Sensitivity of Non-Performing Assets to GDP and Inflation Rate Volatility

Tabassum [1]
Sarveshwar Pande [2]

Abstract

This research examined the impact of inflation rate and gross domestic product (GDP) and their volatility on the non- performing assets (NPAs) in the Indian scheduled commercial banks from 1996–1997 to 2016–17. It examined how the macroeconomic volatility in the inflation rate and GDP significantly impacted the gross NPAs in the sampled banks. An econometric autoregressive model was employed where the gross NPAs were used as the explained variable, while one-period lags of gross NPAs, GDP, and inflation rate were the regressors. Pearson's correlation analysis was also employed. Secondary data analysis was done. The findings confirmed that the one-period lag of gross NPAs had a positive and highly statistically significant effect on the gross NPAs ; whereas, GDP and inflation rate had a highly statistically insignificant effect on the gross NPAs in the sampled banks. It is envisaged that future research studies will be accomplished by including bank-specific and other macroeconomic factors. Other categories of Indian banks can be also included in further studies.

Keywords : **sensitivity, non-performing assets, NPAs, inflation rate, GDP, macroeconomic variables, volatility, scheduled commercial banks, econometric autoregressive model, correlation analysis**

JEL Classification : B23, B26, C01, C22, C58, E22

Paper Submission Date : February 18, 2020 ; Paper sent back for Revision : October 10, 2020 ; Paper Acceptance Date : December 23, 2020 ; Paper Published Online : April 15, 2021

Collapsing of the loan portfolios and bank asset quality is the main cause of increasing non-performing assets (NPAs) that hinder the functioning of the financial institutions (Berger & Hefeker, 2008 ; Welfens 2008). This has resulted in banks' failure and economic distress in the economy. Failure of banks and bank asset quality is a sign of bankruptcy. The fundamental indicator that is generally used to assess the financial health and soundness of the banks is the level of NPAs (Boudriga et al., 2009). As per Reserve Bank of India (2015) :

> A non-performing asset (NPA) is a loan or an advance where interest and/ or installment of principal remain overdue for a period of more than 90 days in respect of a term loan…..An asset, including a leased asset, becomes non-performing when it ceases to generate income for the bank. (p. 6)

NPAs are also called bad loans or loan losses or problem loans or delinquencies besides stressed assets (Dhar &

[1] *Research Scholar,* Amity Business School, Amity University Uttar Pradesh, Lucknow Campus, Malhaur, Lucknow - 226 010, Uttar Pradesh. (Email : tabassumhashimi39@gmail.com) ; ORCID iD : https://orcid.org/0000-0003-4839-2958

[2] *Assistant Professor,* Amity Business School, Amity University Uttar Pradesh, Lucknow Campus, Malhaur, Lucknow - 226 010, Uttar Pradesh. (Email : spande@lko.amity.edu) ; ORCID iD : https://orcid.org/0000-0002-6646-3898

DOI : https://doi.org/10.17010/ijf/2021/v15i4/158672

Bakshi, 2015). The resulting financial vulnerability hampers fiscal development (Reinhart & Rogoff, 2011). NPAs not only cause bank failure, but also result in economic degradation. Hence, it is important to regulate and manage NPAs, which can be done effectively only when their root causes and sensitivity to these causes are well known.

The factors that influence NPAs in the banks are not only bank-specific, but also macroeconomic. Thus, there is a close link between NPAs and macroeconomic variables as well as macroeconomic uncertainty. In this research study, we will discuss two critical macro-variables that are GDP and inflation rate. We will also examine the volatility linked with these factors and how these variables will explain the sensitivity of NPAs. The study includes all scheduled commercial banks of India and the period is from 1996–1997 till 2016–17. An econometric autoregressive model along with Pearson correlation analysis is employed. Besides these, some econometric tests like the Jarque – Bera test, Augmented Dickey – Fuller (ADF) test, Breusch – Godfrey serial correlation LM test, and Breusch – Pagan Godfrey test are also employed to verify the suitability of the data and the regression model used in this study.

Review of Literature

An extensive review of the research on the NPAs and their determinants helped us to understand the sensitivity of the NPAs to macroeconomic variables like GDP, inflation rate, and volatility related to them.

Syed and Tripathi (2020) concluded that unemployment rate, interest rate, inflation rate, exchange rate, and economic growth had a significant impact on the NPAs of public sector banks as well as SBI and its associates while interest rate, economic growth, and inflation rate had a significant impact on the bad loans of the private sector banks. Syed and Tripathi (2019) confirmed that GDP growth, inflation, and savings rate impacted the NPAs negatively while the unemployment rate impacted the NPAs positively. Similarly, Abdelbaki (2019) confirmed that inflation, domestic credit to the private sector to GDP ratio, and non-oil GDP growth negatively impacted the NPA levels, while economic crisis and interest rate positively impacted the NPA levels. Similarly, Messai and Gallali (2019) concluded that bi-directional causality was found between four factors (NPAs, unemployment rate, GDP growth rate, and stock price index) and default risk growth. Tarchouna et al. (2019) confirmed that there was a statistically significant positive effect of the economic crisis on the NPAs, while Apergis and Eleftheriou (2019) reported the real causal factors that affected the Greek banks and economy. Similarly, Viswanathan and Muthuraj (2019) examined the primary causes that resulted in the occurrence of NPAs.

Szarowska (2018) reported that economic growth, inflation, and exchange rate negatively impacted the NPAs while the interest rate positively impacted the NPAs. Similarly, Upadhyaya and Roy (2017) concluded that global volatility, GDP growth, and variation in exchange rate strongly impacted the NPAs in Indian banks.

Jabra et al. (2017) reported that inflation and economic growth negatively impacted credit risk. Dimitrios et al. (2016) confirmed that the growth rate and unemployment rate strongly affected the NPAs while risk preferences and management skills caused future NPAs. Uppal and Khanna (2015) examined the main factors leading to NPAs in scheduled commercial banks of Punjab and recommended the measures to control them. Otašević (2015) concluded that GDP growth and CPI inflation negatively affected credit risk. Chaibi and Ftiti (2015) confirmed that excluding the inflation rate, all other macro-variables such as interest rate, unemployment rate, GDP growth rate, and exchange rate had an intense impact on the NPAs. Similarly, Beck et al. (2015) stated that stock price and exchange rate negatively impacted the NPAs while GDP growth and lending rate also impacted the NPA levels. Similarly, Abid et al. (2014) concluded that the real lending rate (RLR), real GDP growth rate, and inflation rate strongly impacted the NPAs. Yurdakul (2014) confirmed that money supply, unemployment rate, foreign exchange rate, interest rate, and inflation rate impacted the credit risk positively, while GDP growth and ISE index decreased the credit risk. Similarly, Agrawal and Maheshwari (2014) verified that CPI sensitivity negatively

affected the defaulting possibility while stock market sensitivity positively impacted the chance of default of the firms.

Castro (2013) confirmed that growth in real GDP lowered the NPA levels significantly which was in line with the findings of some other researchers (Bonfim, 2009 ; Cifter et al., 2009 ; Louzis et al., 2012). Likewise, Louzis et al. (2012) concluded that bad loans were strongly impacted by the inflation rate, lending rate, public debt, real GDP growth rate, and unemployment rate. Fainstein and Novikov (2011) confirmed that the real estate market growth rate, unemployment rate, and loan portfolio growth increased the NPA levels, while GDP growth strongly impacted the NPAs. Ali and Daly (2010) confirmed that GDP impacted the NPAs negatively while the debt-to-GDP ratio had an extremely significant positive impact on the default risk. Bonfim (2009) reported that default of loans was strongly affected by the macroeconomic conditions, while Tsai et al. (2009) concluded that defaulting probability reduced with a higher rate of inflation as there were higher consumer demand and a stronger economy.

Research Gaps

Several studies in the international context have been conducted related to the macroeconomic variables impacting NPAs in banks (Abdelbaki, 2019 ; Beck et al., 2015 ; Castro, 2013 ; Fainstein & Novikov, 2011 ; Messai & Gallali, 2019 ; Otašević, 2015 ; Szarowska, 2018 ; Yurdakul, 2014) with minimal research emerging in the Indian context (Agrawal & Maheshwari, 2014 ; Dhar & Bakshi, 2015 ; Upadhyaya & Roy, 2017). To the best of our knowledge based on the extensive literature study and discussion with the subject specialists, no research has been found in the Indian context that has investigated the impact of the inflation rate, gross domestic product (GDP), and their volatility on the non - performing assets (NPAs) in the Indian scheduled commercial banks. Indeed, a research gap existed in the previous research studies related to this current research. Hence, this research tries to fulfill this research gap. The Indian economy is different from other international economies, thus a specific model is required which fits into the dynamics of the Indian economy.

Objectives of the Research

The objectives included in the following research are :

(1) To investigate the trend in the gross NPA percent in the Indian scheduled commercial banks as well as the trend in real GDP and inflation rate in the Indian economy.

(2) To explain the current status of gross NPA percent in the Indian scheduled commercial banks, real GDP, and inflation rate in India.

(3) To explore the sensitivity of gross NPA percent in the Indian scheduled commercial banks to real GDP growth.

(4) To explore the sensitivity of gross NPA percent in the Indian scheduled commercial banks to the inflation rate.

(5) To explore the sensitivity of gross NPA percent in the Indian scheduled commercial banks to its one-period lag at time t–1.

(6) To formulate an econometric autoregressive model showing the empirical relationship of gross NPAs with a one-period lag of gross NPAs, inflation rate, and real GDP growth.

Indian Macroeconomy and NPAs in the Indian Scheduled Commercial Banks

In 2007–08, after the Global Economic Crisis due to the spillover effect of the US Subprime mortgage crisis in 2007–08, there was a drastic transformation in the Indian macroeconomy which had negative repercussions on the Indian banks ; whereas, before the Global Financial Crisis, the Indian economy was performing well and there was a boom period in the Indian stock market from 2003 – 04 to 2006 – 07. There was rapid credit growth especially in the retail loans with poor quality collateral. This introduced borrowers with low credit ratings into the bank credit universe, which increased the probability of default of loans in the Indian banks after the crisis in 2007–08.

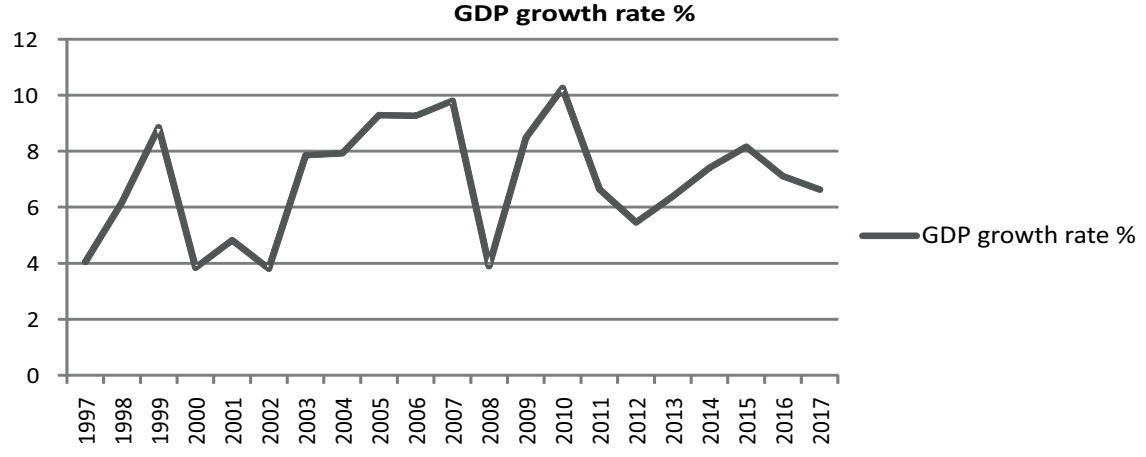
Primarily, Indian banks were supposed to be free from the after-effects of the crisis in 2007–08 because of their careful management and heavy public ownership, but surprisingly there was a reduction in deposits in Indian public and private banks during as well as after the crisis while there was a rapid expansion in deposits in State Bank of India. SBI and the other public-sector banks experienced more provisioning and fewer profits (Eichengreen & Gupta, 2013).

Nachane and Shahidul Islam (2012) concluded that there was strong depreciation in real GDP growth and the Indian economy faced high and volatile inflation after the economic crisis in 2007–08. They found that export growth lowered from 28.9% to 13.7% in 2007 – 2008 and 2008 – 2009, respectively. After that, it reduced to –4.7% in 2009 – 2010. They also reported that the cash reserve ratio, the reverse repo rate, the statutory liquidity ratio, and the repo rate declined after the crisis. Similarly, Gulati and Kumar (2016) confirmed that policy rates were reduced after the crisis, and Indian banks' returns competence decreased mildly by 3% in the crisis period but revived speedily after the crisis. They also confirmed that the profit competence of foreign banks was higher as compared to other banks and new private banks were the least profit competent in the crisis period. Similar findings were obtained by Ghosh and Chandrasekhar (2009). They concluded that there was a decline in the real GDP growth and exports as well as industrial production declined. Food inflation prevailed in the economy. There was a rise in the prices of food and medicines. They also confirmed that there was a rise in the unemployment rate.

Trend in GDP

Figure 1 shows the trend in GDP in the Indian economy.

Figure 1. ***Trend in GDP in Indian Economy***



Source : GDP growth (annual %) 2018, World Bank (2018).

From Figure 1, it can be observed that there was a sharp increase in the GDP growth from 4.1% in 1997 to 8.85% in 1999 after which, it reduced abruptly to 3.84% in 2000 due to recession. GDP growth again increased to 4.8% in 2001.

Again, there was a sharp increase in the GDP growth from 3.8% in 2002 to 9.8% in 2007. But after 2007, there was an abrupt decline in the GDP growth to 3.89% in 2008. This unexpected decline in GDP growth in 2008 can be linked to the U.S Subprime Crisis 2007–08 whose spillover effect in other countries led to the Financial Crisis in 2007–08.

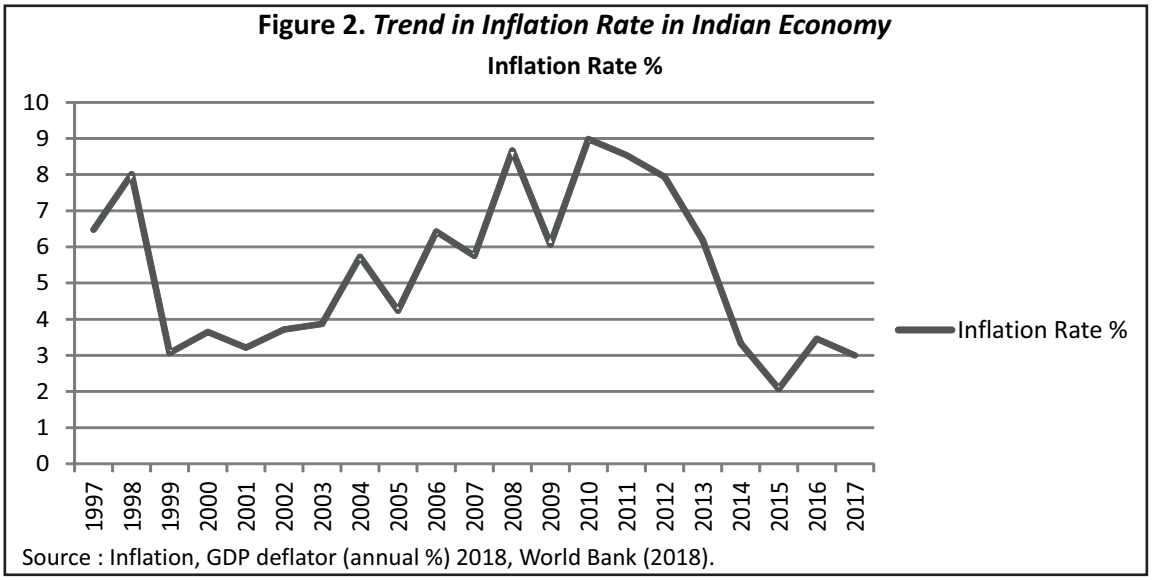
After the crisis in 2007–08, macroeconomic conditions improved and there was an abrupt increase in the GDP growth to 8.5% in 2009 and 10.23% in 2010. After 2010, there was again a decline in GDP growth to 6.6% in 2011 and 5.5% in 2012. Then there was a rise in GDP growth from 6.4% in 2013 to 8.2% in 2015. GDP growth decreased to 7.1% in 2016 and further to 6.6% in 2017. This uncertain, volatile, and unpredictable behavior in the GDP growth rate (as shown in Figure 1) accounted for macroeconomic volatility.

Trend in Inflation Rate

The trend in the inflation rate in the Indian economy is illustrated in Figure 2. It can be observed from Figure 2 that the inflation rate rose from 6.5% in 1997 to 8% in 1998 but there was an abrupt decline in it in 1999 to 3.1%. This unexpected decline in the inflation rate was due to the recession in 2000. After this recession period ended, there was a gradual increase in the inflation rate from 3.6% in 2000 end to 3.9% in 2003 after which it increased to 5.7% in 2004. The inflation rate lowered to 4.2% in 2005 and then increased to 6.4% in 2006. There was a sharp increase in the inflation rate from 5.76% in 2007 to 8.7% in 2008. This unexpected rise in the inflation rate in 2008 can be related to the U.S Subprime Crisis 2007–08 whose spillover effect in other countries led to the Financial Crisis in 2007–08.

After the crisis period ended, the inflation rate lowered to 6.1% in 2009 but it again rose to 8.98% in 2010. After 2010, there was a sharp and abrupt decline in the inflation rate to 2.07% in 2015. It increased to 3.46% in 2016 and further decreased to 2.998% in 2017. This uncertain, volatile, and unpredictable behavior in the inflation rate (as shown in Figure 2) accounted for macroeconomic volatility.

Figure 2. ***Trend in Inflation Rate in Indian Economy***



Source : Inflation, GDP deflator (annual %) 2018, World Bank (2018).

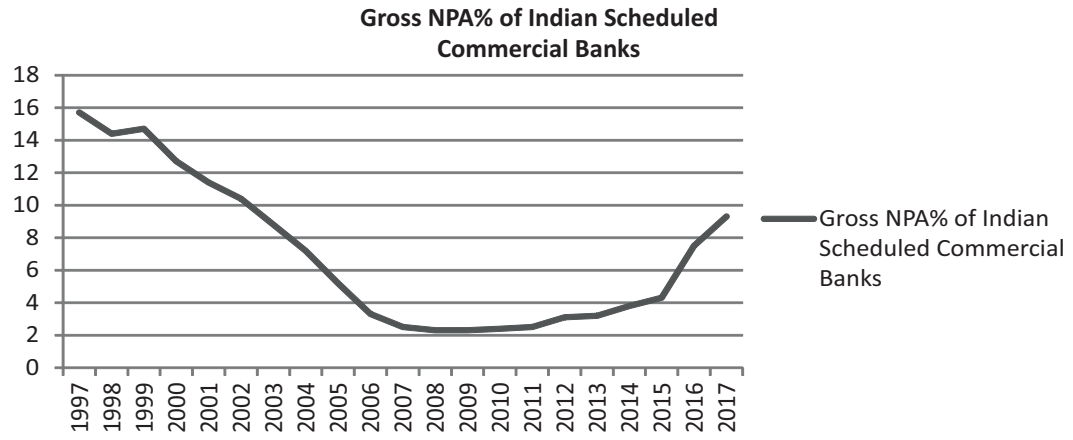
Trend in Gross NPA% of Indian Scheduled Commercial Banks

Figure 3 shows the trend in gross NPA% of Indian scheduled commercial banks. Figure 3 displays that the gross NPA percent of Indian scheduled commercial banks was 15.7% in 1997 which lowered to 14.4% in 1998. Further, in 1999, it raised to 14.7%.

Then there was an abrupt decrease in the gross NPA percent from 14.7% in 1999 to 2.3% in 2008. This was because of improved macroeconomic conditions in India during this time and a sharp rise in the GDP growth from 3.8% in 2002 to 9.8% in 2007 (World Bank, 2018).

GNPA percent of scheduled commercial banks increased sharply from 2.3% in 2008 to 9.3% in 2016 – 17. This was due to the outbreak of the Global Financial Crisis in 2007– 08 that shattered almost all the emerging economies including the Indian economy (Ghosh & Chandrasekhar, 2009 ; Kshetri, 2011; Sharma, 2009).

Figure 3. ***Trend in Gross NPA% of Indian Scheduled Commercial Banks***



Source : Reserve Bank of India (2018).

Research Methodology

Description of Variables

The sample includes all Indian scheduled commercial banks and secondary data are used for the study. Annual data related to gross NPAs as the percentage of gross advances for all the sampled banks were collected from the *Handbook of Statistics on the Indian Economy* retrieved from the database of RBI. GDP and inflation rate data were derived from the database of the World Bank. The period of the study is from the year 1996 – 1997 till 2016 –17. The reason behind selecting this period from 1997 – 2017 is that we were interested in examining both the equal pre and post-crisis period of 10 years before and 10 years after the Global Financial Crisis 2007–08 in which the pre-crisis period is from 1997 – 2007 (10 years before the Global Financial Crisis 2007–08) and the post-crisis period from 2007 – 2017 (10 years after the Global Financial Crisis 2007–08). During both the periods (pre-crisis period of 10 years from 1997–2007 and the post-crisis period of 10 years from 2007 – 2017), there were significant variations in the macroeconomic conditions in India and NPAs in the Indian scheduled commercial banks. Consequently, a research query arose, that is, whether there is any causality between the NPAs and macroeconomic variables during these pre and post-crisis periods of 10 years each.

Methodology

The methodology employed in the study is as follows.

Firstly using MS Excel, the trend in gross NPA percent in the Indian scheduled commercial banks as well as the trend in inflation rate and real GDP growth rate in the Indian economy was analyzed.

Secondly, using EVIEWS 7.1 version, the descriptive statistics were observed and then the quantitative analysis was done where the data were analyzed by employing various tests like Jarque – Bera test, Augmented Dickey – Fuller (ADF) test, Breusch – Godfrey serial correlation LM test, Breusch – Pagan Godfrey test, Pearson correlation analysis, and econometric autoregressive model. The econometric autoregressive model was formulated where the gross non-performing assets were regressed upon the one-period lag of gross NPAs, real gross domestic product, and inflation rate.

Model Specifications

The estimation of the econometric autoregressive model is given in equations (1) and (2) :

$$y_t = a + b_1 x_1 + b_2 x_2 + \mathrm{b}_3 y_{t-1} + e_t \quad \text{.....} \quad (1)$$

$$GNPA_t = \beta_0 + \beta_1 GDP_t + \beta_2 INFR_t + \beta_3 GNPA_{t-1} + e_t \quad \text{.....} \quad (2)$$

where,

a or β_0 is a constant,

b_1, b_2, and b_3 are the coefficients of regressors,

β_1 is the coefficient of GDP at time t,

β_2 is the coefficient of inflation rate at time t,

β_3 is the coefficient of one-period lag of gross NPAs at time t–1,

y_t is the dependent variable,

x_1 and x_2 are regressors,

y_{t-1} is the one-period lag of the dependent variable at time t–1 used as regressor,

$GNPA_t$ is gross non-performing assets at time t,

$GNPA_{t-1}$ is the one-period lag of gross NPAs at time t–1,

GDP_t is the gross domestic product at time t,

$INFR_t$ is inflation rate at time t,

e_t is the random error term,

t is the time interval.

Hypotheses

Some hypotheses are formed and tested within the context of the model discussed in this paper. These hypotheses are as following :

Hypothesis 1

- **H01 :** One period lag of gross NPAs has no statistically significant positive effect on gross NPAs.
- **Ha1 :** One period lag of gross NPAs has a statistically significant positive effect on gross NPAs.

Hypothesis 2

- **H02 :** Real GDP growth has no statistically significant negative effect on gross NPAs.
- **Ha2 :** Real GDP growth has a statistically significant negative effect on gross NPAs.

Hypothesis 3

- **H03 :** Inflation rate has no statistically significant positive effect on gross NPAs.
- **Ha3 :** Inflation rate has a statistically significant positive effect on gross NPAs.

Empirical Analysis and Results

To examine the appropriateness of the model, some characteristics of the data such as white noise, normality, stationarity, kurtosis, and skewness have to be tested. The assumption generally considered in the extant literature where a linear regression model is formulated and employed is that the residuals are distributed normally and obey a strict white noise process. Each variable used in the research should be stationary to prevent spurious regression. All data series must be normally distributed, stationary, and free from multicollinearity to give linear regression results.

Descriptive Statistics

The variables' general statistics such as standard deviation, median, mean, minimum, and maximum value are represented by descriptive statistics which are depicted in Table 1.

Table 1. ***Descriptive Statistics***

	GNPA	*GDP*	*INFR*
Mean	7.000000	6.956930	5.351340
Median	5.200000	7.112686	5.725407
Maximum	15.70000	10.25996	8.983820
Minimum	2.300000	3.803975	2.071894
Std. Dev.	4.647150	2.055235	2.176481
Skewness	0.580815	–0.183650	0.286029
Kurtosis	1.900713	1.892188	1.735614
Jarque – Bera	2.238089	1.191886	1.685184
Probability	0.326592	0.551043	0.430593
Sum	147.0000	146.0955	112.3781
Sum Sq. Dev.	431.9200	84.47983	94.74136
Observations	21	21	21

As per Table 1, the mean of GNPAs in the sampled banks over the sampled period is 7.00% ; whereas the minimum value of GNPAs is 2.30% and the maximum value is 15.70%. The mean GDP growth is 6.96%, with a maximum expansion of 10.26% in 2010 and a minimum growth of 3.80% in 2002. The mean inflation rate growth is 5.35%, with minimum growth of 2.07% in 2015 and maximum growth of 8.98% in 2010.

In quantitative analysis, the data were examined by applying various tests like the Jarque – Bera test, Augmented Dickey – Fuller (ADF) test, Breusch – Pagan Godfrey analysis method, Breusch – Godfrey serial correlation LM test, correlation analysis, and econometric autoregressive model.

Augmented Dickey – Fuller (ADF) Unit Root Test

To prevent spurious regression, each of the employed variables must be stationary. Hence, the ADF test is used to confirm if the data are stationary or not. Table 2 displays the results of this test at a level form.

Table 2 shows that at a 5% significance level, GDP is stationary ; whereas, GNPA and INFR are non-stationary at level form. Hence, the first and second differences of the non-stationary variables are used. Two new variables generated which are D2GNPA (2nd difference of GNPA) and D1INFR (1st difference of INFR) which are stationary will be used in the final regression model along with GDP. It is noticed that the first difference of GNPA is also non-stationary but its 2nd difference is stationary in the no intercept and no trend form, while D1INFR, that is, the 1st difference of INFR is stationary at intercept when ADF test was employed again on them. Now, each variable series has become stationary. The new outcome of the unit root test along with two new variables is as given in Table 3.

Table 2. ***Outcome of ADF Test - 1 at Level Form***

Variables	*p*-value	Outcome at 5% Significance Level
GNPA	0.5216 at intercept	Non-stationary
GDP	0.0091 at intercept	Stationary
INFR	0.2072 at intercept	Non-stationary

Table 3. ***Outcome of ADF Test - 2***

Variables	*p*-value	Outcome
D2GNPA	0.0000 at none	Stationary
GDP	0.0091 at intercept	Stationary
D1INFR	0.0001 at intercept	Stationary

Jarque – Bera Test

To prevent spurious regression, each of the employed variables must be normally distributed. Hence, to ensure whether the variables are normally distributed or not, the Jarque – Bera test is applied. Table 4 gives the results of this test.

The outcome of the Jarque – Bera test in Table 4 confirms that all the variables including residual are distributed normally. The null hypothesis in the Jarque – Bera test which states that the variable is normally distributed will not be rejected at a 5% significance level as the probability value in the case of all the three variables and residual is greater than 0.05. Hence, all three variables and residuals under the study are normally distributed.

Table 4. *Outcome of Jarque–Bera Test*

Variables	Probability	Results
GNPA	0.326592	Normally distributed
GDP	0.551043	Normally distributed
INFR	0.430593	Normally distributed
D2GNPA	0.456251	Normally distributed
D1INFR	0.768070	Normally distributed
$D2GNPA_{t-1}$	0.456251	Normally distributed
RESID	0.769247	Normally distributed

Test to Check Serial Correlation or Autocorrelation

Breusch – Godfrey serial correlation LM test was employed to check autocorrelation in the regression model, where the null hypothesis displays that autocorrelation is not present in the residuals at up to 2 lags. The outcome confirms that as the *p*-value is statistically significant and less than 0.05, that is, 0.0003. Hence, the alternative hypothesis that favors that error terms are autocorrelated is accepted. Hence, it is confirmed that residuals are autocorrelated, which is an undesirable condition for a linear regression model and it has to be taken care of. The results of the serial correlation are depicted in Table 5.

To remove autocorrelation from the residuals, a one-period lag of the dependent variable, that is, $D2GNPA_{t-1}$ will be included in the final regression model as an additional independent variable. Hence, a new variable $D2GNPA_{t-1}$ is created. Again, the Breusch – Godfrey Serial Correlation LM test is employed. The new outcome confirms that the *p*-value is statistically insignificant and more than 0.05, which is 0.5662. Hence, the null hypothesis will not be rejected at a 5% significance level, which implies that the autocorrelation is not present in the error terms of the employed model. This is a favorable condition for the linear regression model. The new outcome of serial correlation is given in Table 6.

Table 5. *Results of Serial Correlation*

Test	Probability Value	Findings
Breusch–Godfrey Serial Correlation LM test	0.0003	1. At 5 % significance level, the *p*-value is statistically significant. 2. Residuals are autocorrelated or serially correlated.

Table 6. *New Outcome of Serial Correlation*

Test	Probability Value	Findings
Breusch–Godfrey Serial Correlation LM test	0.5662	1. *p*-value is statistically insignificant at a 5 % significance level. 2. Residuals are non-autocorrelated or serially uncorrelated.

Table 7. ***The Results of Heteroskedasticity Test***

Test	*p*-value	Findings
Breusch – Pagan Godfrey Test	0.7902	1. *p*-value is statistically insignificant at a 5 % significance level. 2. Homoskedasticity is present.

Test to Check Heteroskedasticity

Breusch – Pagan Godfrey test is employed to confirm homoskedasticity in the regression model where the null hypothesis states that no heteroskedasticity is found in the residuals of the model. The findings show that the *p*-value is more than 0.05, that is, 0.7902. Hence, the null hypothesis will not be rejected at a 5% significance level, which signifies that homoskedasticity is present in the residuals of the regression model. Hence, it is verified that error terms or residuals are homoskedastic in nature. The results of the heteroskedasticity test are depicted in Table 7.

Correlation Analysis

Correlation confirms how and to which extent the variables under study are associated with each other. Table 8 shows the outcome of the correlation analysis.

Table 8 shows the results of correlation analysis, which are as follows. GDP and D2GNPA have a negative coefficient of –0.086912. Similarly, D2GNPA and D1INFR also have a negative coefficient of –0.175434. D2GNPA and $D2GNPA_{t-1}$ have a positive coefficient of 0.923149. Since a significant strong relationship among the external or independent variables is not seen in the outcome, therefore, it may be assumed that the data does not have a multicollinearity issue.

Table 8. ***Outcome of Correlation Analysis***

	D2GNPA	*GDP*	*D1INFR*	$D2GNPA_{t-1}$
D2GNPA	1.000000	–0.086912	–0.175434	0.923149
GDP	–0.086912	1.000000	–0.073688	–0.098008
D1INFR	–0.175434	–0.073688	1.000000	–0.291112
$D2GNPA_{t-1}$	0.923149	–0.098008	–0.291112	1.000000

Econometric Autoregressive Model

All the assumptions of the linear regression model except one assumption (that is residuals are serially uncorrelated) are supported in this study. Serial correlation present in the residuals is removed by taking one-period lag of the dependent variable, that is, $D2GNPA_{t-1}$ as the additional independent variable in the final regression model. Hence, econometric autoregressive model is employed in this study. In this econometric autoregressive model, the dependent variable is D2GNPA while the regressors are GDP_t, $D1INFR_t$, and $D2GNPA_{t-1}$. The estimation of the econometric autoregressive model is given in equation (3) :

$$D2GNPA_t = \beta_0 + \beta_1 GDP_t + \beta_2 INFR_t + \beta_3 D2GNPA_{t-1} + e_t \quad \text{.....} \quad (3)$$

where,

$D2GNPA_t$ is the 2nd difference of *GNPA* (gross non-performing assets) at time *t,*

GDP_t is real gross domestic product at time *t*,

$D1INFR_t$ is 1st difference of *INFR* (inflation rate) at time *t*,

$D2GNPA_{t-1}$ is the one-period lag of *D2GNPA* at time *t*–1,

β_0 is a constant or intercept term,

β_1 is the coefficient of GDP at time *t*,

β_2 is the coefficient of inflation rate at time *t*,

β_3 is the coefficient of $D2GNPA_{t-1}$, that is, one-period lag of *D2GNPA* at time *t*–1,

e_t is the random error,

t is the time interval.

The results of the econometric autoregressive model are shown in Table 9. The representation of the estimated output depicted in Table 9 is given as equation (4) :

$$D2GNPA_t = 0.375337 + 0.017338 * GDP_t + 0.149072 * D1INFR_t + 1.161076 * D2GNPA_{t-1} \quad \text{.....} \quad (4)$$

The coefficient of $D2GNPA_{t-1}$, that is, one period lag of gross NPAs is 1.161076, which is highly statistically significant at a 5% significance level and confirms that as the $D2GNPA_{t-1}$ increases by one point, the gross NPAs also increase by 1.16 points. Hence, alternative hypothesis Ha1 is accepted and null hypothesis H01 is rejected at a 5% significance level. This implies that the one-period lag of gross NPAs, that is, $D2GNPA_{t-1}$ has a statistically significant effect on gross NPAs at time *t* of the sampled Indian scheduled commercial banks.

The coefficient of GDP is 0.017338, which is statistically insignificant at a 5% significance level. Hence, null hypothesis H02 is rejected and alternative hypothesis Ha2 is accepted at a 5% significance level. This implies that real GDP growth has no statistically significant effect on the gross NPAs of the sampled Indian scheduled commercial banks.

Table 9. ***Results of the Econometric Autoregressive Model***

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C	0.375337	0.886324	0.423477	0.6784
GDP_t	0.017338	0.121816	0.142327	0.8888
$D1INFR_t$	0.149072	0.150327	0.991651	0.3382
$D2GNPA_{t-1}$	1.161076	0.127252	9.124206	0.0000
R-squared	0.861916	Mean dependent var		–0.683333
Adjusted *R*-squared	0.832327	*S.D.* dependent var		2.492164
S.E. of regression	1.020489	Akaike info criterion		3.071572
Sum squared resid	14.57958	Schwarz criterion		3.269432
Log likelihood	–23.64415	Hannan –Quinn criter.		3.098854
F - statistic	29.12923	Durbin–Watson stat		1.578957
Prob (*F* - statistic)	0.000003			

The coefficient of D1INFR is 0.149072, which is statistically insignificant at a 5% significance level. Hence, null hypothesis H03 is not rejected and alternative hypothesis Ha3 is rejected at a 5% significance level. This implies that inflation has no statistically significant impact on the gross NPAs of the sampled Indian scheduled commercial banks.

The intercept term of the regression equation is 0.375337, which is also statistically insignificant at a 5% significance level. The coefficient of determination, that is, *R*-square is 0.861916 or 86.19%, which signifies that the explanatory power of the three regressors to describe the variation in the explained variable is quite good. All three regressors can explain 86.19% of the variation in the dependent variable ; whereas, the rest 13.81% of the variation in the explained variable is described by the residuals. This is quite good and acceptable. The probability value of the corresponding *F*-statistic is 0.0000, which is highly statistically significant at a 5% significance level and confirms the overall significance of the model. It confirms that the regression model is quite good and acceptable.

Conclusion and Policy Recommendations

As per the Reserve Bank of India (2018) in the *Handbook of Statistics on Indian Economy*, the gross NPAs of scheduled commercial banks of India lowered sharply before the commencement of the Global Financial Crisis (GFC) from 14.7% in 1999 to 2.3% in 2008. This was due to the prevailing favorable macroeconomic environment in India which elevated the growth in GDP sharply from 3.8% in 2002 to 9.8% in 2007 (World Bank, 2018). As an aftermath of the GFC, the GNPA percent in the Indian scheduled commercial banks increased abruptly from 2.3% in 2008 to 9.3% in 2016–17 as the GFC negatively impacted the Indian economy (Ghosh & Chandrasekhar, 2009 ; Kshetri, 2011 ; Sharma, 2009). The GNPAs of scheduled commercial banks became 9.08% in March 2019 and 8.21% in March 2020 (Reserve Bank of India, 2021). As per NSO, the GDP became –23.9% in the first quarter of 2020–21 ("India GDP Data Highlights," 2020). GDP grew 0.4% in the last quarter of 2020–21 (Trading Economics, 2021a) ; retail price inflation in India became 5.03% in February of 2021 (Trading Economics, 2021b).

The findings conclude that one-period lag of gross NPAs, that is, $D2GNPA_{t-1}$ is highly statistically significant at a 5% significance level and has a positive impact on the gross NPAs at time *t* of the sampled Indian scheduled commercial banks. The findings also conclude that the real GDP growth is highly statistically insignificant at a 5% significance level, assuming other factors remaining constant, which implies that real GDP growth has no statistically significant effect on gross NPAs of the sampled Indian scheduled commercial banks. This result is against the economic theory which confirms that higher real GDP expansion increases the earning ability and income of the borrowers. Hence, the borrowers can positively repay their debt which further lowers the NPA levels, which implies that growth in GDP affects the gross NPAs negatively. But this economic theory is violated in this research and this study has proven that real GDP growth has no statistically significant effect on gross NPAs of the sampled Indian scheduled commercial banks, which is quite innovative.

The reason for this counter-intuitive finding could be due to the other macroeconomic factors which are not considered in the employed regression model, but these factors are captured by the error term of the regression model and might have impacted the explained variable, that is, gross NPAs. There is also a possibility that these other macroeconomic factors might have some correlation with the included regressors (such as real GDP growth rate and inflation rate) and influenced the impact of the real GDP growth on the gross NPAs. Hence, with these other macroeconomic factors, the impact of the real GDP growth on the gross NPAs is against the expectations and proposed economic theory.

It is also concluded that the inflation rate is statistically insignificant at a 5% significance level, assuming other factors remaining constant, which implies that the inflation rate has no statistically significant effect on gross

NPAs of the sampled Indian scheduled commercial banks, which is against the economic theory and dissimilar to the findings of some researchers who confirmed that the inflationary pressure increases the default probability of loans, which further increase NPAs (Yurdakul, 2014).

It is observed that in the Indian scheduled commercial banks, macroeconomic variables like real GDP growth and inflation rate do not have a statistically significant effect on the gross NPAs as the bank-specific variables which cause defaulting of loans and an increase in the level of NPAs can be regulated by the RBI and Indian banks, but the macroeconomic variables, which cause a rise in the NPAs can be identified and regulated only by the government by implementing effective policies. Hence, recently, the Government of India implemented some very effective policies. It enforced the Banking Regulation (Amendment) Ordinance, 2017 on May 5, 2017 for empowering the RBI with additional powers to resolve the problem of inflating NPAs in the Indian banks and to initiate insolvency procedures under IBC 2016 to recover NPAs (Tiwari, 2017). Soon this ordinance was replaced by the Banking Regulation (Amendment) Bill 2017 in July 2017 which appointed committees for advising the banks to resolve the problem of stressed assets. Reserve Bank of India (RBI) revised the Prompt Corrective Action Framework and made it obligatory to keep the net NPA ratio less than 6% for the banks to remain outside the PCA Framework and save themselves from corrective measures. The Indian Government also recapitalized the Indian public sector banks by 2.1 trillion in October 2017 through budgetary assistance and recapitalization bonds since they faced the problem of higher gross NPAs than private sector and foreign banks. The government also approved the Insolvency and Bankruptcy Code (Amendment) Ordinance, 2017 for modifying the IBC 2016 and reinforcing the insolvency resolution plan.

Besides these policies, some other policy recommendations for the Government of India to promote a favorable macroeconomic environment in the economy can be as follows. Firstly, the government can enforce such economic development policies that enhance the overall income and production levels in the economy. Secondly, as the inflation rate has negative repercussions on the bank asset quality and causes defaulting of loans ; hence, policymakers can frame such directives that control the inflation rate. Thirdly, the government must also regulate other macroeconomic variables which may cause NPAs like unemployment rate, exchange rate, and interest rate by formulating effective policies.

Limitations of the Study and Scope for Further Research

The research period of this research is restricted to 1996–1997 till 2016–17. The data were not easily available due to privacy concerns. Limited sample size can restrict the generalization of the study. The sample in this research included all Indian scheduled commercial banks as a whole. Different categories of Indian banks such as public sector banks, private sector banks, foreign banks, RRBs, etc. were not studied individually. This study considered only two macroeconomic variables to examine the sensitivity of NPAs ; other macroeconomic and bank-specific variables were not taken into consideration. There is a broad scope for future research in this area. It is envisaged that future research studies can be accomplished by including bank-specific and other macroeconomic factors. The other groups of Indian banks can be also incorporated in further studies.

Authors' Contribution

Tabassum envisaged the concept and formulated the econometric modeling to carry out this empirical research. She extracted various research papers from highly reputed journals based on keywords. Dr. Sarveshwar Pande validated the econometric tools and supervised the study. The statistical calculations were done by Tabassum using EVIEWS 7.1 version and MS Excel. Tabassum wrote the manuscript in consultation with the co-author, Dr. Sarveshwar Pande.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter, or materials discussed in this manuscript.

Funding Acknowledgment

The authors received no financial support for the research, authorship, and/or for the publication of this article.

References

Abdelbaki, H. H. (2019). Macroeconomic determinants of non-performing loans in GCC economies : Does the global financial crisis matter ? *International Journal of Economics and Business Research, 17*(4), 433 – 447. https://doi.org/10.1504/IJEBR.2019.099973

Abid, L., Ouertani, M. N., & Zouari-Ghorbel, S. (2014). Macroeconomic and bank-specific determinants of household's non-performing loans in Tunisia : A dynamic panel data. *Procedia Economics and Finance, 13,* 58 – 68. https://doi.org/10.1016/S2212-5671(14)00430-4

Agrawal, K., & Maheshwari, Y. (2014). Default risk modelling using macroeconomic variables. *Journal of Indian Business Research, 6*(4), 270 – 285. https://doi.org/10.1108/JIBR-04-2014-0024

Ali, A., & Daly, K. (2010). Macroeconomic determinants of credit risk : Recent evidence from a cross country study. *International Review of Financial Analysis, 19*(3), 165 – 171. https://doi.org/10.1016/j.irfa.2010.03.001

Apergis, I., & Eleftheriou, S. (2019). The impact of the 2008 financial crisis on the Greek banking system. *International Journal of Economics and Business Research, 17*(3), 333 – 341. https://doi.org/10.1504/IJEBR.2019.098879

Beck, R., Jakubik, P., & Piloiu, A. (2015). Key determinants of non-performing loans : New evidence from a global sample. *Open Economies Review, 26*(3), 525 – 550. https://doi.org/10.1007/s11079-015-9358-8

Berger, H., & Hefeker, C. (2008). Does financial integration make banks more vulnerable ? Regulation, foreign owned banks, and the lender-of-last resort. *International Economics and Economic Policy, 4*(4), 371 – 393. https://doi.org/10.1007/s10368-007-0093-5

Bonfim, D. (2009). Credit risk drivers : Evaluating the contribution of firm level information and of macroeconomic dynamics. *Journal of Banking & Finance, 33*(2), 281 – 299. https://doi.org/10.1016/j.jbankfin.2008.08.006

Boudriga, A., Taktak, N. B., & Jellouli, S. (2009). Banking supervision and nonperforming loans : A cross - country analysis. *Journal of Financial Economic Policy, 1*(4), 286 – 318. https://doi.org/10.1108/17576380911050043

Castro, V. (2013). Macroeconomic determinants of the credit risk in the banking system : The case of the GIPSI. *Economic Modelling, 31,* 672 – 683. https://doi.org/10.1016/j.econmod.2013.01.027

Chaibi, H., & Ftiti, Z. (2015). Credit risk determinants : Evidence from a cross-country study. *Research in International Business and Finance, 33,* 1–16. https://doi.org/10.1016/j.ribaf.2014.06.001

Cifter, A., Yilmazer, S., & Cifter, E. (2009). Analysis of sectoral credit default cycle dependency with wavelet networks : Evidence from Turkey. *Economic Modelling, 26*(6), 1382–1388. https://doi.org/10.1016/j.econmod.2009.07.014

Dhar, S., & Bakshi, A. (2015). Determinants of loan losses of Indian Banks : A panel study. *Journal of Asia Business Studies, 9*(1), 17 – 32. https://doi.org/10.1108/JABS-04-2012-0017

Dimitrios, A., Helen, L., & Mike, T. (2016). Determinants of non-performing loans : Evidence from Euro-area countries. *Finance Research Letters, 18,* 116 – 119. https://doi.org/10.1016/j.frl.2016.04.008

Eichengreen, B., & Gupta, P. (2013). The financial crisis and Indian banks : Survival of the fittest ? *Journal of International Money and Finance, 39,* 138 – 152. https://doi.org/10.1016/j.jimonfin.2013.06.022

Fainstein, G., & Novikov, I. (2011). The role of macroeconomic determinants in credit risk measurement in transition country : Estonian example. *International Journal of Transitions and Innovation Systems, 1*(2), 117 – 137. https://doi.org/10.1504/IJTIS.2011.039621

Ghosh, J., & Chandrasekhar, C. P. (2009). The costs of 'coupling': The global crisis and the Indian economy. *Cambridge Journal of Economics, 33*(4), 725 – 739. https://doi.org/10.1093/cje/bep034

Gulati, R., & Kumar, S. (2016). Assessing the impact of the global financial crisis on the profit efficiency of Indian banks. *Economic Modelling, 58,* 167 – 181. https://doi.org/10.1016/j.econmod.2016.05.029

India GDP Data Highlights | Q1FY21 GDP at -23.9%, worst contraction on record. (2020, August 31). Moneycontrol.com. https://www.moneycontrol.com/news/business/india-gdp-data-live-updates-india-economy-coronavirus-covid-19-hit-business-5775151.html

Jabra, W.B., Mighri, Z., & Mansouri, F. (2017). The determinants of credit and insolvency risk of European commercial banks : A dynamic panel data analysis. *International Journal of Monetary Economics and Finance, 10*(2), 111 – 143. https://doi.org/10.1504/IJMEF.2017.084208

Kshetri, N. (2011). Emerging economies and the global financial crisis : Evidence from China and India. *Thunderbird International Business Review, 53*(2), 247 – 262. https://doi.org/10.1002/tie.20404

Louzis, D. P., Vouldis, A. T., & Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece : A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking & Finance, 36*(4), 1012 – 1027. https://doi.org/10.1016/j.jbankfin.2011.10.012

Messai, A. - S., & Gallali, M.I. (2019). Macroeconomic determinants of credit risk: A P-VAR approach evidence from Europe. *International Journal of Monetary Economics and Finance, 12*(1), 15–24. https://doi.org/10.1504/IJMEF.2019.098638

Nachane, D. M., & Shahidul Islam, M. (2012). Post-crisis South Asia : Monetary management and macro-prudential regulation. *South Asian Journal of Global Business Research, 1*(2), 189–209. https://doi.org/10.1108/20454451211252732

Otašević, D. (2015). The influence of macroeconomic risks on credit risk in the Serbian banks' loan portfolio. *Neo-Transitional Economics, 16,* 219 – 243. https://doi.org/10.1108/S1569-376720150000016010

Reinhart, C. M., & Rogoff, K. S. (2011). From financial crash to debt crisis. *American Economic Review, 101*(5), 1676 – 1706. https://doi.org/10.1257/aer.101.5.1676

Reserve Bank of India. (2015). *Master Circular – Prudential norms on income recognition, asset classification and provisioning pertaining to advances.* https://rbidocs.rbi.org.in/rdocs/notification/PDFs/101MC16B68A0EDCA9434CBC239741F5267329.PDF

Reserve Bank of India. (2018). *Handbook of statistics on Indian economy 2017 – 18.* https://rbi.org.in/Scripts/AnnualPublications.aspx?head=Handbook+of+Statistics+on+Indian+Economy

Reserve Bank of India. (2021). *Database on Indian economy : Bank wise and bank group-wise gross non-performing assets, gross advances and gross NPA ratio of scheduled commercial banks.* https://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications

Sharma, S. D. (2009). Dealing with the contagion : China and India in the aftermath of the subprime meltdown. *China & World Economy, 17*(2), 1–14. https://doi.org/10.1111/j.1749-124X.2009.01138.x

Syed, A. A., & Tripathi, R. (2019). Non - performing loans in BRICS nations : Determinants and macroeconomic impact. *Indian Journal of Finance, 13*(2), 22 – 35. http://doi.org/10.17010/ijf/2019/v13i2/141684

Syed, A. A., & Tripathi, R. (2020). Macroeconomic vulnerabilities and their effect on nonperforming loans in Indian commercial banks. *Indian Journal of Finance, 14*(2), 34–49. http://doi.org/10.17010/ijf/2020/v14i2/150555

Szarowska, I. (2018). Effect of macroeconomic determinants on non-performing loans in Central and Eastern European countries. *International Journal of Monetary Economics and Finance, 11*(1), 20 – 35. https://doi.org/10.1504/IJMEF.2018.090564

Tarchouna, A., Jarraya, B., & Bouri, A. (2019). To what extent the global financial crisis deteriorated loan quality of US commercial banks ? *International Journal of Management and Enterprise Development, 18*(1/2), 63 – 84. https://doi.org/10.1504/IJMED.2019.097801

Tiwari, D. (2017, May 16). IMF alert on NPAs may have made RBI seek more power. *The Economics Times.* https://economictimes.indiatimes.com/news/economy/policy/imf-alert-on-npas-may-have-made-rbi-seek-more-power/articleshow/58689239.cms

Trading Economics. (2021a.). *India GDP annual growth rate.* https://tradingeconomics.com/india/gdp-growth-annual

Trading Economics. (2021b.). *India inflation rate.* https://tradingeconomics.com/india/inflation-cpi

Tsai, B. - H., Lee, C. - F., & Sun, L. (2009). The impact of auditors' opinions, macroeconomic and industry factors on financial distress prediction : An empirical investigation. *Review of Pacific Basin Financial Markets and Policies, 12*(03), 417 – 454. https://doi.org/10.1142/S0219091509001691

Upadhyaya, P., & Roy, S. G. (2017). Analysis of macroeconomic factors causing non-performing loans in India. *International Journal of Business and Globalisation, 18*(2), 182–193. https://doi.org/10.1504/IJBG.2017.081948

Uppal, R., & Khanna, P. (2015). Factors affecting NPAs of scheduled commercial banks : An empirical study based in Punjab. *Indian Journal of Finance, 9*(2), 7 – 16. http://doi.org/10.17010/ijf/2015/v9i2/71517

Viswanathan, P., & Muthuraj, M. (2019). Factors leading to non - performing assets (NPAs) : An empirical study. *Indian Journal of Finance, 13*(1), 55 – 64. http://doi.org/10.17010/ijf/2019/v13i1/141051

Welfens, P. J. (2008). Banking crisis and prudential supervision : A European perspective. *International Economics and Economic Policy, 4*(4), 347 – 356. https://doi.org/10.1007/s10368-007-0095-3

World Bank. (2018). *GDP growth (annual %).* https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

Yurdakul, F. (2014). Macroeconomic modelling of credit risk for banks. *Procedia-Social and Behavioral Sciences, 109,* 784 – 793. https://doi.org/10.1016/j.sbspro.2013.12.544

About the Authors

Ms. Tabassum is a PhD Scholar at the Amity Business School in Amity University Uttar Pradesh, Lucknow Campus, Lucknow, Uttar Pradesh (India). Her current areas of interest are banking and finance, economics, and insurance. She has work experience of more than 2 years in a reputed organization in the banking and insurance industry. She is the author of various publications presented in national and international conference proceedings and journals.

Dr. Sarveshwar Pande is an Assistant Professor at the Amity Business School in Amity University Uttar Pradesh, Lucknow Campus, Lucknow, Uttar Pradesh (India). His current areas of interest are accounting, finance, and auditing. He is the author of various publications in reputed national and international journals.