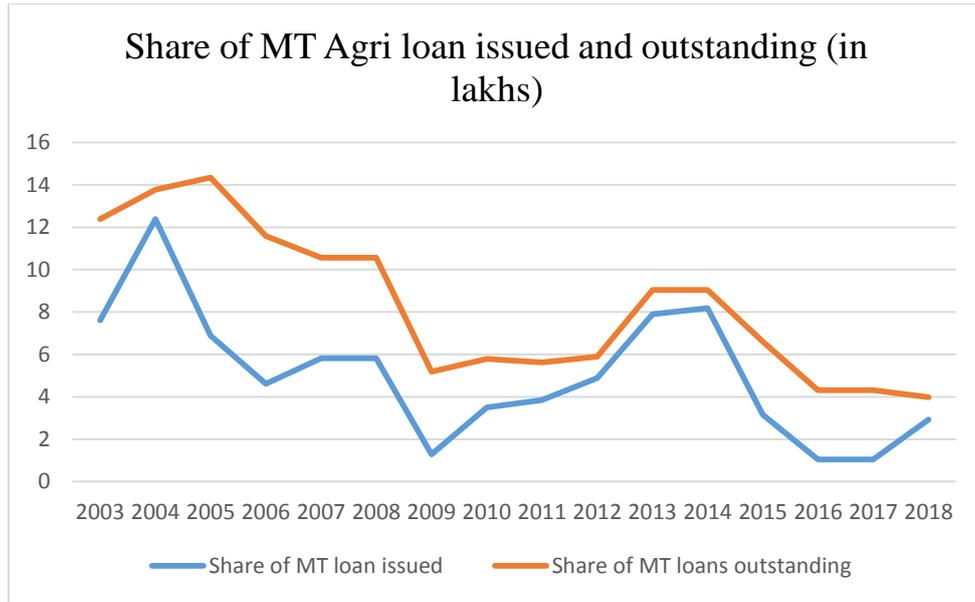


Figure 15: Share of medium term agricultural loans issued and outstanding. Source: (NAFSCOB)

As we see from the graphs above, as the financial health and scope of operations has widened for the cooperative bank, so has the NPA as a percentage of outstanding loans. The share of short term agricultural loans issued and outstanding has shown a steady level across the time considered, while for the medium term agricultural loans issued and outstanding, it is cyclical in nature.

The following table summarises the correlation coefficient between area under cultivation for Karnataka (in thousand hectares) and the amount of loans issued and outstanding. It is seen that there is a negative relation between the total grown-sown area and area under rice cultivation (thousand hectares) and a positive relation with area under cultivation of sugarcane and pulses. No conclusive evidence can be developed from this table as there can be causal relationships among the variables and differences is land distribution patterns.

	ST agri loans issued	ST agri loans outstanding
Total grown-sown area	-0.437387565	-0.447201884
Area cultivated under rice	-0.505976291	-0.531101747
Area cultivated under sugarcane	0.784047372	0.780108282
Area cultivated under pulses	0.738576409	0.754275563

Table 1: Correlation matrix

A linear regression with ST agricultural loans outstanding and area cultivated under rice, sugarcane and pulses fetches the following results:

Multiple R	R Square	Adjusted R sqd	Standard Error	
0.925527	0.856601	0.813581	74916.58	
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	48561.91	262018.8	0.185338	0.85667
Area_Rice	-413.562	129.7787	-3.18667	0.009709
Area_Sug	928.7378	290.9774	3.191787	0.009625
Area_Pulses	181.9167	87.59487	2.076796	0.064544

Table 2: Regression between area under cultivation and loans

The above information pertains to the regression equation between short term agricultural loans outstanding and area of rice, pulses and sugarcane between 2003 and 2018. The model is significant with an 85% goodness of fit. The intercept value is not significant, but a regression through origin model is not considered, as theoretically it is not possible. Here as well, the coefficient of rice is negative, implying an increase in area under rice cultivation reduces the total short term agricultural loans outstanding. The coefficient is positive for all other items, indicating that an increase in area under cultivation leads to an increase in short term loans outstanding. From this analysis, we get an intuitive idea on the overall impact of cultivation area and NPA. Conclusive analysis can only be possible taking into account the pattern of land holding.

The following part develops an empirical analysis of the NPA based on macroeconomic risks.

6. Methodology

As mentioned under the research objective, this study aims at explaining the non-performing assets through the macroeconomic variables. Data from 2003 to 2018 was considered for both the explanatory and the dependent variables and simple linear regression was considered separately for each variable to explain the effect of the macro variables on NPA. Further tests of heteroscedasticity and autocorrelation² were performed to ensure the significance of the models obtained from the regression exercise.

² Appendix

After obtaining the coefficients of the regression models, a certain degree of shocks in the explanatory variables are considered to obtain the level of NPA generated from each of these shocks. The shocks considered were calculated from the mean and standard deviation of the explanatory variables. As calculated by RBI for the “Financial Stability” reports, a mean – sd value is considered as the independent shock on the variable under consideration. The mean component of the shock represents the core value of the variable over time and the sd component identifies the volatility measured as a deviation from the mean. NPA, as a percentage of loan outstanding, is considered as the dependent variable for all the models.

The explanatory variables were transformed into its natural logarithm to normalise the data and also to ensure meaningful values of the coefficients.

The explanatory variable consisted of the following variables:

- 1) SDP at factor cost agriculture (SDP_agr): StCB primarily advances loans to the agricultural sector of the state. Hence, any change in the SDP should have an impact on the NPA and so it is considered to capture the effect of agricultural volatility on NPA.
- 2) NVA (NVA): It is the value of output minus the values of both intermediate consumption and consumption of fixed capital. It is a macro indication of production in the economy. Though StCB majorly forwards credit to the agricultural sector, certain small scale industries also have a share of loans in the StCB. Hence, NVA is used to capture that fraction of the loans.
- 3) Per Capita NSDP at Factor Cost (NSDP_pc): Per capita state domestic product or simply per capita income should have a positive impact on NPA. This variable is considered to capture the effect of standard of living on NPA which is proxied by the per capita income.
- 4) Rice, Tur and Sugarcane MSP (Rice_MSP, Sug_MSP, Tur_MSP): These variables are considered to see the effect of MSP on the NPA from the agricultural sector. These items are the primarily produced agriculture produces in Karnataka and considered due to its significance in Karnataka’s agricultural production basket.

Certain macroeconomic indicators were rejected due to the insignificant impact on the Non-Performing Assets. These include the Index of Agricultural Production (IIP), Wholesale Price Index (WPI) and Consumer Price Index (CPI). WPI for primary articles has also not contributed to NPA significantly. Also, the variables are considered keeping in mind the objective of

macroeconomic shocks. This set of macroeconomic variables considered are not exhaustive in nature and there are other variables which should significantly affect NPA.

The hypothesis considered is:

All the explanatory variables have a negative relation with NPAs. An increase in each of the variables will result in a decline of NPA.

Statistical package of MS Excel is used to obtain the results of the regression.

	Mean	SE	Median	SD	Variance	Kurtosis	Skewness	Range
Ln_nsdp	11.0577	0.1836	10.9428	0.7346	0.5397	-1.459	0.0277	2.1947
Ln_sug_MS	4.8426	0.1229	4.901	0.4917	0.2418	-1.8034	0.121	1.2927
Ln_rice_MSP	6.8036	0.1041	6.9321	0.4166	0.1735	-1.8691	-0.124	1.0731
Ln_NVA	15.0892	0.1464	15.2231	0.5672	0.3217	-0.2713	-0.6862	1.9599
Ln_SDP_agr	15.4269	0.1283	15.4992	0.5134	0.2636	-1.3096	-0.2495	1.5997
Ln_tur_MSP	7.8604	0.1382	7.9505	0.5529	0.3057	-1.9084	-0.0594	1.41798

Table 3: Descriptive Statistics summary

7. Results

The first portion of the result pertains to the trends of the explanatory variables. A simple column graph is implemented to understand the pattern for the period 2003 – 2018.

The graphs are as follows

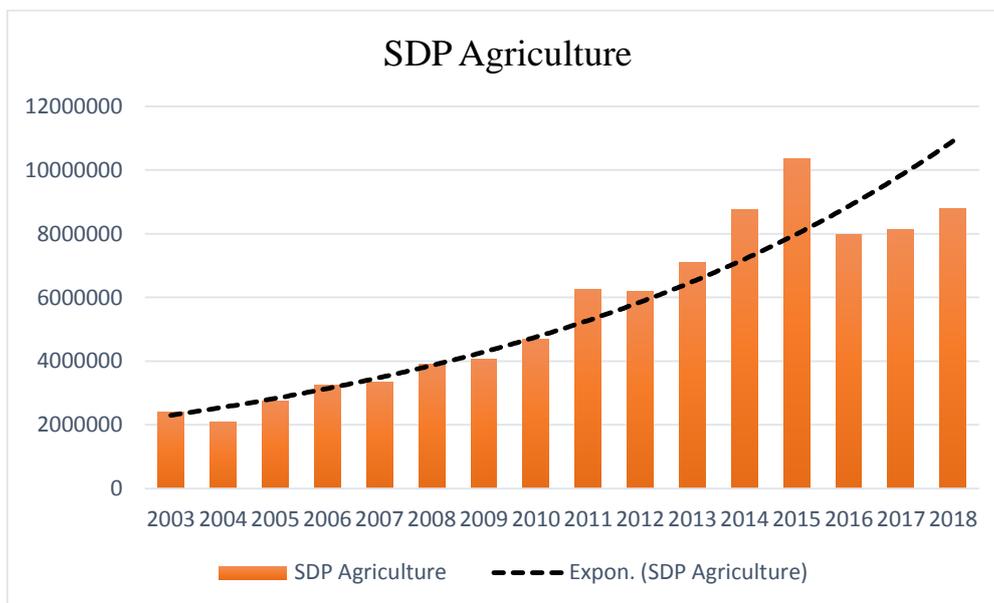


Figure 16: State Domestic Product – Agriculture Source: RBI

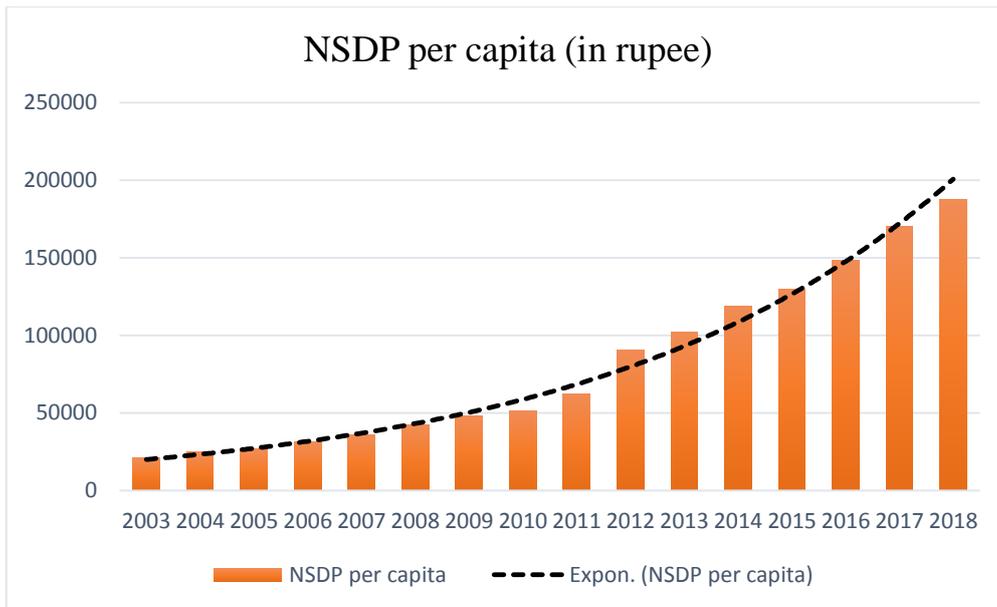


Figure 17: Net State Domestic Product per capita. Source RBI

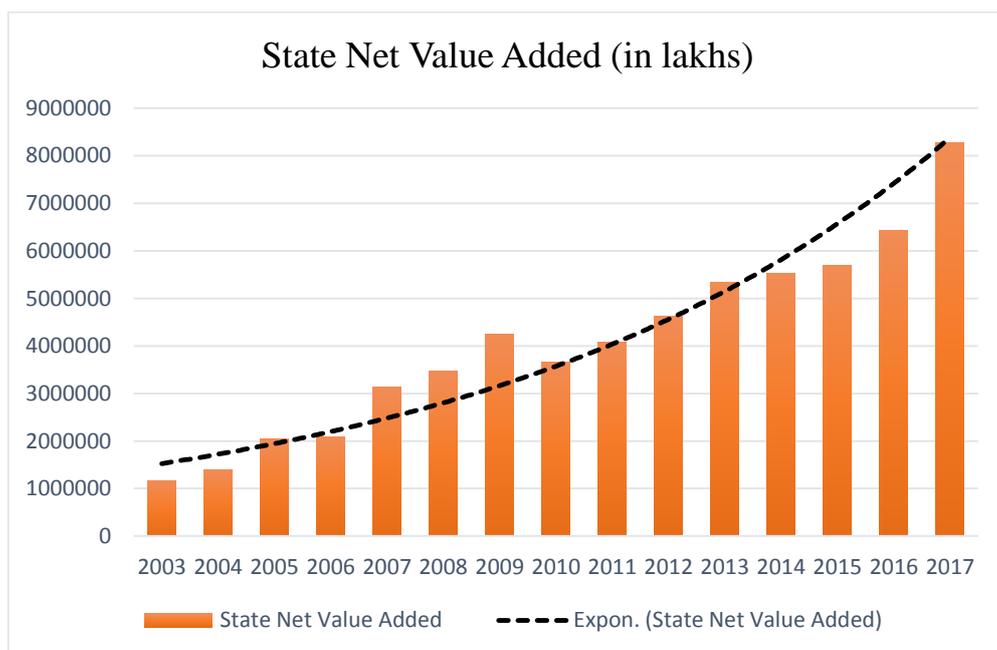


Figure 18: State Net Value added. Source: RBI

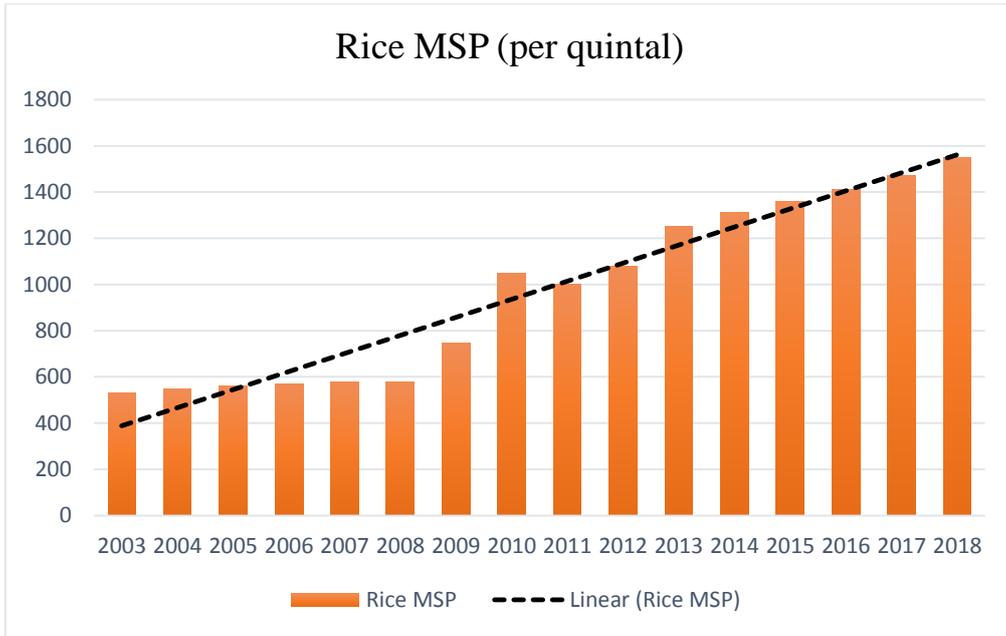


Figure 19: Minimum Support Price for Rice. Source: RBI

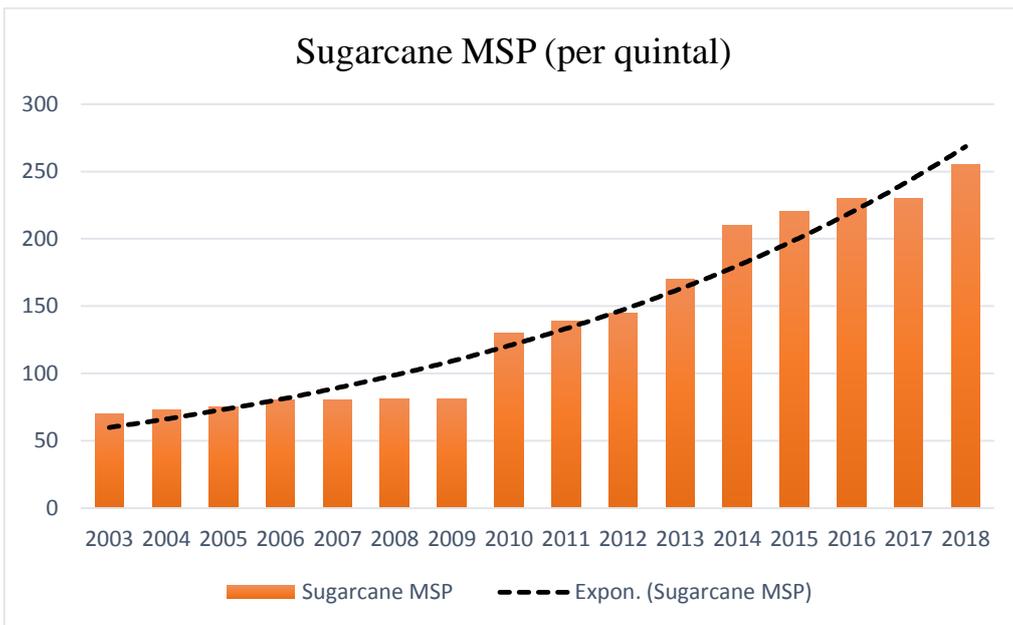


Figure 20: Minimum Support Price for Sugarcane. Source: RBI

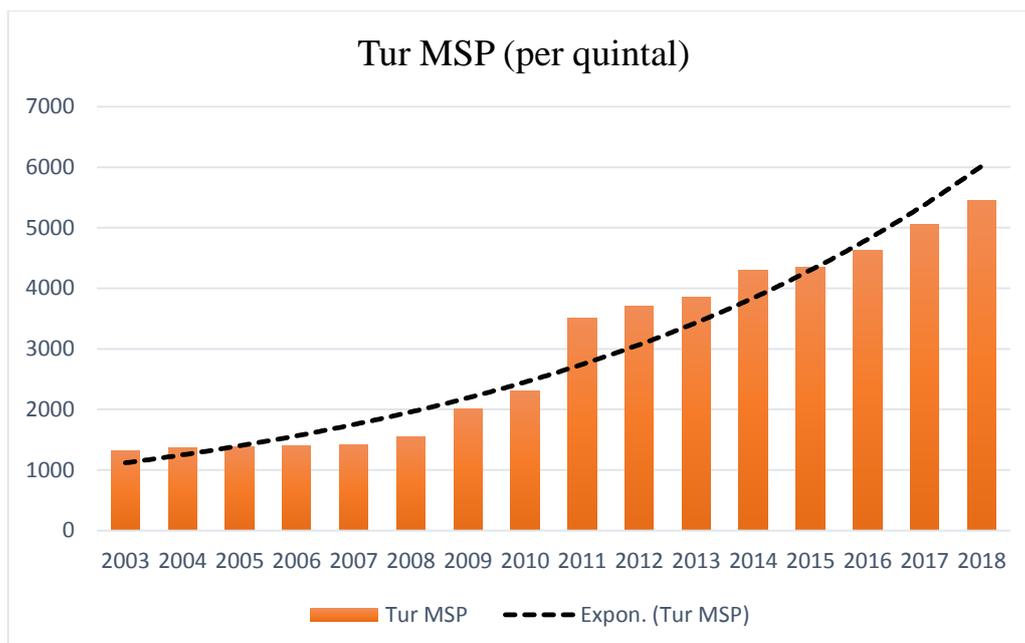


Figure 21: Minimum Support Price for Tur. Source: RBI

A trend line fitted for all the graphs provides an idea of the progression it followed in the fifteen-year time period. There have been some fluctuations in most of them apart from the NSDP per capita, which has shown exponential growth in the time period.

Plotting the dependent variable i.e. the NPA we get the following graph

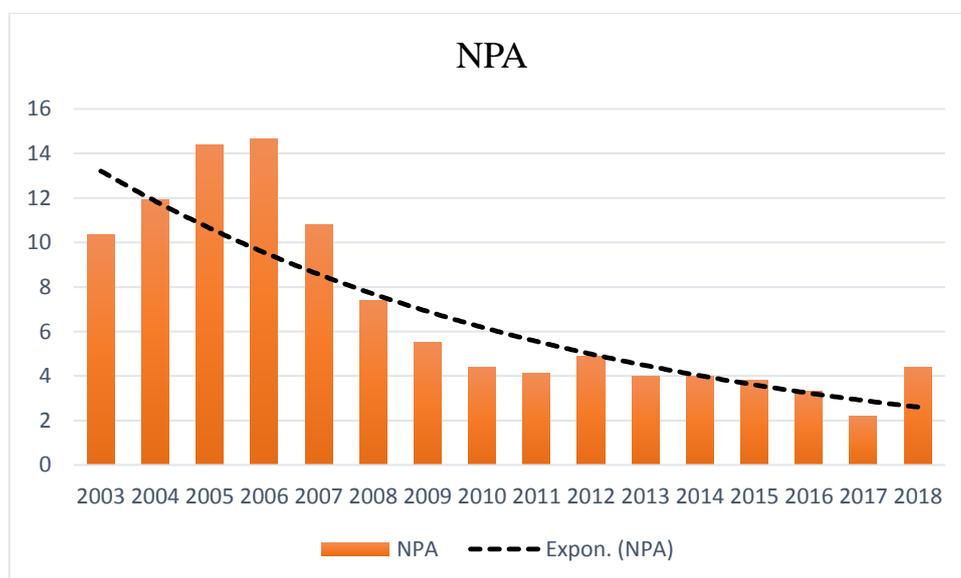


Figure 22: NPA as a percentage of loans outstanding. Source: RBI

NPAs across the time period have shown certain fluctuations but there has been a significant decrease in the level of NPA, owing to better management by the institutions.

The regression exercise, in fact, proves that the hypothesis considered is true with 95% confidence. In simple terms, the slope coefficients are negative with p value less than 0.05 for all the models. The following tables consist of the correlation and regression coefficients for the model considered.

	Multiple R	R squared	Intercept	Slope
SDP Agri	0.857691	0.735634	113.5008	-6.9111
NVA	0.8533	0.728122	103.0049	-6.35921
NSDP Per capita	0.844393	0.713	59.46319	-4.75501
Rice MSP	0.878911492	0.7724854	66.26498888	-8.727792602
Sugarcane MSP	0.820216	0.672754	40.29734	-6.89988
Tur MSP	0.869848	0.756635	58.04424	-6.50859

Table 4: Regression summary

The predicted sign of the slope coefficient is negative for all the variables taken under consideration. This implies that an increase of a unit in the independent variable leads to a decrease of the dependent variable, i.e. NPA. The obtained results can be intuitively explained in the following way. All the independent variables considered are identifiers of some kind of income to the agricultural sector or the overall economy. As a result, any increase in these variables will reduce NPA, as the loans undertaken by the entity shall be paid off from the income. Each of the models mentioned was checked for heteroscedasticity and autocorrelation to ensure efficient prediction from the model.

The models estimated here have a low degree of freedom as the total number of observation is less. An increase in the number of data points will certainly benefit, subject to the data availability. Also, differencing from subsequent values of the same variable also works but it reduces the dataset by the order of the difference. To build a comprehensive model, a large data with conducive periodicity is required. The data can then be made stationary using basic stationarity techniques and then can be used for forecasting purpose.

The final and the most important result that is obtained from the above exercise is the exogenous shock on NPA. The shock considered for the exogenous variable is $\mu \pm \sigma$ for all the variables. This means that any value of the explanatory variable greater than equal to $\mu + \sigma$ and less than or equal to $\mu - \sigma$ is assumed as a shock to the institution. The following table provides the value of NPA as a percentage of outstanding loans generated from the shock in the macro variable:

	$\mu + \sigma$	$\mu - \sigma$
SDP Agri	3.335353	10.43215
NVA	3.442328	10.65634
NSDP Per capita	3.390369	10.37713
Rice MSP	3.247561	10.51994
Sugarcane MSP	3.490393	10.27711
Tur MSP	3.28506	10.48244

Table 5: Level of NPA (percentage of loan outstanding) from shocks in the explanatory variable

From the above table, we get the upper and lower limits of a mean – SD shock on the explanatory variable. As the effects of heteroscedasticity and autocorrelation are mitigated, we can have confidence in the estimations obtained from the following exercise. The value in the table is calculated taking the help of the estimated regression coefficients.

As expected, any negative shock on the net value added and minimum support price for rice generates the most amount of NPAs. This is due to the importance of the above two items in the economy of the state. The minimum support price of rice plays a significant role in the creation of NPAs. Any shock greater the $\mu - \sigma$ and less than $\mu + \sigma$ will have a level of NPA in between the two values (roughly 3 – 10 percentage).

Shocks of this intensity are not very often in a practical scenario and hence these levels can be considered as the upper and lower bounds. Hence, for a bank, these levels can be the maximum stress that banks need to endure. However, it may seem unlikely to prepare for the worst case but in a dynamic scenario with a continuous estimation of NPAs, this issue can be handled with real-time estimation and policy reaction.

8. Conclusion

The above analysis has provided us a set of macroeconomic variables significantly affecting NPAs. The set, though not exhaustive, includes agricultural state domestic product, net value added, per capita net state domestic product, and minimum support price for rice, sugarcane and tur. The analysis has effectively highlighted the sensitivity of NPA with respect to the variables. Though the values are not to be considered as examples of real-life scenarios,

however, they provide a clear indication of the importance of macroeconomic stress management for cooperative banks.

As mentioned earlier, cooperatives are bestowed with certain vital roles, which are of paramount importance in different dimensions. These dimensions range from financial inclusion, inclusive growth and poverty reduction to the promotion of small and medium businesses and industries and many other key sectors. In this section, certain measures are established to mitigate macroeconomic risks, which are often taken as exogenous by the authorities. Macroeconomic risks are inherent to the economy. They cannot be completely diversified. But with the help of technology and allied tools, the cooperative banks can mitigate, to some degree, the risks mentioned in the analysis.

Technology

With industry 4.0 at the doorstep, technology is becoming the single most important thing in our way of life. The same is true for the banking sector in general and the cooperatives in particular. While public sector banks have been transformed with the aid of technology, it is time for the cooperatives as well. Technology does not only include modern machines, but also the approach towards functionality. For example, cooperatives forwarding loans to the agricultural sector should have the mechanism to predict the agricultural output generated from the loans. This requires efficient collaboration with multiple departments at various levels. Hence, a proper communication system should be developed to evaluate the credit scores of borrowers. Apart from this, proper data management systems should be implemented to store, access and analyse big data sets to model credit risk and other risks optimally. This also needs skilled employees working at the proper domain to provide the desired result. Also, technological shifts in the physical domains should also be incorporated by allowing electronic matching of the demand and supply side of the products, thereby minimising and eventually eliminating middlemen and time lags which often cause a havoc on the agricultural sector.

Data Analysis

The primary reason for having a well-built technology eco-system is to make way for advanced data analytics. The current world is characterised by volatility of great amplitude. Hence, sporadic review and report will lead to loss occurring from the dynamic changes. Hence, to avoid such scenario, a dynamic analysis is required, especially for institutions dealing with the agricultural sector. The agricultural sector is highly volatile and hence requires continuous

assessment in the area of risk and uncertainty. Big data collected from the field can effectively solve this issue by providing warning when the concerned variable crosses the risk threshold.

Decentralisation

Decentralisation is one of the most important policies that the authority should keep in mind. India being a vast country with significant diversity, regulations cannot be expected to be identical across the length and breadth of the country. A certain degree of freedom should be granted to the local authorities to manage the situation, keeping in mind the inherent features of the geographical area, culture and society. This will also lead to an efficient functioning of the cooperative and would lead to reduced management costs. Moreover, the agricultural sector which the state cooperative banks mostly work with is heavily influenced by the local geographic, environmental and societal characteristics. Hence, a decentralised body taking the decisions based on all these considerations will lead to better outcomes.

Efficient administration

As mentioned earlier, proper working of the cooperative requires a well-knit web of a number of institutions. These may include local bodies, block offices, panchayats, the agricultural body, and the meteorological departments. Hence, an efficient administration is essential to avoid the red tape problem. In addition, state cooperative banks being short-term credit advancing institutions, their periodicity should match with the seasonality of the sector where the loans are advanced.

Therefore, the above suggestions together will lead to a better management of the cooperative banks. This will have lagged effects in welfare goals like financial inclusion, reduction of poverty and inequality, employment generation and various other fields.

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Appendix

1. Heteroscedasticity and autocorrelation test

For heteroscedasticity, Goldfeld Quandt test was applied. The data set was partitioned into two sets, 7 of each. The central two observations were omitted.

Separate regression were estimated for the two partitioned data sets. Let RSS_1 be the residual sum of squares for the data set pertaining to the smaller values of x and let RSS_2 be the residual sum of squares for the larger values of x .

$$\text{Let } F_{obs} = \frac{RSS_2}{RSS_1}$$

If F_{obs} is greater than the critical value of F distribution at the 95% confidence level, we reject the hypothesis of homoscedasticity i.e., conclude that heteroscedasticity is very likely.

For the data set on which the study is made, the same exercise was performed and the observed F is found to be less than the critical value of F at 0.05 level of significance.

For autocorrelation, owing to the sample size, the Run's test was performed as the Durbin – Watson test were inconclusive. The Run's test considers the sign of the residuals obtained from the regression of the primary data set.

Here, a run is defined as an uninterrupted sequence of one symbol (+ or -). The length of a run is the number of symbols in each run.

The test analyses the randomness of the runs. If there were too many runs, it would imply that the residuals changes sign frequently, thereby indicating negative correlation and vice versa.

Let N = total number of runs

N_1 = number of + symbols

N_2 = number of – symbols, $N = N_1 + N_2$

R = number of runs

Then under null hypothesis that successive outcomes are independent, the number of runs are normally distributed with

$$\text{Mean: } E(R) = \frac{2 \cdot N_1 N_2}{N} + 1$$

$$\text{Variance: } \sigma^2_R = \frac{2N_1N_2(2N_1N_2-N)}{N^2(N-1)}$$

If the null hypothesis holds then

$$\text{Probability } [E(R) - 1.96 \sigma^2_R \leq R \leq E(R) + 1.96 \sigma^2_R] = 0.95$$

That is, there is a 95% probability that the preceding interval will include R. Hence, we apply the following rule,

Do not reject the null hypothesis of randomness with 95% confidence if R lies in the preceding interval. Reject the null hypothesis if R lies outside it.

The same exercise was performed for all the variables and no signs of autocorrelation was found except for the variable per capita state domestic product. This is expected as the per capita state domestic product at the t-1 period will certainly influence it in the tth time period as well.