CHAPTER 3
RESEARCH METHODOLOGY

3.1 Rationale of the Study

Reserve Bank of India is regulator and supervisor of financial system in India. It works for keeping monetary stability and economic development in the country. Central Banks are aware of the fact that economic cycle follows the cycle of boom and burst phase. It is the role of banking industry to help economy in its turbulent time. But it is witnessed that lending activities of banks, have magnified the momentum of underlying economic cycles. During recession it is expected from banking industry that it would help economy to come out of recession, by providing a stimulus of credit to economy; but on contrary, during downswing in economic cycle, banks constrained lending activities. Instead of helping economy by providing loans and advances and giving stimulus to production, banks in recession put a brake on lending activities and thus pushing the economy more into recession. This leads to extreme swings in economic activity and absolute collapse of the regular linkages between savers and investors. Such experiences during recession have led central banks to worry about excessive procyclicality of the financial system especially the banking system which unnecessarily intensify swings in the real economy. In the literature review, the researcher found that almost all studies on procyclical behaviour of banks are carried out outside India. This topic is not explored in India except few studies are done by the researchers of RBI. The researcher further found that no study has been done in India where the procyclical behaviour of public sector banks and private sector banks are compared and analyzed. In this study, the researcher focused on understanding of procyclical behaviour of public sector banks Group and private sector banks Group. The Bank Groups (State Bank of India and its Associates Banks, Nationalized Banks, Indian Private Banks and Foreign Banks operating in India and) are considered for the study. The major theme is to study the procyclical behaviour of public sector banks and private sector banks with a focus on bank
credit. The study finds the impact of macroeconomic factors especially economic output and bank specific factors on the credit extended by banks to economy. The study also finds the lead-lag pattern of bank credit and output in economy. The other important area which is covered in this study is the cyclical behaviour of nonperforming assets. The study finds the impact of current state of economy, economic fluctuations and other macroeconomic and bank specific factors on the non performing assets of banks. The study also investigates the cyclical behaviour of capital adequacy ratio or capital buffer. The study also involves understanding relationship of profitability parameters with macroeconomic variables. Thus this research study will bring the unique contribution to the body of knowledge.

3.2 Objectives of the Study

1. To study the procyclical behaviour of bank credit with a focus on demand function and supply function in public and private sector banks in India.
2. To study the lead-lag pattern in the interaction between growths cycle of India and credit cycles of public and private sector banks in India.
3. To study the procyclical behaviour of Non Performing Assets in presence of Macroeconomic and Bank Specific variables in public and private sector banks in India.
4. To study the procyclical behaviour of Capital Adequacy in presence of Macroeconomic and Bank Specific variables in public and private sector banks in India.
5. To study the relationship of Profitability parameters with Macroeconomic and Bank Specific variables in public and private sector banks in India.

3.3 Type of Research: Causal Research

Zikmund (2010), “A research conducted to identify cause-and-effect relationship among variables when the research has already been narrowly defined”. The causal research attempts to establish that when we do one thing, another thing will follow.
3.4 Population of the Study
The study has been carried on Scheduled Commercial Banks in India (excluding Regional Rural Banks) which have been divided into following bank groups:-

1. State Bank of India and its Associates (SBI Banks Group)
2. Nationalized Banks Group
3. Foreign Banks Group
4. Indian Private Banks Group

In this study Public Sector Banks Group is grouped as SBI Banks Group and Nationalized Banks Group. Private Sector Banks Group is grouped as Indian Private Banks Group and Foreign Banks Group. All Banks Group is grouped as SBI Banks Group, Nationalized Banks Group, Indian Private Banks Group and Foreign Banks Group.

3.5 Period of the Study
The data analysis has been done for period 1999-2000 to 2012-2013, a period of 14 years.

3.6 Data Source
Data has been collected from various sources like “Statistical Tables Relating to Banks in India” Published by Reserve Bank of India for the Years 1999-2000 to 2012-2013, “Report on Trend and Progress of Banking in India” Published by Reserve Bank of India for the Years 1999-2000 to 2012-2013, Planning Commission, Government of India and data published by World Bank on its website.

3.7 Tools for Data Analysis
- IBM Statistical Package for Social Sciences (SPSS)-20.0 Version
Descriptive Statistics – Mean and Standard Deviation, Correlation Analysis, Regression Analysis, Durbin-Watson Statistic (d-test), t-test, F-test have been calculated using SPSS Package.
Regression Analysis
Regression analysis is a technique for measuring the linear association between a dependent and an independent variable. Although regression and correlation are mathematically related, regression assumes that the dependent variable Y is predicatively linked to the independent variable. Regression analysis attempts to predict the values of a continuous, interval scale dependent variable from specific values of independent variable. Bivariate linear regression is a form of regression investigates a straight line relationship of the type

\[ Y = \alpha + \beta X \]  \hspace{1cm} \text{(Equation-1)}

Where Y is the dependent variable, X is the independent variable, \( \alpha \) and \( \beta \) are two constants to be estimated. The symbol \( \alpha \) represents the Y intercept and \( \beta \) is slope coefficient. The slope \( \beta \) is change in Y due to a corresponding change of one unit in X. The Y intercept; the point at which a regression line intersects the Y-axis. The inclination of a regression line as compared to a base line, rise (vertical distance) over run (horizontal difference) is called slope (Zikmund, 2010).

If the variables in a bivariate distribution are related, the points in the scatter diagram will cluster round some curve called the “curve of regression”. If the
curve is straight line, it is called the line of regression and there is said to linear regression between the variables, otherwise regression is said to be curvilinear. The line of regression is the line which gives the best estimate to the value of one variable for any specific value of the other variable. Thus the line of regression is the line of “best fit” and is obtained by the principle of least squares (Gupta and Kapoor, 2006).

The above equation -1 represents a family of straight lines for different values of the arbitrary constants $\alpha$ and $\beta$. The problem is to determine $\alpha$ and $\beta$ so that the line is the line of “best fit”. The term best fit is interpreted in accordance with Legendre’s principle of least squares which consists in minimising the sum of squares of the deviations of the actual values of $y$ from their estimated values as given by the line of best fit (Gupta and Kapoor, 2006).

**Least Squares Method of Regression Analysis** is a mathematical technique of ensuring that the regression line will best represent the linear relationship between $X$ and $Y$. No straight line can completely represents every dot in the scatter diagram. Unless there is a perfect correlation between two variables, there will be discrepancy in most of the actual scores and the predicted score best on regression line. Simply stated any straight line that is drawn will generate errors. The method of least squares uses the criterion of attempting to make the least of total error in prediction of $Y$ from $X$. More technically the procedure used in the least squares method generates straight line, which minimizes the sum of squared deviations of the actual values from the predicted regression line. With the symbol $e$ representing the deviations of the dots from the line, the least squares criterion is

$$e_i = Y_i - Y_i^\wedge.$$  

$e_i$ is the residual error.  
$Y_i$ is the actual value of the dependent variable.  
$Y_i^\wedge$ is the estimated value of the dependent variable.  
i= number of particular observation.
The residual error is the difference between the actual value of the dependent variable and the estimated value of the dependent variable in the regression equation (Zikmund, 2010).

The general equation of a straight line equals \( Y = \alpha + \beta X \). A more appropriate equation includes an allowance for error:

\[
Y = \alpha + \beta X + e
\]

The symbols \( \alpha \) and \( \beta \) are utilized when the equation is a regression estimate of the line. Thus to compute the estimated values of \( \alpha \) and \( \beta \) the formulas used are:

\[
\beta = n \left( \sum XY \right) - \left( \sum X \right) \left( \sum Y \right) / n \left( \sum X^2 \right) - \left( \sum X \right)^2 \\
\hat{\alpha} = \bar{Y} - \beta \bar{X}
\]

where,

\( \beta \) is the estimated slope of the line (the regression coefficient)
\( \hat{\alpha} \) is the estimated intercept of the \( Y \)-axis
\( Y \) is dependent variable
\( \bar{Y} \) is mean of the dependent variable
\( X \) is independent variable
\( \bar{X} \) is mean of the independent variable
\( n \) is the number of observations.

**Measuring the Fit of the Regression Model**

A regression equation can be developed for any variables \( X \) and \( Y \), even random numbers. It is important to know whether the model is actually helpful in predicting \( Y \) based on \( X \)? Should the researcher have confidence in model? Does the model provide better predictions that simply using the average of the \( Y \) values? For example in a construction company sales figures \( Y \) varied from a low of 4.5 to a high of 9.5 and the mean was 7. If each sales value is compared with the mean, it is important to see how far they deviate from the mean and
we could compute a measure of the total variability in sales. Because Y is sometimes higher and sometimes lower than the mean, there may be both positive and negative deviations. Simply summing these values would be misleading because negatives would cancel out the positives, making it appear that the numbers are closer to the mean than they actually are. To prevent this problem, Sum of the Squares (SST) is used to measure the total variability in Y (Render, Stair and Hanna, 2009).

\[ \text{SST} = \sum(Y - \bar{Y})^2 \]

Regression line may be used to predict the value of Y, and while there are still errors involved, the sum of these squared errors will be less than the total sum of squares just computed. Sum of squared errors (SSE) measures the variability in Y about the regression line.

\[ \text{SSE} = \sum e^2 = \sum(Y - \bar{Y})^2 \]

Using the regression line reduces the variability in the sum of squares. This is called the sum of squares due to regression (SSR) and indicates how much of the total variability in Y is explained by the regression model. Mathematically, this can be calculated as

\[ \text{SSR} = \sum (\hat{Y} - \bar{Y})^2 \]

1. **Coefficient of determination \((R^2)\)**

The SSR is sometimes called the explained variability in Y while in SSE is the unexplained variability in Y. The proportion of the variability in Y that is explained by the regression equation is called the coefficient of determination. It is a measure of that portion of the total variance of a variable that is accounted for by knowing the value of another variable.

\[ R^2 = \frac{\text{Explained Variance}}{\text{Total Variance}} \]

Or,

\[ R^2 = \frac{\text{SSR}}{\text{SST}} = 1 - \frac{\text{SSE}}{\text{SST}} \]

The value of \(R^2\) (coefficient of determination) measures part of the total variance of the dependent variable is explained by all the independent variables.
in the model. In other words $R^2$ measures the variability in $Y$ that is explained by the regression equation. If every point lies on regression line, $R^2 = 1$. (Render, Stair and Hanna, 2009)

2. **Correlation Coefficient** ($r$)

Correlation Coefficient is another measure related to the coefficient of determination. The measure also expresses the degree or strength of the linear relationship. It is usually expressed as $r$ and can be any number between and including +1 and -1. The value of $r$ is the square root of $r^2$. It is negative if the slope is negative and it is positive if the slope is positive. Thus,

$$ r = \pm \sqrt{r^2} $$

The correlation coefficient ranges from +1 to -1 (Render, Stair and Hanna, 2009).

**Test of Statistical Significance of Model**

To see if there is any linear relationship between $X$ and $Y$, a statistical hypothesis test is performed. The null hypothesis is that there is no linear relationship between two variables and the alternate hypothesis is that there is a linear relationship. If the null hypothesis can be rejected, then it is proven that a linear relationship does exist.

1. An F-test is a appropriate for determining whether there is a linear relationship. F-test or an analysis of a variance is a procedure used to determine whether there is more variability in the scores of sample than in scores of other sample. Whereas F-statistic is a test statistic that measures the ratio of one sample variance to another sample variance such as the variance between groups to variance within groups. To obtain F-Statistic larger sample variance is divided by smaller sample variance.

$$ F = \frac{MSR}{MSE} $$

Where MSR is Mean Squared Regression calculated using below formula:
MSR = SSR/k

where, k is number of independent variables in the model.

The overall F-Statistic of the model is significant at say, 95% confidence level or 5% level of significance then it indicates that the model is overall good and linear.

The F test determines whether or not there is a relationship between the variables. However the best measure of the strength of relationship is the coefficient of determination. There a good regression model should have low significance level for the F-test and a high (close to 1) $R^2$ (Render, Stair and Hanna, 2009).

**Multiple Regressions**

A multiple regression model has more than one independent variable.

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \ldots + b_kX_k$$

Where $Y$ is dependent variable; $X_1, X_2, X_3 \ldots$ and $X_k$ are independent variables; $a$ is intercept and $b_1, b_2, b_3, b_k$ are sample coefficients.

**Binary or Dummy Variables**

There are many times when we believe a qualitative variable rather than a quantitative variable would be helpful in predicting the dependent variable $Y$. In such situation a special variable is used called a dummy variable (or a binary variable or an indicator variable) would be used. A dummy variable is assigned a value of 1 if a particular condition is met and a value of 0 otherwise. The number of dummy variables must be equal one less than the number of categories of a qualitative variable.

**Model Building**

In developing a good regression model, possible independent variables are selected and the best ones are selected to be used in model. The best model is statistically significant model with a high $R^2$ and few variables. As more variables are added to a regression model, $R^2$ will usually increase and it can
decrease. The adjusted $R^2$ may decrease when more variables are added to model.

Adjusted $R^2$
Adjusted $R^2$ (often written as $R^2$ and pronounced "R bar squared") is an attempt to take account of the phenomenon of the $R^2$ automatically and spuriously increasing when extra explanatory variables are added to the model. It is a modification that adjusts for the number of explanatory terms in a model relative to the number of data points. The adjusted $R^2$ can be negative, and its value will always be less than or equal to that of $R^2$. Unlike $R^2$, the adjusted $R^2$ increases when a new explanator is included only if the new explanator improves the $R^2$ more than would be expected by chance. Adjusted $R^2$ is the version of $R^2$ that has been adjusted for the numbers of predictors in the model. $R^2$ tends to overestimate the strength of the association, especially when there are more than one independent variables. As more and more independent variables are increased, Adjusted $R^2$ increases less than the unadjusted $R^2$. Adjusted $R^2$ can be negative, although $R^2$ necessarily non negative. It is good practice to use Adjusted $R^2$ rather than $R^2$.

$$R^2 = 1 - \frac{RSS}{TSS}$$

Where, $RSS = \text{Residual Sum of Squares}$
$TSS = \text{Total Sum of Squares}$

$$\text{Adjusted } R^2 = 1 - \frac{RSS/(n-k)}{TSS/(n-1)}$$

Here, $n = \text{number of observations}$, $k = \text{number of independent variables including intercept term}$. 
Durbin-Watson Statistic (d-test)

In regression studies involving data collected over time, a special type of correlation among the error terms can cause problems; it is called serial correlation or autocorrelation. Durbin Watson test can be used to detect significant autocorrelation (Anderson, Sweeney and Williams, 2008). Durbin–Watson statistic is a test used to detect the presence of autocorrelation in the residuals (prediction errors) from a regression analysis. It is named after James Durbin and Geoffrey Watson. Autocorrelation is a relationship between values separated from each other by a given time lag.

The Durbin-Watson test uses the following statistic:

\[ d = \frac{\sum_{i=2}^{n}(e_i - e_{i-1})^2}{\sum_{i=1}^{n}e_i^2} \]

where the \( e_i = y_i - \hat{y}_i \) are the residuals, \( n \) = the number elements in the sample and \( k \) = the number of dependent variables.

Autocorrelation

Autocorrelation refers to the correlation of a times series with its own past and future values. Autocorrelation may also be defined as “correlation between members of series of observations ordered in time (as in time series data) or space (as in cross-sectional data). In other word autocorrelation is a linear correlation between the error term for one observation and the next. Autocorrelation is also sometimes called as “lagged correlation” or “serial correlation”. In the regression context, the classical linear regression model assumes that such auto correlation does not exist in the disturbances \( \mu_i \), symbolically,

\[ E = (\mu_i, \mu_j) = 0, \ i \neq j \]

Put simply, the classical model assumes that the disturbance term relating to any observation is not influenced by the disturbance term relating to any other observation (Gujrati and Sangeetha, 2007).
Durbin Watson test statistics ranges in value from zero to four, with a value of two indicating no autocorrelation is present. Durbin Watson developed tables that can be used to determine when their test statistics indicate the presence of autocorrelation.

Durbin-Watson test steps are as follows:-

1. Run the Regression and obtain the residuals.
2. Compute d value from the equation above.
3. Determine critical d value lower limit (d_L) and d value upper limit (d_U) from the table for a given sample size and given number of explanatory variable.
4. Decision Criterion for one sided test:
   a. If calculated the value of d < d_L, there is positive autocorrelation.
   b. If d_L ≤ d ≤ d_U, then the test is inconclusive.
   c. If d > d_U, there is no evidence of positive autocorrelation.
   d. If d > 4 - d_L then there is a negative autocorrelation is present.
   e. If 4 - d_U ≤ d ≤ 4 - d_L then the test is inconclusive.
   f. If d < 4 - d_U then there is no evidence of negative autocorrelation.
5. Decision Criterion for two sided test:
   a. If d < d_L or d > 4 - d_L then there is presence of autocorrelation.
   b. If d_L ≤ d ≤ d_U or 4 - d_L ≤ d ≤ 4 - d_U then test is inconclusive.
   c. If d_U < d < 4 - d_U then there is no evidence of autocorrelation.

(Anderson, Sweeney and Williams, 2008).

**Durbin Statistic (h-test)**

Durbin Statistics (h-test) is used to detecting auto-correlation in auto-regressive model. Regression models in which the independent variables are previous values of the time series are referred to as autoregressive models (Anderson, Sweeney and Williams, 2008). In other word, in regression analysis involving time-series data, if the regression model includes not only
the current but also the lagged (past) values of the explanatory variables, it is called a distributed-lag model. If the model includes one or more lagged values of the dependent variable among its explanatory variables, it is called an autoregressive model.

Thus,

\[ Y_t = \alpha + \beta_0 X_t + \beta_1 Y_{t-1} + \mu_t \]

is an example of an autoregressive model (Gujrati and Sangeetha, 2007).

One of the assumptions of applying Durbin-Watson d test is that to find out first order serial correlation, the regression model does not include the lagged value(s) of the dependent variable as one the explanatory variables i.e. it does not apply to autoregressive models because there is built-in bias against discovering (first order) serial correlation. Despite this many researchers compute d value for want of anything better. Durbin has proposed another test of first order serial correlation in autoregressive models. This test is called the h statistic which is defined as

\[ h = \hat{\rho} \sqrt{\frac{n}{1-n[\text{var}(\hat{\beta}_1)]}} \]

Where, \( n = \) Sample size, \( \text{Var}(\beta_1) = \) variance of the coefficient of lagged Y i.e. \( Y_{t-1} \)

\( \hat{\rho} = \) estimate of the first order serial correlation

For a sample size \( n \), Durbin has shown that under the null hypothesis that \( \rho=0 \), h statistic follows the standard normal distribution. If the probability of \( |h| > 1.96 \) is about 5%, we can reject the null hypothesis that \( \rho=0 \), there is evidence of first order autocorrelation in the autoregressive model.
The following steps are used to apply h test:-
1. Estimate the model by Ordinary Least Square Method.
2. Calculate var( $\beta_1$) in the model as well as routinely compute d statistic
3. Using this d value, obtain $\rho = 1 - d / 2$

We cannot use d statistic to test for serial correlation in this model, but we can use it to obtain an estimate of $\rho$
4. Compute h statistic

$$ h = \rho \sqrt{n/1 - n[\text{var}(\hat{\beta}_1)]} $$

If the computed $|h|$ statistic exceeds 1.96, we can conclude that there is evidence of first order autocorrelation.

Multicollinearity
In a linear regression analysis, the independent (explanatory variables) are considered to be statistically independent of each other. However there might be situations where explanatory variables are highly correlated amongst themselves. This leads to problem of multicollinearity (Srivastava, Shenoy and Sharma, 2008). In other words, in multiple regressions analysis multicollinearity refers to the correlation among independent variable (Anderson, Sweeney and Williams, 2008). When multicollinearity is present, the exclusion of one of the variables from the model does not decrease the explanation of dependent variable. An alternate and more scientific approach is to collect additional set of data as multicollinearity does not exist in case of large samples (Srivastava, Shenoy and Sharma, 2008).
Lagged Independent Variables

In realistic formulation of regression models, it is necessary to introduce the lagged values of independent (explanatory) variables (Srivastava, Shenoy and Sharma, 2008).

\[ Y = a + b_0X_t + b_1X_{t-1} + \ldots + b_sX_{t-s} + U_t \]

**t-Test**

If the F test shows that multiple regression relationship is significant, a \( t \)-test can be conducted to determine the significance of each of the individual parameters (Anderson, Sweeney and Williams, 2008). Test was developed by Irish Statistician William S. Gosset in 1908. Gosset adopted the pen name ‘student’ and thereafter \( t \)-distribution is commonly called students’ \( t \)-distribution or \( t \)-test. The \( t \)-statistic is defined as

\[ t = \frac{\text{Sample Mean - population Mean}}{\text{Standard Error of Mean}} \]

Standard Error of Mean\( = \sqrt{\frac{S^2}{n-1}} \),

where, \( S = \) Standard deviation of the sample
\( n = \) Sample size

The \( t \)-test for individual significance follows:

Let the Equation of the Regression Model is

\[ Y_i = \beta_0 + \beta_i X_i + \mu_i \]

**Step 1:** For any parameter \( \beta_i \), construct hypothesis.

\( H_0: \beta_i = 0 \)
\( H_a: \beta_i \neq 0 \)
Null: There is no significant impact of independent variable $X_i$ on dependent variable $Y_i$.

Alternative: There is significant impact of independent variable $X_i$ on dependent variable $Y_i$.

**Step2:** Construct the t-statistic

$$t = \frac{\hat{\beta}_i - \beta_i}{\text{Standard Error of } \hat{\beta}_i}$$

Where, $\hat{\beta}_i$ is the estimator and $\beta_i$ is the parameter.

Under $H_0$, it has a t-distribution with $n-k$ d.f.

**Step3:** Looking to the t-table, the entry corresponding to $n-k$ d.f. and find the value of $t$ at $\alpha$ or $\alpha/2$ level of significance (two-tailed test).

**Step4:** If the calculated value of $|t|$ is greater than the table value at $\alpha$ or $\alpha/2$ level of significance, then reject the null hypothesis and accept the alternative hypothesis. However, if the calculated value of $|t|$ is less than the table value at $\alpha$ or $\alpha/2$ level of significance, then do not reject the null hypothesis (Gujrati and Sangeetha, 2007).

**Correlation Analysis**

Gupta, S. P. (2007), Correlation Analysis attempts to determine the degree of relationship between two variables. Correlation analysis helps us in determining the degree of relationship between two or more variables. Of the several mathematical methods of measuring correlation, the Karl Pearson’s method popularly known as Pearson’s coefficient of correlation is most widely used in practice. The Pearson coefficient of correlation is denoted by symbol ‘r’.

The formula for computing ‘r’ is

$$r = \frac{\Sigma x y}{N (\text{S.D}_x) (\text{S.D}_y)}.$$
where, $x = (X-X)$, $y = (Y-Y)$

$S.D_x = \text{Standard Deviation of Series X}$

$S.D_y = \text{Standard Deviation of Series Y}$

$N = \text{No. of Pairs of observations}$

$r = \text{the product moment correlation coefficient}$

**Granger Causality Test**

Granger causality is a statistical concept of causality that is based on prediction. According to Granger causality, if a signal $X_1$ "Granger-causes" (or "G-causes") a signal $X_2$, then past values of $X_1$ should contain information that helps predict $X_2$ above and beyond the information contained in past values of $X_2$ alone. Its mathematical formulation is based on linear regression modeling of stochastic processes (Granger 1969). More complex extensions to nonlinear cases exist, however these extensions are often more difficult to apply in practice.

Granger causality (or "G-causality") was developed in 1960s and has been widely used in economics since the 1960s. However it is only within the last few years that applications in neuroscience have become popular (Anil Seth, 2007).

**Mathematical Formulation**

G-causality is normally tested in the context of linear regression models. For illustration, consider a bivariate linear autoregressive model of two variables $X_1$ and $X_2$:

$$X_1(t) = \sum_{j=1}^{p} A_{11,j} X_1(t-j) + \sum_{j=1}^{p} A_{12,j} X_2(t-j) + E_1(t)$$

$$X_2(t) = \sum_{j=1}^{p} A_{21,j} X_1(t-j) + \sum_{j=1}^{p} A_{22,j} X_2(t-j) + E_2(t)$$

Where $p$ is the maximum number of lagged observations included in the model (the model order), the matrix $A$ contains the coefficients of the model (i.e., the
contributions of each lagged observation to the predicted values of $X_1(t)$ and $X_2(t)$, and $E_1$ and $E_2$ are residuals (prediction errors) for each time series. If the variance of $E_1$ (or $E_2$) is reduced by the inclusion of the $X_2$ (or $X_1$) terms in the first (or second) equation, then it is said that $X_2$ (or $X_1$) Granger-(G)-causes $X_1$ (or $X_2$). In other words, $X_2$ G-causes $X_1$ if the coefficients in $A_{12}$ are jointly significantly different from zero. This can be tested by performing an F-test of the null hypothesis that $A_{12} = 0$, given assumptions of covariance stationarity on $X_1$ and $X_2$. The magnitude of a G-causality interaction can be estimated by the logarithm of the corresponding F-statistic (Geweke 1982). Note that model selection criteria, such as the Bayesian Information Criterion (BIC, (Schwartz 1978)) or the Akaike Information Criterion (AIC, (Akaike 1974)), can be used to determine the appropriate model order $p$.

As mentioned in the previous section, G-causality can be readily extended to the $n$ variable case, where $n > 2$, by estimating a variable autoregressive model. In this case, $X_2$ G-causes $X_1$ if lagged observations of $X_2$ help predict $X_1$ when lagged observations of all other variables $X_3 \ldots X_N$ are also taken into account. (Here, $X_3 \ldots X_N$ correspond to the variables in the set $W$ in the previous section; see also Boudjellaba et al. (1992) for an interpretation using autoregressive moving average (ARMA) models.) This multivariate extension, sometimes referred to as ‘conditional’ G-causality (Ding et al. 2006), is extremely useful because repeated pair wise analyses among multiple variables can sometimes give misleading results. For example, a repeated bivariate analysis would be unable to disambiguate the two connectivity patterns in Figure 2. By contrast, a conditional/multivariate analysis would infer a causal connection from $X$ to $Y$ only if past information in $X$ helped predict future $Y$ above and beyond those signals mediated by $Z$. Another instance in which conditional G-causality is valuable is when a single source drives two outputs with different time delays. A bivariate analysis, but not a
multivariate analysis, would falsely infer a causal connection from the output with the shorter delay to the output with the longer delay.

Application of the above formulation of G-causality makes two important assumptions about the data: (i) that it is covariance stationary (i.e., the mean and variance of each time series do not change over time), and (ii) that it can be adequately described by a linear model (Anil Seth, 2007).

**Hodrick-Prescott Filter**

The Hodrick–Prescott filter is a mathematical tool used in macroeconomics, especially in real business cycle theory, to separate the cyclical component of a time series from raw data. The Hodrick-Prescott Filter helps to find out a smooth estimate of the long-term trend component P_t of a series by minimizing the variance of Y_t around P_t, subject to a penalty that constrains the second difference of P_t. The HP filter chooses P_t to minimise the following function: \( Y_t - P_t \)\(^2 + \lambda (P_{t+1} - P_t) - (P_t - P_{t-1})\)^2. A penalty parameter \( \lambda = 100 \) is generally used for annual frequency data in the HP filter.

**Schwartz Information Criterion**

Schwarz criterion or Bayesian information criterion is a criterion for model selection among a finite set of models. It is based, in part, on the likelihood function and it is closely related to the Akaike information criterion (AIC) ("Schwarz criterion is a criterion for model selection", n.d.).

Schwarz criterion is an index used as an aid in choosing between competing models. It is defined as

\[-2L_m + m \ln n\]

Where \( n \) is the sample size, \( L_m \) is the maximized log-likelihood of the model and \( m \) is the number of parameters in the model. The index takes into account both the statistical goodness of fit and the number of parameters that have to be
estimated to achieve this particular degree of fit, by imposing a penalty for increasing the number of parameters. ("An index used as an aid", n.d.)

Similar to Schwarz Information criterion, Akaike information criterion (AIC) is a measure of the relative quality of a statistical model for a given set of data. As such, AIC provides a means for model selection. Akaike information criterion deals with the trade-off between the goodness of fit of the model and the complexity of the model. ("Akaike information criterion (AIC) is a measure of the relative quality", n.d.)

**Augmented Dicky-Fuller Test**

Augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence. ("Augmented Dickey–Fuller test (ADF) is a test", nd)

### 3.8 Hypotheses of the Study

**Null Hypothesis**

**For Objective-1**

**Model 1**

**Model 1(1)**

$H_{01(1)}$: There is no significant impact of Gross Domestic Product, Inflation, Cash Reserve Ratio, Capital Buffer, Bank Deposit and Gross NPA Ratio on Bank Credit in SBI Banks Group.

**Model 1(2)**

$H_{01(2)}$: There is no significant impact of Gross Domestic Product, Inflation, Cash Reserve Ratio, Capital Buffer, Bank Deposit and Gross NPA Ratio on Bank Credit in Nationalized Banks Group.
Model 1(3)
H_{01(3)} : There is no significant impact of Gross Domestic Product, Inflation, Cash Reserve Ratio, Capital Buffer, Bank Deposit and Gross NPA Ratio on Bank Credit in Indian Private Banks Group.

Model 1(4)
H_{01(4)} : There is no significant impact of Gross Domestic Product, Inflation, Cash Reserve Ratio, Capital Buffer, Bank Deposit and Gross NPA Ratio on Bank Credit in Foreign Banks Group.

Model 1(5)
H_{01(5)} : There is no significant impact of Gross Domestic Product, Inflation, Cash Reserve Ratio, Capital Buffer, Bank Deposit and Gross NPA Ratio on Bank Credit in Public Sector Banks Group.

Model 1(6)
H_{01(6)} : There is no significant impact of Gross Domestic Product, Inflation, Cash Reserve Ratio, Capital Buffer, Bank Deposit and Gross NPA Ratio on Bank Credit in Private Sector Banks Group.

Model 1(7)
H_{01(7)} : There is no significant impact of Gross Domestic Product, Inflation, Cash Reserve Ratio, Capital Buffer, Bank Deposit, Gross NPA Ratio and Dummy variable representing banks ownership on Bank Credit in All Banks Group.

For Objective-2
Model 2
Model 2(1)
H_{02(1)}: (A) Credit Cycle does not Granger Cause Economic Cycle (Growth Cycle) in SBI Banks Group. (B) Economic Cycle (Growth Cycle) does not Granger Cause Credit Cycle in SBI Banks Group.
Model 2(2)

\( H_{02(2)} \): (A) Credit Cycle does not Granger Cause Economic Cycle (Growth Cycle) in Nationalised Banks Group. (B) Economic Cycle (Growth Cycle) does not Granger Cause Credit Cycle in Nationalised Banks Group.

Model 2(3)

\( H_{02(3)} \): (A) Credit Cycle does not Granger Cause Economic Cycle (Growth Cycle) in Public Sector Banks Group. (B) Economic Cycle (Growth Cycle) does not Granger Cause Credit Cycle in Public Sector Banks Group.

Model 2(4)

\( H_{02(4)} \): (A) Credit Cycle does not Granger Cause Economic Cycle (Growth Cycle) in Indian Private Banks Group. (B) Economic Cycle (Growth Cycle) does not Granger Cause Credit Cycle in Indian Private Banks Group.

Model 2(5)

\( H_{02(5)} \): (A) Credit Cycle does not Granger Cause Economic Cycle (Growth Cycle) in Foreign Banks Group. (B) Economic Cycle (Growth Cycle) does not Granger Cause Credit Cycle in Foreign Banks Group.

Model 2(6)

\( H_{02(6)} \): (A) Credit Cycle does not Granger Cause Economic Cycle (Growth Cycle) in Private Sector Banks Group. (B) Economic Cycle does not Granger Cause Credit Cycle in Private Sector Banks Group.

For Objective-3

Model 3

Model 3(1)

\( H_{03(1)} \): There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Economy Wide Fluctuations, Current Year’s GDP and Unsecured Lending on Gross Non Performing Asset Ratio in SBI Banks Group.
Model 3(2)
\[ H_{03(2)} : \text{There is no significant impact of Economy Wide Fluctuations, Current Year’s GDP, and Inflation on Gross Non Performing Asset Ratio in SBI Banks Group.} \]

Model 3(3)
\[ H_{03(3)} : \text{There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset and Unsecured Lending on Gross Non Performing Asset Ratio in SBI Banks Group.} \]

Model 3(4)
\[ H_{03(4)} : \text{There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Economy Wide Fluctuations, Current Year’s GDP, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Nationalized Banks Group.} \]

Model 3(5)
\[ H_{03(5)} : \text{There is no significant impact of Economy Wide Fluctuations, Current Year’s GDP, and Inflation on Gross Non Performing Asset Ratio in Nationalized Banks Group.} \]

Model 3(6)
\[ H_{03(6)} : \text{There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Nationalized Banks Group.} \]

Model 3(7)
\[ H_{03(7)} : \text{There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Economy Wide Fluctuations, Current Year’s GDP, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Public Sector Banks Group.} \]
Model 3(8)

$H_{03(8)}$: There is no significant impact of Economy Wide Fluctuations, Current Year’s GDP, and Inflation on Gross Non Performing Asset Ratio in Public Sector Banks Group.

Model 3(9)

$H_{03(9)}$: There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Public Sector Banks Group.

Model 3(10)

$H_{03(10)}$: There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Economy Wide Fluctuations, Current Year’s GDP, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Indian Private Sector Banks Group.

Model 3(11)

$H_{03(11)}$: There is no significant impact of Economy Wide Fluctuations, Current Year’s GDP, and Inflation on Gross Non Performing Asset Ratio in Indian Private Sector Banks Group.

Model 3(12)

$H_{03(12)}$: There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Indian Private Sector Banks Group.

Model 3(13)

$H_{03(13)}$: There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Economy Wide Fluctuations, Current Year’s GDP, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Foreign Banks Group.
Model 3(14)

$H_{03(14)}$: There is no significant impact of Economy Wide Fluctuations, Current Year’s GDP, and Inflation on Gross Non Performing Asset Ratio in Foreign Banks Group.

Model 3(15)

$H_{03(15)}$: There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Foreign Banks Group.

Model 3(16)

$H_{03(16)}$: There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Economy Wide Fluctuations, Current Year’s GDP, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Private Sector Banks Group.

Model 3(17)

$H_{03(17)}$: There is no significant impact of Economy Wide Fluctuations, Current Year’s GDP, and Inflation on Gross Non Performing Asset Ratio in Private Sector Banks Group.

Model 3(18)

$H_{03(18)}$: There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in Private Sector Banks Group.

Model 3(19)

$H_{03(19)}$: There is no significant impact of Credit Inclination, Cost Condition, Interest Return on Asset, Economy Wide Fluctuations, Current Year’s GDP, Unsecured Lending and Loan Maturity on Gross Non Performing Asset Ratio in All Banks Group.
For Objective-4

Model 4

Model 4(1)

\( H_{04(1)} \) : There is no significant impact of Gross Domestic Product, Lag 1 Buffer, Gross NPA Ratio, Return on Equity and Deposit to Total Liabilities on Capital Buffer of SBI Banks Group.

Model 4(2)

\( H_{04(2)} \) : There is no significant impact of Gross Domestic Product, Lag 1 Buffer, Gross NPA Ratio, Return on Equity and Deposit to Total Liabilities on Capital Buffer of Nationalized Banks Group.

Model 4(3)

\( H_{04(3)} \) : There is no significant impact of Gross Domestic Product, Lag 1 Buffer, Gross NPA Ratio, Return on Equity and Deposit to Total Liabilities on Capital Buffer of Public Sector Banks Group.

Model 4(4)

\( H_{04(4)} \) : There is no significant impact of Gross Domestic Product, Lag 1 Buffer, Gross NPA Ratio, Return on Equity and Deposit to Total Liabilities on Capital Buffer of Indian Private Banks Group.

Model 4(5)

\( H_{04(5)} \) : There is no significant impact of Gross Domestic Product, Lag 1 Buffer, Gross NPA Ratio, Return on Equity and Deposit to Total Liabilities on Capital Buffer of Foreign Banks Group.

Model 4(6)

\( H_{04(6)} \) : There is no significant impact of Gross Domestic Product, Lag 1 Buffer, Gross NPA Ratio, Return on Equity and Deposit to Total Liabilities on Capital Buffer of Private Sector Banks Group.
Model 4(7)

$H_{04(7)}$: There is no significant impact of Gross Domestic Product, Lag 1 Buffer, Gross NPA Ratio, Return on Equity and Deposit to Total Liabilities on Capital Buffer of All Banks Group.

For Objective-5

Model 5

Model 5(1)

$H_{05(1)}$: There is no significant relationship of Return on Assets with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in SBI Banks Group.

$H_{05(2)}$: There is no significant relationship of Return on Assets with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Nationalized Banks Group.

$H_{05(3)}$: There is no significant relationship of Return on Assets with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Public Sector Banks Group.

$H_{05(4)}$: There is no significant relationship of Return on Assets with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Indian Private Banks Group.

$H_{05(5)}$: There is no significant relationship of Return on Assets with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Foreign Banks Group.

$H_{05(6)}$: There is no significant relationship of Return on Assets with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank
Credit, Bank Deposit and Loan Loss Provisioning in Private Sector Banks Group.

**H_{05(7)}**: There is no significant relationship of Return on Equity with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in SBI Banks Group.

**H_{05(8)}**: There is no significant relationship of Return on Equity with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Nationalised Banks Group.

**H_{05(9)}**: There is no significant relationship of Return on Equity with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Public Sector Banks Group.

**H_{05(10)}**: There is no significant relationship of Return on Equity with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Indian Private Banks Group.

**H_{05(11)}**: There is no significant relationship of Return on Equity with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Foreign Banks Group.

**H_{05(12)}**: There is no significant relationship of Return on Equity with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Loan Loss Provisioning in Private Sector Banks Group.

### 3.9 Econometric Models Framework and Description of Variables

The study mainly analyses the procyclical behaviour of public sector banks and private sector banks in India. It considers the impact of macroeconomic factors and bank specific factors on bank credit, non performing assets and capital buffer. In this study State Bank of India and its Associates (SBI Banks Group),
Nationalized Banks- Group, Foreign Banks- Group, Indian Private Banks-
Group, Public Sector Banks Group (SBI Banks Group and Nationalized Banks
Group), Private Sector Banks Group (Indian Private Banks Group and Foreign
Banks Group) and All Banks Group (SBI Banks Group, Nationalized Banks
Group, Indian Private Banks Group and Foreign Banks Group) have been
consider for study. In this study considering the total number of observations =
56 (each bank group 14 years data is available for the period 2000-2013), and
four bank groups (State bank of India & its Associates, Nationalized Banks,
Foreign Banks operating in India and Indian Private Banks), a Panel Data
Regression Model is suitable and hence used for the causal study.

Types of Data
Types of data that is generally available for empirical analysis namely:

i) Time-Series

ii) Cross-Section

iii) Panel

In time series data, the researcher studies the value of one or more variables
over a period of time like bank credit for several years.

In cross-section data, values of one or more variables are collected for several
sample units or entities, at the same point in time like different bank Groups
(SBI, Nationalized Banks, Indian Pvt. Banks and Foreign Banks) data on bank
deposits growth for a given year.

In panel data, the same cross-sectional unit (say a bank group Foreign Banks
Group) is reviewed over time. Panel data have space (cross-sections) as well as
time dimensions. It is also called as pooled data (polling of time series and
cross-sectional observations). In this study, there are six cross-sectional units
i.e. six bank groups (State bank of India & its Associates, Nationalized Banks,
Public Sector Banks, Indian Private Banks, Foreign Banks operating in India
and Private Sector Banks). In case of State bank of India & its Associates,
Nationalized Banks, Indian Private Banks and Foreign Banks operating in India
for each cross sectional unit (bank group), there is a time series data (for 14 years), and hence there are 14 observations. While in case of Public Sector Banks and Private Sector Banks for each cross sectional unit (bank group), there is a time series data (for 14 years*2 groups), and hence there are 28 observations for each public sector banks and private sector banks. In case of All Banks Group there is a time series data (for 14 years*4 groups), and hence there are 56 observations for each All Banks Group in a panel study.

Models for Objective 1

In order to study the impact of demand factors and supply factors on the bank credit, econometric models have been developed for demand side and supply side variables together. In this objective seven models have been proposed; one model each for SBI banks Group, Nationalized banks Group, Public sector banks Group, Indian Private banks Group, Foreign banks Group and Private sector banks Group. Model 1(1) to Model 1(6) includes only quantitative variable while Model 1(7) includes both quantitative and qualitative (Dummy) variables. Model 1 (1) studies the impact of demand factors (Gross Domestic Product (GDP) and Inflation (INF)) and supply factors (Cash Reserve Ratio (CRR), Capital Buffer (CB), Bank Deposit (BD) and Gross NPA Ratio (GNPA) on bank credit (BC) extended by State Bank of India and its Associates banks Group. Model 1 (2) studies the impact of demand factors (Gross Domestic Product (GDP) and Inflation (INF)) and supply factors (Cash Reserve Ratio (CRR), Capital Buffer (CB), Bank Deposit (BD) and Gross NPA Ratio (GNPA) on bank credit (BC) extended by nationalized banks Group. Model 1 (3) studies the impact of demand factors (Gross Domestic Product (GDP) and Inflation (INF)) and supply factors (Cash Reserve Ratio (CRR), Capital Buffer (CB), Bank Deposit (BD) and Gross NPA Ratio (GNPA) on bank credit (BC) extended by Indian private banks Group. Model 1 (4) studies the impact of demand factors (Gross Domestic Product (GDP) and Inflation (INF)) and supply factors (Cash Reserve Ratio (CRR), Capital Buffer (CB), Bank Deposit (BD) and Gross NPA Ratio (GNPA) on bank credit (BC) extended by private sector banks Group.
Bank Deposit (BD) and Gross NPA Ratio (GNPA) on bank credit (BC) extended by Foreign banks Group. **Model 1 (5)** studies the impact of demand factors (Gross Domestic Product (GDP) and Inflation (INF)) and supply factors (Cash Reserve Ratio (CRR), Capital Buffer (CB), Bank Deposit (BD) and Gross NPA Ratio (GNPA) on bank credit (BC) extended by Public Sector Banks Group. **Model 1 (6)** studies the impact of demand factors (Gross Domestic Product (GDP) and Inflation (INF)) and supply factors (Cash Reserve Ratio (CRR), Capital Buffer (CB), Bank Deposit (BD) and Gross NPA Ratio (GNPA) on bank credit (BC) extended by Private Sector Banks Group. **Model 1 (7)** which include both quantitative and qualitative variables, studies the impact of demand factors (Gross Domestic Product (GDP) and Inflation (INF)) and supply factors (Cash Reserve Ratio (CRR), Capital Buffer (CB), Bank Deposit (BD), Gross NPA Ratio (GNPA) and Dummy variable which captures the ownership effect (DBG) on bank credit (BC) extended by All Banks Group.

The study has been carried out on four bank groups
- State Bank of India and its Associates (SBI Banks Group)
- Nationalized Banks Group
- Foreign Banks Group
- Indian Private Banks Group

Public Sector Banks Group is grouped as SBI Banks Group and Nationalized Banks Group. Private Sector Banks Group is grouped as Indian Private Banks Group and Foreign Banks Group. All Banks Group is grouped as SBI Banks Group, Nationalized Banks Group, Indian Private Banks Group and Foreign Banks Group.

However, the researcher has taken an assumption that same demand and supply function is applicable to all four banks groups mentioned above.
Specification of variables used in model for Objective-1

1. Bank Credit (BC)
Bank Credit is defined as the amount of credit available to a company or individual from the banking system. In this study bank credit is described as bank credit adjusted by GDP deflator and used in log levels.

Bank credit adjusted by GDP deflator and used in log levels is used as dependent variable in this study.

2. Gross Domestic Product (GDP)
Current state of economy is reflected through the variable Gross Domestic Product. Gross Domestic Product is defined as GDP at factor cost at constant price. GDP is Gross Domestic Product defined as the market value of all officially recognized final goods and services produced within a country in a year.

Gross Domestic Product is used as independent variable in this study.

3. Inflation (INF)
Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. Inflation and interest rates are associated, and often referenced in macroeconomics. Inflation refers to the rate at which prices for goods and services rises. Higher inflation forced central bank to raise interest rate on loans and advances.

Inflation adjusted by GDP deflator is used as Independent Variable in this study.
4. Cash Reserve Ratio (CRR)
Cash Reserve Ratio (CRR) is a specified minimum fraction of the total deposits of customers, which commercial banks have to hold as reserves either in cash or as deposits with the central bank. CRR is a crucial monetary policy tool and is used for controlling money supply in an economy.

Cash Reserve Ratio (CRR) is used as independent variable in this study.

5. Capital Buffer (CB)
Capital Buffer is defined as mandatory capital that banks are required to hold in addition to other minimum capital requirements. In this study the difference between capital adequacy ratios of bank group and minimum required regulatory capital requirements is taken as capital buffer.

Capital buffer is taken as independent variable in this study.

6. Bank Deposits (BD)
The core business of banks is to accept the deposit from customer and provide the credit to borrowers. Deposits are the major source of finance for providing credit by the bank.

In this study bank deposits are taken as bank deposit adjusted by GDP deflator and used in log levels. Bank deposit is taken as independent variable in this study.

7. Gross NPA Ratio (GNPA)
NPA is defined as loans & advances for which interest or repayment of principle or both remain outstanding for a period of more than two quarters. NPA act as an indicator which shows the bankers credit risk and efficiency of allocation of resources.
In this study Gross NPA Ratio is used as an appropriate measure of Non Performing Assets.

\[
\text{Gross NPA Ratio} = \frac{\text{Gross NPA}}{\text{Gross Advances}}
\]

In this study Gross NPA Ratio is taken as independent variable.

8. Dummy Variable for Bank Group (DBG)

Dummy variable for bank group is used as independent variable and it captures the effect of ownership in panel regression model.

**Model 1(1): Impact of Demand Function and Supply Function on Bank Credit adjusted by GDP deflator and used in log levels of SBI Banks Group.**

**Panel Data Linear Regression Model**

(Slope coefficients and Intercept constant across Bank Groups)

\[
\text{BC}_{it} = \beta_0 + \beta_1 \text{GDP}_{1it} + \beta_2 \text{INF}_{2it} + \beta_3 \text{CRR}_{3it} + \beta_4 \text{CB}_{4it} + \beta_5 \text{BD}_{5it} + \beta_6 \text{GNPA}_{6it} + \mu_{it}
\]

\(\beta_0\) = Intercept

\(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6\) = Slope Coefficients of GDP, INF, CRR, CB, BD and GNPA.

\(\mu_{it}\) = Error term.

Dependent Variable = BC

Independent Variable = GDP, INF, CRR, CB, BD and GNPA.

BC = Bank Credit adjusted by GDP deflator and used in log levels.

GDP = Gross Domestic Product.

INF = Inflation adjusted by GDP deflator.

CRR = Cash Reserve Ratio

CB = Capital Buffer
BD = Bank deposit adjusted by GDP deflator used in log levels.
GNPA = Gross NPA Ratio.
i stands for ith cross – sectional unit i.e. SBI Banks group
t stands for the t\textsuperscript{th} time period (From year 2000-2013)

**Model 1(2): Impact of Demand Function and Supply Function on Bank Credit adjusted by GDP deflator and used in log levels of Nationalized Banks Group.**

**Panel Data Linear Regression Model**
(Slope coefficients and Intercept constant across Bank Groups)

\[
BC_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 INF_{2it} + \beta_3 CRR_{3it} + \beta_4 CB_{4it} + \beta_5 BD_{5it} + \beta_6 GNPA_{6it} + \mu_{it}
\]

\(\beta_0\) = Intercept
\(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6\) = Slope Coefficients of GDP, INF, CRR, CB, BD and GNPA.
\(\mu_{it}\) = Error term.
Dependent Variable = BC
Independent Variable = GDP, INF, CRR, CB, BD and GNPA.
BC = Bank Credit adjusted by GDP deflator and used in log levels.
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
CRR = Cash Reserve Ratio
CB = Capital Buffer
BD = Bank deposit adjusted by GDP deflator used in log levels.
GNPA = Gross NPA Ratio.
i stands for ith cross – sectional unit i.e. Nationalized Banks group
t stands for the t\textsuperscript{th} time period (From year 2000-2013)
Model 1(3): Impact of Demand Function and Supply Function on Bank Credit adjusted by GDP deflator and used in log levels of Indian Private Banks Group.

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ BC_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 INF_{2it} + \beta_3 CRR_{3it} + \beta_4 CB_{4it} + \beta_5 BD_{5it} + \beta_6 GNPA_{6it} + \mu_{it} \]

\( \beta_0 = \) Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 = \) Slope Coefficients of GDP, INF, CRR, CB, BD and GNPA.
\( \mu_{it} = \) Error term.

Dependent Variable = BC
Independent Variable = GDP, INF, CRR, CB, BD and GNPA.
BC = Bank Credit adjusted by GDP deflator and used in log levels.
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
CRR = Cash Reserve Ratio
CB = Capital Buffer
BD = Bank deposit adjusted by GDP deflator used in log levels.
GNPA = Gross NPA Ratio.
i stands for ith cross-sectional unit i.e. Indian Private Banks Group
\( t \) stands for the \( t^{th} \) time period (From year 2000-2013)
Model 1(4): Impact of Demand Function and Supply Function on Bank Credit adjusted by GDP deflator and used in log levels of Foreign Banks Group.

Panel Data Linear Regression Model

(Slope coefficients and Intercept constant across Bank Groups)

\[ BC_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 INF_{2it} + \beta_3 CRR_{3it} + \beta_4 CB_{4it} + \beta_5 BD_{5it} + \beta_6 GNPA_{6it} + \mu_{it} \]

\( \beta_0 = \) Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 = \) Slope Coefficients of GDP, INF, CRR, CB, BD and GNPA.
\( \mu_{it} = \) Error term.

Dependent Variable = BC
Independent Variable = GDP, INF, CRR, CB, BD and GNPA.
BC = Bank Credit adjusted by GDP deflator and used in log levels.
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
CRR = Cash Reserve Ratio
CB = Capital Buffer
BD = Bank deposit adjusted by GDP deflator used in log levels.
GNPA = Gross NPA Ratio.
i stands for ith cross – sectional unit i.e. Foreign Banks group
t stands for the \( t^{th} \) time period (From year 2000-2013)
Model 1(5): Impact of Demand Function and Supply Function on Bank Credit adjusted by GDP deflator and used in log levels of Public Sector Banks Group.

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

$$BC_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 INF_{2it} + \beta_3 CRR_{3it} + \beta_4 CB_{4it} + \beta_5 BD_{5it} + \beta_6 GNPA_{6it} + \mu_{it}$$

$\beta_0$ = Intercept
$\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$, $\beta_6$ = Slope Coefficients of GDP, INF, CRR, CB, BD and GNPA.
$\mu_{it}$ = Error term.
Dependent Variable= BC
Independent Variable = GDP, INF, CRR, CB, BD and GNPA.
BC = Bank Credit adjusted by GDP deflator and used in log levels.
GDP = Gross Domestic Product.
INF= Inflation adjusted by GDP deflator.
CRR = Cash Reserve Ratio
CB = Capital Buffer
BD = Bank deposit adjusted by GDP deflator used in log levels.
GNPA = Gross NPA Ratio.
i stands for ith cross – sectional unit i.e. Public Sector Banks group (1.SBI Banks Group and 2. Nationalized Banks Group)
t stands for the t\textsuperscript{th} time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 1(6): Impact of Demand Function and Supply Function on Bank Credit adjusted by GDP deflator and used in log levels of Private Sector Banks Group.

**Panel Data Linear Regression Model**

(Slope coefficients and Intercept constant across Bank Groups)

\[
BC_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 INF_{2it} + \beta_3 CRR_{3it} + \beta_4 CB_{4it} + \beta_5 BD_{5it} + \beta_6 GNPA_{6it} + \mu_{it}
\]

\(\beta_0 = \text{Intercept}\)

\(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 = \text{Slope Coefficients of GDP, INF, CRR, CB, BD and GNPA.}\)

\(\mu_{it} = \text{Error term.}\)

**Dependent Variable= BC**

**Independent Variable = GDP, INF, CRR, CB, BD and GNPA.**

**BC = Bank Credit adjusted by GDP deflator and used in log levels.**

**GDP = Gross Domestic Product.**

**INF = Inflation adjusted by GDP deflator.**

**CRR = Cash Reserve Ratio**

**CB = Capital Buffer**

**BD = Bank deposit adjusted by GDP deflator used in log levels.**

**GNPA = Gross NPA Ratio.**

i stands for ith cross – sectional unit i.e. Private Sector Banks Group (Indian Private Banks Group and Foreign Banks Group).

\(t\) stands for the \(t^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 1(7): Impact of Demand Function and Supply Function on Bank Credit adjusted by GDP deflator and used in log levels of All Banks Group.

Fixed Effects Regression Model (Supply Function)

OR

Least Square Dummy Variable (LSDV) Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ BC_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 INF_{2it} + \beta_3 CRR_{3it} + \beta_4 CB_{4it} + \beta_5 BD_{5it} + \beta_6 GNPA_{6it} + \beta_7 DBG_{7it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7 \) = Slope Coefficients of GDP, INF, CRR, CB, BD and GNPA and DBG.
\( \mu_{it} \) = Error term.

Dependent Variable = BC
Independent Variable = GDP, INF, CRR, CB, BD and GNPA.
BC = Bank Credit adjusted by GDP deflator and used in log levels.
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
CRR = Cash Reserve Ratio
CB = Capital Buffer
BD = Bank deposit adjusted by GDP deflator used in log levels.
GNPA = Gross NPA Ratio.
DBG = Dummy variable representing ownership.

DPG = 1, if the observation belongs to Private Sector Banks (Indian Private Banks Group and Foreign Banks Group) Otherwise 0.
i stands for ith cross-sectional unit i.e. All Banks Group (1. Public Sector Banks Group (SBI Banks Group and Nationalized Banks Group) and 2. Private Sector Banks Group (Indian Private Banks Group and Foreign Banks Group)).

\( t \) stands for the \( t^{th} \) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 56 observations studied in this model

**Granger Causality Test for Objective 2**

In order to study the lead-lag pattern in the interaction between growth cycles of India and credit cycles of State Bank of India and its Associates Group, Nationalized Banks Group, Foreign Banks Group, Indian Private Banks Group, Public Sector Banks Group, Private Sector Banks Group and All Banks Group, the **Granger Causality test** has been used in which Bank Credit used in log levels and Gross Domestic Product are analyzed.

Granger causality tests represent the methodology used to see whether bank credit leads or lags GDP growth. These tests are done on GDP growth/growth rate cycles to understand the direction of causality from bank credit to GDP growth or from GDP growth to bank credit. The proponents of growth cycles believe that any annual macroeconomic series is composed of three components: trend, cycle and a random term. Trend component shows the permanent growth in the series and the cyclical component shows ups and downs in the economy. The cyclical component gives a better picture of the lead-lag relationship between credit and growth cycle. (Krittika Banerjee, 2011)

Extracting a cycle involves identifying a series as I (1) i.e. with a unit root. If \( Y_t \sim I(1) \) then it is possible to decompose \( Y_t \) into a non stationary deterministic / stochastic trend component \( P_t \) and a stationary \([I(0)]\) cyclical component \( C_t \), such that \( Y_t = P_t + C_t \). Here, stochastic trend \( P_t \) captures shocks that have permanent effects on the level of GDP and the stationary component \( C_t \)
represents the temporary effects of shocks. For the extraction of cycles the Hodrick–Prescott Filter method was used. Further, both Granger causality tests need the series to be stationary. This is to avoid the folly of non-sense or spurious regression. So the extracted cyclical series being stationary time series can be used in analysis. To determine the stationarity of the series Augmented Dickey Fuller test (ADF) and the Phillips-Perron (PP) tests were used. To bring a uniformity in the stationarity of all the series used for causality analysis, only intercept was included in the test equations of the unit root tests, in effect testing whether the series is difference-stationary or not. (Krittika Banerjee, 2011).

Now it is important to use the number of lagged terms in the causality tests. The number of lagged term is important in determining direction of causality. There are possibilities that causality is witnessed at higher lags. Number of lagged terms used in Granger Causality Analysis is determining by using Schwartz Information Criterion and Akaike Information Criterion. In this study Schwartz Information Criterion is taken as basis for determining the number of lagged terms used. It is considered that lag is optimum at which the Schwartz Information Criterion takes the minimum value and the VAR is stable as well, i.e. all roots of the VAR are less than 1. For determining number of lagged terms using Schwartz Information Criterion the researcher used Unrestricted VAR-Optimal Lag Selection

**Specification of variables used in Granger Causality Test**

1. Bank Credit (BG)

Bank Credit is defined as the amount of loans and advances or credit available to a company of individual from the banking system.

Bank Credit used in log levels is used in this study.
2. Gross Domestic Product (GDP)

GDP is Gross Domestic Product defined as the market value of all officially recognized final goods and services produced within a country in a year.

The health of economy is reflected through the variable Gross Domestic Product. In this analysis Gross Domestic Product is defined as GDP at factor cost at constant price. Economic Cycle is also known as Growth cycle or Output Cycle.

Models for Objective 3

In order to study the impact of Credit Inclination, Unsecured Lending, Cost Condition, Interest Return on Assets, Economy Wide Fluctuations, Current state of economy and Inflation on Gross NPA Ratio of State Bank of India and its Associates Group, Nationalized Banks Group, Foreign Banks Group, Indian Private Banks Group, Public Sector Banks Group, Indian Private Sector Banks Group, Indian Public Sector Banks Group and All Banks Group, econometrics models have been developed. In the models panel data regression is used. In objective 3 total 19 models are proposed. Model 3(1) to Model 3(18) includes only quantitative variable are used while Model 3 (19) includes both quantitative and qualitative (Dummy) variables. Model 3 (1) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Interest Return on Assets (IRA), Loan Maturity (LM), Economy wide Fluctuations(EWF) and Current state of economy (GDP) on Gross NPA Ratio of State Bank of India and its Associates Banks Group. Model 3 (2) includes macroeconomic variables and studies the impact of Economy wide Fluctuations (EWF), Current state of economy (GDP) and Inflation (INF) on Gross NPA Ratio of State Bank of India and its Associates Banks Group. Model 3 (3) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Loan Maturity (LM) and Interest Return on Assets (IRA) on Gross NPA Ratio of State Bank of India and its Associates Banks Group.
Model 3 (4) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Interest Return on Assets (IRA), Loan Maturity (LM), Economy wide Fluctuations (EWF) and Current state of economy (GDP) on Gross NPA Ratio of Nationalized Banks Group. Model 3 (5) includes macroeconomic variables and studies the impact of Economy wide Fluctuations (EWF), Current state of economy (GDP) and Inflation (INF) on Gross NPA Ratio of Nationalized Banks Group. Model 3 (6) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Loan Maturity (LM) and Interest Return on Assets (IRA) on Gross NPA Ratio of Nationalized Banks Group.

Model 3 (7) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Interest Return on Assets (IRA), Loan Maturity (LM), Economy wide Fluctuations (EWF) and Current state of economy (GDP) on Gross NPA Ratio of Public Sector Banks Group. Model 3 (8) includes macroeconomic variables and studies the impact of Economy wide Fluctuations (EWF), Current state of economy (GDP) and Inflation (INF) on Gross NPA Ratio of Public Sector Banks Group. Model 3 (9) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Loan Maturity (LM) and Interest Return on Assets (IRA) on Gross NPA Ratio of Public Sector Banks Group.

Model 3 (10) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Interest Return on Assets (IRA), Loan Maturity (LM), Economy wide Fluctuations (EWF) and Current state of economy (GDP) on Gross NPA Ratio of Indian Private Banks Group. Model 3 (11) includes macroeconomic variables and studies the impact of Economy wide Fluctuations (EWF), Current state of economy (GDP) and Inflation (INF) on Gross NPA Ratio of Indian Private Banks Group. Model 3 (12) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Loan Maturity (LM) and Interest Return on Assets (IRA) on Gross NPA Ratio of Indian Private Banks Group.
Model 3 (13) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Interest Return on Assets (IRA), Loan Maturity (LM), Economy wide Fluctuations (EWF) and Current state of economy (GDP) on Gross NPA Ratio of Foreign Banks Group. Model 3 (14) includes macroeconomic variables and studies the impact of Economy wide Fluctuations (EWF), Current state of economy (GDP) and Inflation (INF) on Gross NPA Ratio of Foreign Banks Group. Model 3 (15) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Loan Maturity (LM) and Interest Return on Assets (IRA) on Gross NPA Ratio of Foreign Banks Group.

Model 3 (16) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Interest Return on Assets (IRA), Loan Maturity (LM), Economy wide Fluctuations (EWF) and Current state of economy (GDP) on Gross NPA Ratio of Private Sector Banks Group. Model 3 (17) includes macroeconomic variables and studies the impact of Economy wide Fluctuations (EWF), Current state of economy (GDP) and Inflation (INF) on Gross NPA Ratio of Private Sector Banks Group. Model 3 (18) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Loan Maturity (LM) and Interest Return on Assets (IRA) on Gross NPA Ratio of Private Sector Banks Group.

Model 3 (19) studies the impact of Credit Inclination (CI), Unsecured Lending (USL), Cost Condition (CC), Interest Return on Assets (IRA), Loan Maturity (LM), Economy wide Fluctuations (EWF), Current state of economy (GDP) and Dummy variable which capture ownership effect on Gross NPA Ratio of All Banks Group.

The study has been carried out on four bank groups

✦ State Bank of India and its Associates (SBI Banks Group)
✦ Nationalized Banks Group
✦ Foreign Banks Group
♦ Indian Private Banks Group

Public Sector Banks Group is grouped as SBI Banks Group and Nationalized Banks Group. Private Sector Banks Group is grouped as Indian Private Banks Group and Foreign Banks Group. All Banks Group is grouped as SBI Banks Group, Nationalized Banks Group, Indian Private Banks Group and Foreign Banks Group.

However, the researcher has taken an assumption that same macroeconomic and bank specific variables are applicable to all four banks groups mentioned above. In above models there are two measures of economic activity is consider for study – 1. Current Year’s GDP 2. Economy Wide Fluctuations (Misra and Dhal, 2010)

**Specification of variables used in model for Objective-3**

1. Non Performing Assets (NPA)

NPA is defined as loans & advances for which interest or repayment of principle or both remain outstanding for a period of more than two quarters. NPA act as an indicator which shows the bankers credit risk and efficiency of allocation of resources.

In this study Gross NPA Ratio is used as an appropriate measure of Non Performing Assets.

\[
\text{Gross NPA Ratio} = \frac{\text{Gross NPA}}{\text{Gross Advances}}
\]

Gross NPA ratio is used as dependent variable in this study.

2. Credit Inclination (CI)

It is commonly used statistics for assessing a bank’s liquidity by dividing the bank’s total credit by its total deposits. It is well known as Credit to Deposit Ratio. If this ratio is too high, it means that banks might not have enough
liquidity to cover any unforeseen condition. If this ratio is too low, banks may not be earning as much as they could be.

Credit Inclination = \( \frac{\text{Bank's Credit}}{\text{Bank's Deposit}} \)

Credit Inclination is used as independent variable in this study.

3. Loan Maturity (LM)

Loan Maturity is a technical way to express loan length. It is defined as the final date for making payments of a loan. Loan maturity had a negative impact on Gross NPA Ratio.

In this study Loan Maturity is defined as ratio of Bank’s Term Loan to Bank’s Total Loans (Misra and Dhal, 2010).

Loan Maturity = \( \frac{\text{Bank’s Term Loan}}{\text{Bank’s Total Loans}} \)

Loan Maturity is used as independent variable in this study.

4. Unsecured Lending (USL)

In unsecured lending, loan is issued and supported only by the borrower’s creditworthiness, rather than by a type of collateral. Borrowers shall have high credit rating to get an approval for an unsecured loan. If credit worthiness of borrowers is compromised while granting loans, it could leads to higher Non Performing Loans. If lending is done to high credit worthy borrowers then it would lead to lower Non Performing Loans.

Unsecured Lending = \( \frac{\text{Unsecured Loans}}{\text{Total Loans}} \)

Unsecured Lending is used as independent variable in this study.
5. Cost Condition (CC)

Cost Condition is an indicator of competitiveness in Banking-Operating Expenses as a proportion of total assets. It is an Intermediation cost of Banks. The intermediation cost of bank refers to the operating cost of the bank and includes all administration and operational costs incurred while offering its services.

\[
\text{Cost Condition} = \frac{\text{Intermediation Cost}}{\text{Total Assets}}
\]

Cost Condition is used as independent variable in this study.

6. Interest Return on Assets (IRA)

Interest Return on Assets gives an idea as to how efficient management is at using its assets to generate interest earnings.

\[
\text{Interest Return on Assets} = \frac{\text{Actual Interest Income}}{\text{Total Assets}}
\]

Interest Return on Assets is used as independent variable in this study.

7. Economy Wide Fluctuations (EWF)

Business Cycle (or Economic Cycle) refers to Economy Wide Fluctuations in production, trade and economic activity in general over several months or years in an economy. It refers to the period of expansions and contractions in the level of economic activities around its long term growth trend. It is also called as boom-bust cycle.

\[
\text{Economy Wide Fluctuations} = \text{Actual GDP (in logarithm scale) less its trend component (using Hodrick-Prescott trend)}
\]

Economic wide Fluctuation is used as independent variable in this study.
8. Current Year’s GDP (GDP)

Current state of economy is reflected through the variable Gross Domestic Product. Current Year’s GDP is defined as GDP at factor cost at constant price. GDP is Gross Domestic Product defined as the market value of all officially recognized final goods and services produced within a country in a year.

Current Years’ GDP is used as independent variable in this study.

9. Inflation Adjusted by GDP Deflator (INF)

Inflation as measured by the yearly growth rate of the GDP implicit deflator shows the rate of price change in the economy in total. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. Inflation and interest rates are associated, and often referenced in macroeconomics. Inflation refers to the rate at which prices for goods and services rises. Higher inflation forced central bank to raise interest rate on loans and advances.

Inflation adjusted by GDP deflator is used as independent variable in this study.
Model 3(1): Impact of Macroeconomic Factors and Bank Specific Factors on Gross NPA Ratio of SBI Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 EWF_{5it} + \beta_6 GDP_{6it} + \mu_{it} \]

- \( \beta_0 \) = Intercept
- \( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 \) = Slope Coefficients of CI, USL, CC, IRA, EWF and GDP.
- \( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, EWF and GDP.
GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending.
CC = Cost Conditions
IRA = Interest Return on Asset
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
i stands for ith cross – sectional unit i.e. SBI Banks Group
t stands for the t\( \text{th} \) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(2): Impact of Macroeconomic Factors on Gross NPA Ratio of SBI Banks Group.

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 EWF_{1it} + \beta_2 GDP_{2it} + \beta_3 INF_{3it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3 \) = Slope Coefficients of EWF, GDP and INF
\( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = EWF, GDP and INF.
GNPA = Gross NPA Ratio
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
i stands for ith cross-sectional unit i.e. SBI Banks Group
t stands for the t\textsuperscript{th} time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(3): Impact of Bank Specific Factors on Gross NPA Ratio of SBI Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 \) = Slope Coefficients of CI, USL, CC, IRA and LM
\( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM
GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending
CC = Cost Conditions
IRA = Interest Return on Asset
LM = Loan Maturity

i stands for ith cross-sectional unit i.e. SBI Banks Group
t stands for the t\(^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(4): Impact of Macroeconomic Factors and Bank Specific Factors on Gross NPA Ratio of Nationalized Banks Group

Panel Data Linear Regression Model

(Slope coefficients and Intercept constant across Bank Groups)

\[
GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \beta_6 EWF_{6it} + \beta_7 GDP_{7it} + \mu_{it}
\]

$\beta_0$ = Intercept

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ = Slope Coefficients of CI, USL, CC, IRA, LM, EWF and GDP respectively.

$\mu_{it}$ = Error term.

Dependent Variable = GNPA

Independent Variable = CI, USL, CC, IRA, LM, EWF and GDP.

GNPA = Gross NPA Ratio

CI = Credit Inclination.

USL = Unsecured Lending.

CC = Cost Conditions

IRA = Interest Return on Asset

LM = Loan Maturity

EWF = Economy Wide Fluctuations

GDP = Gross Domestic Product.

$i$ stands for $i$th cross-sectional unit i.e. Nationalized Banks Group

$t$ stands for the $t^{th}$ time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(5): Impact of Macroeconomic Factors on Gross NPA Ratio of Nationalized Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 EWF_{1it} + \beta_2 GDP_{2it} + \beta_3 INF_{3it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3 \) = Slope Coefficients of EWF, GDP and INF
\( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = EWF, GDP and INF.

GNPA = Gross NPA Ratio
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.

i stands for ith cross – sectional unit i.e. Nationalized Banks Group

\( t \) stands for the \( t^{th} \) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(6): Impact of Bank Specific Factors on Gross NPA Ratio of Nationalized Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

$$\text{GNPA}_{it} = \beta_0 + \beta_1 \text{CI}_{1it} + \beta_2 \text{USL}_{2it} + \beta_3 \text{CC}_{3it} + \beta_4 \text{IRA}_{4it} + \beta_5 \text{LM}_{5it} + \mu_{it}$$

$\beta_0 =$ Intercept
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5 =$ Slope Coefficients of CI, USL, CC, IRA and LM
$\mu_{it} =$ Error term.
Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM
GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending
CC = Cost Conditions
IRA = Interest Return on Asset
LM = Loan Maturity
i stands for ith cross-sectional unit i.e. Nationalized Banks Group.
t stands for the $t^{th}$ time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(7): Impact of Macroeconomic Factors and Bank Specific Factors on Gross NPA Ratio of Public Sector Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[
GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \beta_6 EWF_{6it} + \beta_7 GDP_{7it} + \mu_{it}
\]

\(\beta_0\) = Intercept
\(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7\) = Slope Coefficients of CI, USL, CC, IRA, LM, EWF and GDP respectively.
\(\mu_{it}\) = Error term.

Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM, EWF and GDP.

GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending.
CC = Cost Conditions
IRA = Interest Return on Asset
LM = Loan Maturity
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.

i stands for ith cross-sectional unit i.e. Public Sector Banks Group (SBI Banks Group and Nationalized Banks Group)
t stands for the t\(^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 3(8): Impact of Macroeconomic Factors on Gross NPA Ratio of Public Sector Banks Group.

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 EWF_{1it} + \beta_2 GDP_{2it} + \beta_3 INF_{3it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3 \) = Slope Coefficients of EWF, GDP and INF
\( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = EWF, GDP and INF.

GNPA = Gross NPA Ratio
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
i stands for ith cross-sectional unit i.e. Public Sector Banks Group (SBI Banks Group and Nationalized Banks Group)
t stands for the \( t^{th} \) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 3(9): Impact of Bank Specific Factors on Gross NPA Ratio of Public Sector Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 = \) Slope Coefficients of CI, USL, CC, IRA and LM
\( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM
GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending
CC = Cost Conditions
IRA = Interest Return on Asset
LM = Loan Maturity

i stands for ith cross-sectional unit i.e. Public Sector Banks Group (SBI Banks Group and Nationalized Banks Group)
t stands for the t\(^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 3(10): Impact of Macroeconomic Factors and Bank Specific Factors on Gross NPA Ratio of Indian Private Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \beta_6 EWF_{6it} + \beta_7 GDP_{7it} + \mu_{it} \]

\( \beta_0 = \) Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7 = \) Slope Coefficients of CI, USL, CC, IRA, LM, EWF and GDP respectively.
\( \mu_{it} = \) Error term.

Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM, EWF and GDP.
GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending.
CC = Cost Conditions
IRA = Interest Return on Asset
LM = Loan Maturity
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.

i stands for ith cross-sectional unit i.e. Indian Private Banks- Group.
t stands for the t\(^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(11): Impact of Macroeconomic Factors on Gross NPA Ratio of Indian Private Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ \text{GNPA}_{it} = \beta_0 + \beta_1 \text{EWF}_{1it} + \beta_2 \text{GDP}_{2it} + \beta_3 \text{INF}_{3it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3 \) = Slope Coefficients of EWF, GDP and INF
\( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = EWF, GDP and INF.
GNPA = Gross NPA Ratio
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
i stands for ith cross-sectional unit i.e. Indian Private Banks- Group.
t stands for the t\textsuperscript{th} time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(12): Impact of Bank Specific Factors on Gross NPA Ratio of Indian Private Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \mu_{it} \]

\(\beta_0\) = Intercept
\(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5\) = Slope Coefficients of CI, USL, CC, IRA and LM
\(\mu_{it}\) = Error term.

Dependent Variable= GNPA
Independent Variable = CI, USL, CC, IRA, LM
GNPA= Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending
CC = Cost Conditions
IRA = Interest Return on Asset
LM= Loan Maturity

i stands for ith cross – sectional unit i.e. Indian Private Banks- Group.
t stands for the t\(^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(13): Impact of Macroeconomic Factors and Bank Specific Factors on Gross NPA Ratio of Foreign Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ \text{GNPA}_{it} = \beta_0 + \beta_1 \text{CI}_{1it} + \beta_2 \text{USL}_{2it} + \beta_3 \text{CC}_{3it} + \beta_4 \text{IRA}_{4it} + \beta_5 \text{LM}_{5it} + \beta_6 \text{EWF}_{6it} + \beta_7 \text{GDP}_{7it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7 \) = Slope Coefficients of CI, USL, CC, IRA, LM, EWF and GDP respectively.
\( \mu_{it} \) = Error term.
Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM, EWF and GDP.
GNPA= Gross NPA Ratio.
CI = Credit Inclination.
USL = Unsecured Lending.
CC = Cost Conditions.
IRA = Interest Return on Asset.
LM = Loan Maturity.
EWF = Economy Wide Fluctuations.
GDP = Gross Domestic Product.
i stands for ith cross-sectional unit i.e. Foreign Banks Group.
t stands for the t\textsuperscript{th} time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(14): Impact of Macroeconomic Factors on Gross NPA Ratio of Foreign Banks- Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ \text{GNPA}_{it} = \beta_0 + \beta_1 \text{EWF}_{1it} + \beta_2 \text{GDP}_{2it} + \beta_3 \text{INF}_{3it} + \mu_{it} \]

- \( \beta_0 \) = Intercept
- \( \beta_1, \beta_2, \beta_3 \) = Slope Coefficients of EWF, GDP and INF
- \( \mu_{it} \) = Error term.

Dependent Variable= GNPA
Independent Variable = EWF, GDP and INF.
GNPA= Gross NPA Ratio
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
i stands for ith cross – sectional unit i.e. Foreign Banks- Group.
t stands for the t\(^{th}\) time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 \) = Slope Coefficients of CI, USL, CC, IRA and LM
\( \mu_{it} \) = Error term.

Dependent Variable= GNPA
Independent Variable = CI, USL, CC, IRA, LM
GNPA= Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending
CC = Cost Conditions
IRA = Interest Return on Asset
LM= Loan Maturity

i stands for ith cross – sectional unit i.e. Foreign Banks- Group

\( t \) stands for the \( t^{th} \) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 3(16): Impact of Macroeconomic Factors and Bank Specific Factors on Gross NPA Ratio of Private Sector Banks Group.

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \beta_6 EWF_{6it} + \beta_7 GDP_{7it} + \mu_{it} \]

\( \beta_0 = \) Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7 = \) Slope Coefficients of CI, USL, CC, IRA, LM, EWF and GDP respectively.
\( \mu_{it} = \) Error term.

Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM, EWF and GDP.
GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending.
CC = Cost Conditions
IRA = Interest Return on Asset
LM = Loan Maturity
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
i stands for ith cross – sectional unit i.e. Private Sector Banks Group (Indian Private Banks Group and Foreign Banks Group)
t stands for the t\(^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 3(17): Impact of Macroeconomic Factors on Gross NPA Ratio of Private Sector Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 EWF_{1it} + \beta_2 GDP_{2it} + \beta_3 INF_{3it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3 \) = Slope Coefficients of EWF, GDP and INF
\( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = EWF, GDP and INF.
GNPA = Gross NPA Ratio
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
INF = Inflation adjusted by GDP deflator.
i stands for ith cross-sectional unit i.e. Private Sector Banks Group (Indian Private Banks Group and Foreign Banks Group)
t stands for the t\textsuperscript{th} time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 3(18): Impact of Bank Specific Factors on Gross NPA Ratio of Private Sector Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 \) = Slope Coefficients of CI, USL, CC, IRA and LM
\( \mu_{it} \) = Error term.

Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM
GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending
CC = Cost Conditions
IRA = Interest Return on Asset
LM = Loan Maturity

i stands for ith cross-sectional unit i.e. Private Sector Banks Group (Indian Private Banks Group and Foreign Banks Group)
t stands for the t\textsuperscript{th} time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 3(19): Impact of Bank Specific Factors on Gross NPA Ratio of All Banks Group

Fixed Effects Regression Model (Supply Function)

OR

Least Square Dummy Variable (LSDV) Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[
GNPA_{it} = \beta_0 + \beta_1 CI_{1it} + \beta_2 USL_{2it} + \beta_3 CC_{3it} + \beta_4 IRA_{4it} + \beta_5 LM_{5it} + \beta_6 EWF_{6it} + \beta_7 GDP_{7it} + \beta_7 DBG_{7it} + \mu_{it}
\]

\(\beta_0 = \) Intercept
\(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8 = \) Slope Coefficients of CI, USL, CC, IRA, LM, EWF, GDP and DBG respectively.
\(\mu_{it} = \) Error term.

Dependent Variable = GNPA
Independent Variable = CI, USL, CC, IRA, LM, EWF, GDP and DBG.

GNPA = Gross NPA Ratio
CI = Credit Inclination.
USL = Unsecured Lending.
CC = Cost Conditions
IRA = Interest Return on Asset
LM = Loan Maturity
EWF = Economy Wide Fluctuations
GDP = Gross Domestic Product.
DBG = Dummy variable capturing ownership in banks.

DBG = 1, if the observation belongs to Public Sector Banks (SBI Banks- Group and Nationalized Banks Group) Otherwise 0.

i stands for ith cross – sectional unit i.e. All Banks Group (1.Public Sector Banks Group (SBI Banks Group and Nationalized Banks Group) and 2. Private Sector Banks Group (Indian Private Banks Group and Foreign Banks Group)).
t stands for the \( t^{th} \) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 56 observations studied in this model

Models for Objective 4

In order to study the impact of Gross Domestic Product, Lag Dependent variables, Risk, Return on Equity and Deposit to Total liabilities on capital buffer State Bank of India and its Associates Group, Nationalized Banks Group, Foreign Banks Group, Indian Private Banks Group, Public Sector Banks Group, Private Sector Banks Group and All Banks Group, econometric models have been developed. In the models panel data regression is or dummy variable regression analysis is used. In objective 4 total 07 models are proposed. Similar to objective 1, in objective 4 also seven models have been proposed; one model each for SBI banks Group, Nationalized banks Group, Public sector banks Group, Indian Private banks Group, Foreign banks Group, Private sector banks Group and All Banks Group. Model 4 (1) to Model 4 (6) includes only quantitative variable are used while Model 4 (7) includes both quantitative and qualitative (Dummy) variables are used. Model 4 (1) studies the impact of Gross Domestic Product (GDP), Lagged dependent variable (LDV), Gross NPA Ratio (Risk), Return on Equity (ROE) and Deposit to total Liabilities (DTL) on capital buffer (CB) of SBI banks Group. Model 4 (2) studies the impact of Gross Domestic Product (GDP), Lagged dependent variable (LDV), Gross NPA Ratio (Risk), Return on Equity (ROE) and Deposit to total liabilities (DTL) on capital buffer (CB) of nationalized banks Group. Model 4 (3) studies the impact of Gross Domestic Product (GDP), Lagged dependent variable (LDV), Gross NPA Ratio (Risk), Return on Equity (ROE) and Deposit to total liabilities (DTL) on capital buffer (CB) of Public sector banks Group. Model 4 (4) studies the impact of Gross Domestic Product (GDP), Lagged dependent variable (LDV), Gross NPA Ratio (Risk), Return on Equity (ROE) and Deposit to total liabilities (DTL) on capital buffer (CB) of
Indian private banks Group. **Model 4** (5) studies the impact of Gross Domestic Product (GDP), Lagged dependent variable (LDV), Gross NPA Ratio (Risk), Return on Equity (ROE) and Deposit to total liabilities (DTL) on capital buffer (CB) of foreign banks Group. **Model 4** (6) studies the impact of Gross Domestic Product (GDP), Lagged dependent variable (LDV), Gross NPA Ratio (Risk), Return on Equity (ROE) and Deposit to total liabilities (DTL) on capital buffer (CB) of Private sector banks Group. **Model 4** (7) studies the impact of Gross Domestic Product (GDP), Lagged dependent variable (LDV), Gross NPA Ratio (Risk), Return on Equity (ROE), Deposit to total liabilities (DTL) and Dummy variable (DBG) on capital buffer (CB) of All banks Group.

The study has been carried out on four bank groups

- State Bank of India and its Associates (SBI Banks Group)
- Nationalized Banks Group
- Foreign Banks Group
- Indian Private Banks Group

Public Sector Banks Group is grouped as SBI Banks Group and Nationalized Banks Group. Private Sector Banks Group is grouped as Indian Private Banks Group and Foreign Banks Group. All Banks Group is grouped as SBI Banks Group, Nationalized Banks Group, Indian Private Banks Group and Foreign Banks Group.

However, the researcher has taken an assumption that same factors are used in determining the determinants of capital buffer applicable to all four banks groups mentioned above.
Specification of variables used in model for Objective-4

1. Capital Buffer (CB)
   Capital Buffer is defined as mandatory capital that banks are required to hold in addition to other minimum capital requirements.

   In this study the difference between capital adequacy ratios of bank group and minimum required regulatory capital requirements is taken as capital buffer. Capital buffer is taken as dependent variable in this study.

2. Gross Domestic Product (GDP)
   Current state of economy is reflected through the variable Gross Domestic Product. Gross Domestic Product is defined as GDP at factor cost at constant price. GDP is Gross Domestic Product defined as the market value of all officially recognized final goods and services produced within a country in a year.

   Gross Domestic Product is used as independent Variable in this study.

3. Lagged dependent variable (LDV)
   Lagged dependent variable is lagged variable of dependent variable. In this study lag 1 of dependent variable is used.

4. Gross NPA Ratio (RISK)
   NPA is defined as an advance for which interest or repayment of principle or both remain outstanding for a period of more than two quarters. NPA act as an indicator which shows the bankers credit risk and efficiency of allocation of resources. In this study Gross NPA Ratio is used as an appropriate measure of Non Performing Assets.

   \[
   \text{Gross NPA Ratio} = \frac{\text{Gross NPA}}{\text{Gross Advances}}
   \]
Gross NPA ratio is used as independent variable in this study which represents RISK. In this study RISK is taken as independent variable.

5. Return on Equity (ROE)
The amount of net income returned as a percentage of shareholders equity. Return on equity measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested.

ROE is expressed as a percentage and calculated as:

\[
\text{Return on Equity} = \frac{\text{Net Income}}{\text{Shareholder's Equity}}
\]

6. Deposit to Total Liabilities (DTL)
Deposit to total liabilities is a commonly used statistic for assessing a bank's liquidity by dividing the banks total deposits by total liabilities. This also known as DTL ratio is expressed as a percentage. If the ratio is too high, it means that banks might have enough liquidity to cover any unforeseen capital requirements.

\[
\text{Deposit to Total Liabilities} = \frac{\text{Bank Deposits}}{\text{Total Bank Liabilities}}
\]

7. Dummy Variable for Bank Group (DBG)
Dummy variable for bank group is used as independent variable and it captures the effect of ownership in panel regression model.
Model 4 (1): Impact of macroeconomic factors and bank specific factors on Capital Buffer of SBI Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[
CB_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 LDV_{2it} + \beta_3 RISK_{3it} + \beta_4 ROE_{4it} + \beta_5 DTL_{5it} + \mu_{it}
\]

- \(\beta_0\) = Intercept
- \(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5\) = Slope Coefficients of GDP, LDV, RISK, ROE and DTL respectively.
- \(\mu_{it}\) = Error term.

Dependent Variable = CB
Independent Variable = GDP, LDV, RISK, ROE and DTL.

CB = Capital Buffer.
GDP = Gross Domestic Product.
LDV = Lagged Dependent Variable.
RISK = Gross NPA Ratio.
ROE = Return on Equity
DTL = Deposit to Total Liabilities

i stands for \(i^{th}\) cross-sectional unit i.e. SBI Banks Group

\(t\) stands for the \(t^{th}\) time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 4 (2): Impact of macroeconomic factors and bank specific factors on Capital Buffer of Nationalized Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ CB_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 LDV_{2it} + \beta_3 RISK_{3it} + \beta_4 ROE_{4it} + \beta_5 DTL_{5it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 \) = Slope Coefficients of GDP, LDV, RISK, ROE and DTL respectively.
\( \mu_{it} \) = Error term.

Dependent Variable = CB
Independent Variable = GDP, LDV, RISK, ROE and DTL.
CB = Capital Buffer.
GDP = Gross Domestic Product.
LDV = Lagged Dependent Variable.
RISK = Gross NPA Ratio.
ROE = Return on Equity
DTL = Deposit to Total Liabilities

i stands for ith cross-sectional unit i.e. Nationalized Banks Group

\( t \) stands for the \( t^{th} \) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 4 (3): Impact of macroeconomic factors and bank specific factors on Capital Buffer of Public Sector Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ CB_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 LDV_{2it} + \beta_3 RISK_{3it} + \beta_4 ROE_{4it} + \beta_5 DTL_{5it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 \) = Slope Coefficients of GDP, LDV, RISK, ROE and DTL respectively.
\( \mu_{it} \) = Error term.
Dependent Variable = CB
Independent Variable = GDP, LDV, RISK, ROE and DTL.
CB = Capital Buffer.
GDP = Gross Domestic Product.
LDV = Lagged Dependent Variable.
RISK = Gross NPA Ratio.
ROE = Return on Equity
DTL = Deposit to Total Liabilities
\( i \) stands for ith cross-sectional unit i.e. Public Sector Banks Group (SBI Banks- Group and Nationalized Banks Group)
\( t \) stands for the \( t^{th} \) time period (From year 2000-2013)
Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 4 (4): Impact of macroeconomic factors and bank specific factors on Capital Buffer of Indian Private Banks Group.

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[
CB_{it} = \beta_0 + \beta_1 GDP_{1t} + \beta_2 LDV_{2t} + \beta_3 RISK_{3t} + \beta_4 ROE_{4t} + \beta_5 DTL_{5t} + \mu_{it}
\]

- \(\beta_0\) = Intercept
- \(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5\) = Slope Coefficients of GDP, LDV, RISK, ROE and DTL respectively.
- \(\mu_{it}\) = Error term.

Dependent Variable = CB
Independent Variable = GDP, LDV, RISK, ROE and DTL.

CB = Capital Buffer.
GDP = Gross Domestic Product.
LDV = Lagged Dependent Variable.
RISK = Gross NPA Ratio.
ROE = Return on Equity
DTL = Deposit to Total Liabilities

- \(i\) stands for \(i\)th cross-sectional unit i.e. Indian Private Banks Group
- \(t\) stands for the \(t^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 4 (5): Impact of macroeconomic factors and bank specific factors on Capital Buffer of Foreign Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ CB_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 LDV_{2it} + \beta_3 RISK_{3it} + \beta_4 ROE_{4it} + \beta_5 DTL_{5it} + \mu_{it} \]

\( \beta_0 \) = Intercept

\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 \) = Slope Coefficients of GDP, LDV, RISK, ROE and DTL respectively.

\( \mu_{it} \) = Error term.

Dependent Variable = CB
Independent Variable = GDP, LDV, RISK, ROE and DTL.
CB= Capital Buffer.
GDP = Gross Domestic Product.
LDV= Lagged Dependent Variable.
RISK= Gross NPA Ratio.
ROE= Return on Equity
DTL = Deposit to Total Liabilities

i stands for ith cross-section unit i.e. Foreign Banks Group

\[ t \] stands for the \( t^{th} \) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 14 observations studied in this model.
Model 4 (6): Impact of macroeconomic factors and bank specific factors on Capital Buffer of Private Sector Banks Group

Panel Data Linear Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ CB_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 LDV_{2it} + \beta_3 RISK_{3it} + \beta_4 ROE_{4it} + \beta_5 DTL_{5it} + \mu_{it} \]

\( \beta_0 \) = Intercept
\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 \) = Slope Coefficients of GDP, LDV, RISK, ROE and DTL respectively.
\( \mu_{it} \) = Error term.

Dependent Variable= CB
Independent Variable = GDP, LDV, RISK, ROE and DTL.
CB= Capital Buffer.
GDP = Gross Domestic Product.
LDV= Lagged Dependent Variable.
RISK = Gross NPA Ratio.
ROE= Return on Equity
DTL = Deposit to Total Liabilities

i stands for ith cross – sectional unit i.e. Private Sector Banks Group (Indian Private Banks Group and Foreign Banks Group)
t stands for the t\(^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 28 observations studied in this model.
Model 4 (7): Impact of macroeconomic factors and bank specific factors on Capital Buffer of All Banks Group

Fixed Effects Regression Model (Supply Function)

OR

Least Square Dummy Variable (LSDV) Regression Model
(Slope coefficients and Intercept constant across Bank Groups)

\[ CB_{it} = \beta_0 + \beta_1 GDP_{1it} + \beta_2 LDV_{2it} + \beta_3 RISK_{3it} + \beta_4 ROE_{4it} + \beta_5 DTL_{5it} + \beta_6 DBG_{7it} + \mu_{it} \]

\( \beta_0 \) = Intercept

\( \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6 \) = Slope Coefficients of GDP, LDV, RISK, ROE, DTL and Dummy variable respectively.

\( \mu_{it} \) = Error term.

Dependent Variable= CB

Independent Variable = GDP, LDV, RISK, ROE, DTL and DBG.

CB= Capital Buffer.

GDP = Gross Domestic Product.

LDV= Lagged Dependent Variable.

RISK= Gross NPA Ratio.

ROE= Return on Equity

DTL = Deposit to Total Liabilities

DBG= Dummy variable representing ownership in banks.

i stands for ith cross – sectional unit i.e. Public Sector Banks Group (SBI Banks Group and Nationalized Banks Group) and Private Sector Banks Group (Indian Private Banks Group and Foreign Banks Group)

t stands for the t\(^{th}\) time period (From year 2000-2013)

Since each cross-sectional unit (bank group) has the same number of time series observations, i.e. 14 yrs, in all total 56 observations studied in this model.
**Pearson Correlation Coefficient for Objective 5**

In order to study the relationship of profitability parameters- Return on Assets and Return on Equity with Gross Domestic Product, Economy Wide Fluctuations, Inflation, Capital Buffer, Bank Credit, Bank Deposit and Non Performing Assets in State Bank of India and its Associates Group, Nationalized Banks Group, Foreign Banks Group, Indian Private Banks Group, Public Sector Banks Group and Private Sector Banks Group, Pearson Correlation Test is used.

The study has been carried out on four bank groups:

- State Bank of India and its Associates (SBI Banks Group)
- Nationalized Banks Group
- Foreign Banks Group
- Indian Private Banks Group

Public Sector Banks Group is grouped as SBI Banks Group and Nationalized Banks Group. Private Sector Banks Group is grouped as Indian Private Banks Group and Foreign Banks Group. All Banks Group is grouped as SBI Banks Group, Nationalized Banks Group, Indian Private Banks Group and Foreign Banks Group.

**Specification of variables used in model for Objective-5**

1. Return on Assets (ROA)

Return on Assets is an indicator of how profitable a company is relative to its total assets. The formula for Return on Assets is:

\[
\text{Return on Assets} = \frac{\text{Net Income}}{\text{Total Assets}}.
\]

2. Return on Equity (ROE)

The amount of net income returned as a percentage of shareholders equity. Return on equity measures a corporation's profitability by revealing how much
profit a company generates with the money shareholders have invested.

Return on Equity = \frac{\text{Net Income}}{\text{Shareholder's Equity}}

3. Gross Domestic Product (GDP)
Current state of economy is reflected through the variable Gross Domestic Product. Gross Domestic Product is defined as GDP at factor cost at constant price. GDP is Gross Domestic Product defined as the market value of all officially recognized final goods and services produced within a country in a year.

4. Economy Wide Fluctuations (EWF)
Business Cycle (or Economic Cycle) refers to Economy Wide Fluctuations in production, trade and economic activity in general over several months or years in an economy. It refers to the period of expansions and contractions in the level of economic activities around its long term growth trend. It is also called as boom-bust cycle. It is also called as output gap.

\[
\text{Economy Wide Fluctuations} = \text{Actual GDP (in logarithm scale)} \text{ less its trend component (using Hodrick-Prescott trend)}
\]

5. Capital Buffer (CB)
Capital Buffer is defined as mandatory capital that banks are required to hold in addition to other minimum capital requirements. In this study the difference between capital adequacy ratios of bank group and minimum required regulatory capital requirements is taken as capital buffer.

6. Inflation (INF)
Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. Inflation and interest rates are associated, and often referenced in
macroeconomics. Inflation refers to the rate at which prices for goods and services rises. Higher inflation forced central bank to raise interest rate on loans and advances.

7. Bank Credit (BC)
Bank Credit is defined as the amount of credit available to a company or individual from the banking system. In this study bank credit is described as bank credit adjusted by GDP deflator and used in log levels.

8. Bank Deposits (BD)
The core business of banks is to accept the deposit from customer and provide the credit to borrowers. Deposits are the major source of finance for providing credit by the bank.

In this study bank deposits are taken as bank deposit adjusted by GDP deflator and used in log levels.

9. Loan Loss Provisioning
Loan loss provisioning is an expense kept aside by banks for cover up the losses due to bad loans or non performing assets. In absence of data on Loan Loss Provisioning Gross NPA is used as proxy for it. NPA is defined as an advance for which interest or repayment of principle or both remain outstanding for a period of more than two quarters.

In this study Gross NPA Ratio is used as an appropriate measure of Non Performing Assets and is used as a proxy for loan loss provisioning

\[
\text{Gross NPA Ratio} = \frac{\text{Gross NPA}}{\text{Gross Advances}}
\]