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**RESEARCH ARTICLE**

# CASE STUDY OF CONSUMER CREDIT SCORING: A PROPOSAL

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**ABSTRACT**

The research is an attempt to study the credit scoring methodology adopted by commercial banks in (Chennai) India. The study has focused on main personal finance products of commercial bank i.e. Home loan, Personal Loan and Vehicle Loan. The aim of this study is to highlight the factors affecting the internal and external credit scoring methods followed by the commercial banks and to consolidate the factors considered while scoring the personal finance application form. A qualitative research strategy, case study has been adopted as appropriate for this particular research area. The primary data has been collected through interview schedules and secondary sources from the newspaper, images and video interviews of bankers as well as credit bureaus employees. All the data sources have been analyzed using the new qualitative software known as QSR NVivo. It has been found that the factors which has effect on the credit information report and in turn on credit scores are payment history, high utilization of credit, higher percentage of personal loans and many new accounts opened recently.



## INTRODUCTION

Borrowing and lending has long history related to human behavior (Thomas *et al*., 2002). There is credit risk component associated with lending transactions, in order to reduce the credit risk, credit scoring methods are used to assess the credit worthiness of borrower. The information filled in the personal finance application form is used to develop a numerical score for each applicant (Lewis, 1992; Hand and Jacka, 1998; Thomas *et al*., 2002) and these scores was used to discriminate bad and good loans (Durand, 1941). Credit scores are broadly classified into two categories based on the method used to obtain scores, i.e. deductive or judgmental credit scoring and empirical or statistical credit scoring (Muller, 1997; Liu, 2001; Caire, 2004).

### Credit scoring definitions

The use of statistical models to transform relevant data into numerical measures that guide credit decisions is referred as credit scoring (Anderson, 2007). In order to reduce the credit risk, credit scoring is one of the important methods used by banks to classify customers as bad and good customers. The process of modeling creditworthiness of borrower by lenders in referred as credit scoring (Hand and Jacka, 1998). Credit means 'buy now, pay later'. It is derived from the Latin word "credo" which means 'I believe' or 'I trust in'. Scoring is the numerical expression to represent single quality. Credit scoring is defined as the transformation of qualitative data into numbers using statistical methods (Anderson, 2007). Credit scoring is used to determine the likelihood that consumers like to default on the personal finance products, using statistical methods. These methods are used to evaluate consumer loans (Gup and Kolari, 2005). Credit scoring is the most successful application of research in banking (Chuang and Lin, 2009; Sustersic *et al*., 2009). It had been very difficult for lender to expand efficiently their retail as well as commercial credit products, without using credit scoring techniques (Thomas *et al*., 2002).

### Judgment systems versus credit scoring systems

Credit scoring compares the characteristics of the consumer with other earlier period customers, who have availed loan and repaid as well. If the characteristics of the existing loan applicant are similar to the characteristics of those consumers who have availed loan and have defaulted, then the loan applicant tends to be rejected and if the characteristics are satisfactory like those, who have repaid their loans properly, then the applicant is granted loan. In general banks use two techniques for assessing the creditworthiness of consumer i.e. loan officer's subjective judgment or credit scoring (Crook, 1996). The strength of judgmental process lies with the in experience and common sense of the loan officer (Bailey, 2004). So, judgmental scoring techniques are associated with subjectivity, inconsistency and individual preferences motivating decisions (Al Amari, 2002).

On the other hand credit scoring models are most successful models used by commercial banks (Bailey, 2004). Credit scores are used in measuring the credit risk of the applicant (Bhatia, 2006). The historical data of previously sanctioned loans with qualitative techniques are used to develop credit scoring (Thomas *et al*., 2002). The main aim of the credit

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scoring is to categorize the loan applicant into bad or good, reject or accept, based on their predicted repaying behavior. Hence, credit scoring problems are more related to discrimination and classification problems (Johnson and Wichern, 1998). Statistical methods (parametric as well as nonparametric) and artificial intelligence approaches are proposed to help the credit decision of loan officers in sanctioning of loans (Thomas, 2000).

**Benefits and criticism of credit scoring**

Credit scoring requires less time and considers only those factors which are statistically significant and correlated (Crook, 1996). Credit scoring has more efficient processing time. It minimizes the credit process cost and efforts. It does fewer errors (Al Amari, 2002). Credit scoring techniques uses less customer information for taking decision (Chandler and Coffman, 1979).

Unless credit scoring has data for every variable, it misclassifies the borrower (Crook, 1996). Credit scoring models differ from one market to another and are very expensive to buy. Sometimes credit scoring technique used to reject the customer by changing his job (Al Amari, 2002).

## REVIEW OF LITERATURE

### *Credit scoring applications*

The concept of credit scoring is now as old as credit or other banking concepts (Banasik and Crook, 2010; Sarlija *et al*., 2009). Credit has been applied in many fields including finance and account (Landajo *et al*., 2007), marketing (Chaing *et al*., 2006), engineering and manufacturing (Dvir *et al*., 2006), health and medicine (Behrman *et al*., 2007). The credit scoring in accounting and finance is used for bankruptcy prediction (Nanni and Lumini, 2009), bankruptcy classification (Min and Jeong, 2009), scoring application (Crook *et al*, 2007; Huang *et al*, 2007; Huang *et al*, 2006), classification problems (Ben-David & Frank, 2009), financial distress (Mukkamala, *et al*., 2008) and financial decisions and financial returns (Yu *et al*, 2009). The application of credit scoring has got insight during the last couple of decades (Banasik and Crook, 2010), because of rise in demand for personal finance products offered by commercial banks. Credit scoring are mainly used by banks for personal finance products that includes home loan, vehicle loan and personal finance (Sustersic *et al*., 2009)

### *Determinants of credit scoring*

The main aim of the credit scores is to classify customers into good credit and bad credit (Lee *et al*., 2002) or forecast the bad creditors (Lim and Sohn, 2007). The credit score model are build based on gender, age, marital status, dependents having a telephone, educational level, occupation, time at present address and having a credit card (Sustersic *et al*, 2009). Apart from these factor house owner, monthly income, time at present job, bank accounts, loan amount, loan duration, having a car, mortgage, purpose of loan, guarantees etc are also used to score the customer. this list of variables is not limited, in some cases spouse personal information, such as age, salary, bank account are also used in developing the score cards (Orgler, 1971).

### *Credit scoring techniques*

The contributions of various researchers have been aggregated and presented in the following table 1.

**Table 1** contribution of various researchers towards credit scoring tools and techniques

| Author | Tools and Techniques |
|---|---|
| Orgler (1971), Lucas (1992), Henley (1995); Arminger *et al*., (1997), Desai *et al*., (1997), Hand and Henley, (1997); Hand and Jacka, 1998, West 2000,Baesens *et al*.,2003, Abdou *et al*.,2008, | Logistic Regression |
| Durand (1941), Altman (1968), Boyle *et al*.,1992, Henley 1995, Desai *et al*., 1996, Desai *et al*.,1997, Hand and Henley, 1997; Caouette *et al*., 1998; Hand *et al*., 1998; West 2000, Baesens *et al*., 2003, Malhotra and Malhotra 2003, Sarlija *et al*., 2004; Abdou and Pointon, 2009, | Discriminant Analysis |
| Grablowsky and Talley (1981); Guillen and Artis (1992); Pindyck and Rubinfeld, 1997; Maddala, 2001 | Probit Analysis |
| Baesens *et al*. (2003), Stefanowski and Wilk (2001), Thomas (2000), Fritz and Hosemann (2000), Hand and Jacka (1998), Henley and Hand (1996) and Coffman (1986), Paleologo *et al*. (2010), Breiman *et al*., 1984; Arminger *et al*., 1997, Breiman *et al*. (1984). Rosenberg and Gleit (1994 | DT or CART or recursive partitioning |
| Bishop, 1995; Masters, 1995; Arminger *et al*.,1997, Stefanowski and Wilk, 2001; Lee *et al*., 2002; Malhotra and Malhotra 2003, Kim and Sohn 2004; Zekic Susac *et al*., 2004, Lee and Chen 2005; Yim and Mitchell, 2005; Blochlinger and Leippold, 2006; Seow and Thomas, 2006; Abdou *et al*.,2007, Trinkle and Baldwin, 2007, | Neural Network |
| Koza, 1994; Teller and Veloso, 2000; Xia *et al*., 2000; McKee and Lensberg, 2002; Nunez Letamendia, 2002; Chen and Huang, 2003; Zhang and Bhattacharyya, 2004; Ong *et al*., 2005; Lensberg *et al*., 2006; Huang *et al*., 2006; Huang *et al*., 2007; Etemadi *et al*., 2009. | Genetic Programming |
| Sarkar and Sriram 2001, Sun and Shenoy, 2007 Liu *et al*., 2009, | Bayesian Model Markov Model |

**Sources:** *Compiled from various sources by researcher*

### *Credit scoring performance evaluation criteria*

Performance evaluation criteria, such as the confusion matrix or the Average Correct Classification (ACC) rate, the estimated misclassification cost, mean square error (MSE), root mean square error (RMSE), mean absolute error (MAE), the receiver operating characteristics (ROC) curve, GINI coefficient, and other criteria are all used in credit scoring applications under different fields.

The average correct classification rate is a significant criterion in evaluating the classification capability of the proposed scoring models. The idea of correct classification rates comes from a matrix, which is occasionally called "a confusion matrix" (Zhang *et al*., 2004), otherwise called a classification matrix (Abdou, 2009c). A classification matrix presents the combinations of the number of actual and predicted observations in a data-set. In Yang *et al*. (2004) study, the confusion matrix was compared with another two criteria: Mahalanobis Distance and Kolmogorov-Smirnov Statistics with reference to ROC curve. In other studies this matrix has been compared with MSE and RMSE (Kumar *et al*. 1995). The ROC curve illustrates the achieved overall performance with reference to all cut-off score points. The ROC curve illustrates the behaviour of classifiers with no regard to misclassification costs or different class distributions; therefore, it effectively separates classification performance from these features (Yang *et al*. 2004). The ROC curve identifies appropriate cut-off score points, whose scores can maximize the Kolmogorov-

Smirnov statistic, but it visualizes the details from the Kolmogorov-Smirnov statistic if the ROC is illustrated (Blochlinger & Leippold, 2006). It should be emphasized that there are other performance evaluation criteria, such as the GINI coefficient, which "gives one number that summarizes the performance of the scorecard over all cut-off scores" (Thomas *et al*., 2002), MSE, RMSE, MAE, and Goodness of Fit test or calibration (Paliwal & Kumar, 2009).

### *Failure Mode, Effect and Critical Analysis (FMECA)*

Failure Modes, Effects and Criticality Analysis (FMECA) is methodology designed to identify potential failure modes for a product or process before the problems occur, to assess the risk; Ideally, FMEA's are conducted in the product design or process development stages, although conducting an FMEA on existing products or processes may also yield benefits. The FMEA team determines, by failure mode analysis, the effect of each failure and identifies single failure points that are crucial. It may also rank each failure according to the criticality of a failure effect and its probability of occurring. The FMECA is the result of two steps: Failure Mode and Effect Analysis (FMEA) and Criticality Analysis (CA) (Benbow *et al*., 2002). With the use of FMEAs by engineers in the design process, it made easy to draw out failures and manufacture dependable, protected, and customer satisfying goods. *FMEAs* also carry chronological information for use in upcoming product development (Bergman and Klefsjo, 2010).

## METHODOLOGY

The research methodologies include the qualitative as well quantitative approaches in data collection as it involves both studying the existing credit scoring model as well as developing the new credit scoring model using failure mode, effects and criticality analysis (FMECA) method.

### *Research Objectives*

To find out the internal and external credit scoring methods used by the commercial banks for the applicants of personal finance.

To consolidate the factors that commercial banks consider while assessing the application for consumer personal finance.
To explore the positive and negative factors affecting the credit score of personal finance applicant.

To develop the credit scoring model using failure mode, effects and criticality analysis method.

### *Research Design*

This study is qualitative in nature under the case study method. Case study research design is of four types. The primary distinction between case study research strategies is between single and multiple cases designs. In another way case study differ in units of analysis as holistic and embedded case studies. Credit scoring has been studied for multiple cases i.e. public sector banks, private sector banks and foreign banks. In each bank multiple cases has been selected based on the branches as well as personal finance products. So, multiple embedded case study research design has been chosen for this study (Figure 1).

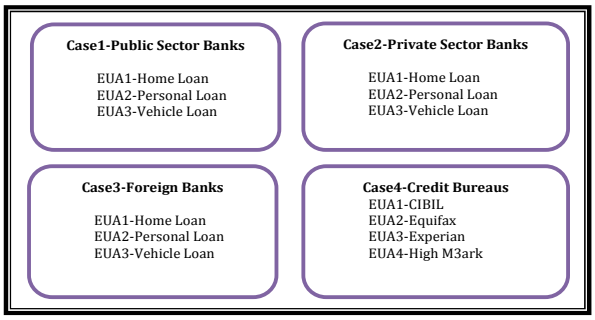


**Figure 1** Embedded Multiple Case Study Research Design

**Sources:** *Prepared by Rais Ahmad Itoo and A. Selvarasu*

### *Research Problem*

The global recession which came in 2008 has negatively impacted the minds of many people, which was triggered by United States financial sector. It pushes for the importance of credit risk management in banking as well as non-banking sectors. Credit risk is the popular risk which both financial as well as non financial sector deal with. Credit risk or default risk occurs when borrowers fails to repay his loan obligations (Greuning & Bratanovic, 2009). Credit risk department is to manage or to minimize the risk exposure and occurrence. There are different tools used by commercial banks, which differ in factors used for developing the technique as well as their respective weightage. So, banks need to use updated credit risk assessment techniques and assess the factors which need to be considered while scoring the borrower.

Non-performing assets (NPA) is a negative financial indicator A healthy banking sector is indication of healthy economy Banks should avoid providing loans to the borrowers whose creditworthiness is not up to the mark. Credit worthiness of borrower is measured by adopting certain credit measures. Indian banking sector has depressed because of rise in NPA (Veerakumar, 2012). In order to bring down the level of NPA, banks has adopted risk assessment tools. The credit risk assessment tool used by Indian commercial banks is credit scores and credit information reports general internally by banks or externally by credit bureaus like CIBIL, High Mark, Equifax or Experian. As the time passes the behavior of people keep on changing, this drift in population outdates the credit scoring. So there is need to study the factors which has effect on credit risk assessment techniques. Keeping all the above problems in mind, researcher wants to study the consumer credit scoring of personal finance by commercial banks.

### *Conceptual Model and Work Plan*

Credit scoring is defined as the use of statistical models to transform relevant data into numerical measures that guide credit officers in taking decisions (Anderson, 2007). Credit scoring is a technique where scores are assigned for each loan application form factors based on the behavior of past customers and prediction of behavior of current customer. The factors assessed from the loan application form are divided into four categories i.e. demographic, employment, financial and behavioral. Maximum scores are assigned to each item of these four dimensions and scores of current customers are calculated, depending on the cutoff score the application is

rejected or accepted. This study is about the credit scoring of personal finance products done by commercial banks, internally within banks as well as externally with credit bureaus. This study covers commercial banks in India, which are divided into three categories i.e. public sector banks, private sector banks and foreign banks which offer different personal finance products to their customers as per their needs. This study is focused on secured loans i.e. Home loans and Vehicle loan as well as unsecured loans i.e. Personal loans. Almost all the commercial banks are offering all the personal finance products. The credit risk component associated with them is assessed using the internal credit scoring methods and taking credit reports as well as credit scores generated by credit bureaus currently operating in India i.e. CIBIL, High Mark, Equifax and Experian. Retail customer approaches the bank for personal finance, it is either secured loan or unsecured, and banks generates the external credit scoring for behavioral of customer and internal scores for the eligible loan amount, interest rate, EMI and loan tenure. All these loan parameters are decided based on the internal scoring or decision taken by loan officers.

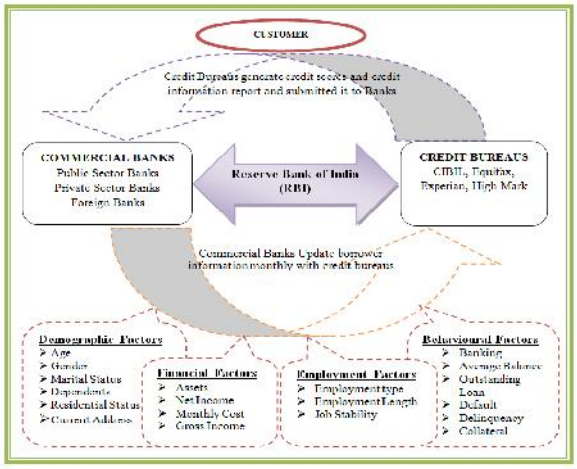


**Figure 2** Credit Scores and Credit Information Report Process Model

**Sources:** *Prepared by Rais Ahmad Itoo and A. Selvarasu*

**Population and Sample Element**

The area of study has been chosen as Chennai, capital city of Tamil Nadu, as there is variety of banks and updated methods are used for assessing the credit worthiness of borrowers. The total population of commercial banks in Chennai is 47 which are distributed as public sector banks 21, private sector banks 18 and foreign banks 8.

**Data collection tool**

The tool used for the data collection from the source of evidences of the multiple case study research design is interview schedule (Rubin & Rubin, 1995). The case study interviews are open ended in nature (Beckar, 1998), so has been adopted in this study. The strength of the interview is that it is focused directly on the case study topic and provides perceived inferences (Yin, 2003).

**Sampling Technique and Sample Size**

This study is qualitative in nature and has the purpose to generate theories on credit scoring of personal finance rather than testing hypothesis. In qualitative research number of respondents selected to collect data is not a matter rather than considering size of the sample, depth of the data collection is important. Based on the level of NPA in 2012-13, the banks with low level of NPA have been studied from all the three sectors of commercial banks. The sample for this qualitative case study research has been taken as 8 public sector banks, 7 private sector banks and 3 foreign banks and in total 18 commercial banks. The units of evidence from the selected banks are those people who actually score the application form and prepare the credit information report, and those whose formulate the related policies of credit scoring for personal finance products. Theoretical sampling and constant comparison principles have been used as sampling technique for data collection process. In case of theoretical sampling, new targets for data collection are directed by the results collected from the preceding sample. Constant comparison is process of coding and analyzing the collected data (Partington, 2000). The respondents in case study research strategy can suggest other persons for the interview as well as source of evidence (Becker, 1998). The sample in the present study includes 47 credit department employees dealing with scoring of application and preparation of credit information report for personal finance products (25 respondents from public sector banks, 17 respondents from private sector banks and 5 respondents from foreign banks). The respondents were Assistant General Mangers (AGM), Chief Managers (CM), Branch Managers (BM) and loan processing officers. The selection of every next respondent was based on the collection, codes and analysis of data collected from the previous respondent (Glaser and Strauss, 1967). The sources of data apart from the interviews are 79 images related to credit scoring models and CIBIL, 65 CIBIL newspaper articles, 102 news articles (19 bank loan, 22 credit scores, 10 loans, 10 home loan, 16 RBI and loans, 25 loan defaulters) and 59 videos.

**Pre test**

The questions to be included in the interview schedule were found by thorough review of literature, the researcher's academic and professional experience and discussion with the subject experts. In order to make the interview schedule to be more valid and reliable for the study, pre-test was carried out by interviewing 6 bankers (2 respondents from State Bank of India, 1 respondent from City Union Bank, 1 respondent from HDFC, 1 from ICICI and 1 respondent from Punjab National Bank) dealing the credit scoring of personal finance products offered to customers by various sectors of commercial banks. Based on the codes generated from the pilot study interviews, the interview schedule was modified. Those questions which reached saturation in pilot study were removed from the schedule and some new questions which came in knowledge of researcher were included for the final study.

**Ethical consideration**

Welman, Kruger & Mitchell (2005), suggested that following steps should be followed for ethical consideration:

***Voluntary Participation:*** Researcher took permission from the respondents before conducting final (main) study.

***Informed Consent:*** the main objective of the study was explained to the respondents before commencing the study so that they could decide whether they wanted to participate or not.

***Anonymity:*** All the information that was collected were kept confidential. The details of respondent could be hide if they wanted.

**Validity and Reliability**

Proportional reduction in loss method was used to assess the reliability of coding scheme. The proportional reduction in loss for this study is 0.81, which is well above the 0.70 cut-off level recommended for exploratory research (Rust and Cooil, 1994).

$$\mathbf{PRL = [E_{max}(\mathit{L}) - E(\mathit{L})]/E_{max}(\mathit{L})}$$

Where E(L) is expected loss that is estimated from the sample and $E_{max}(L)$ is the maximum loss that can occur when elements are completely unreliable.

To ensure validity, the present study followed five interrelated procedures recommended for qualitative research (Silverman and Marvasti, 2008): (a) Respondent Validation, (b) Refutability, (c) Constant Comparison, (d) Comprehensive Data Treatment, and (e) Deviant Case Analysis. Researcher shared the findings of this study with the bank employee to validate the findings that come out from the data analysis and their viewed the interpretation of data and credibility of the findings. By having sample from different groups of bank employees from different commercial banks, an attempt was made to see if findings emerging in one context could be disproved in another. Almost all the findings were consistent across different bank employees for different personal finance products. The emergent findings were validated by trying and finding additional cases for the study. The data was examined thoroughly and comprehensively prior to drawing conclusions. Since all the data sources were translated and transcribed using NVivo software.

**Research Steps Followed in this Study**

The whole study has been divided into four stages, which in turn has been divided into 13 steps. The stages and steps followed in this study are shown in table 2.

**Phase-1**

***Step 1: Preparation***

The first step in designing this study of consumer credit scoring is defining the research methodology and scope of the study. This study has been started by defining the basic research questions. The scope of the credit scoring study has been kept narrow enough to provide focus and feasibility; the scope has been kept broad enough to allow flexibility as the study evolves and support discovery of new concepts.

**Step 2: Case Selection**

The next step to finalizing the research questions was to select and identify the study case.

The units of analysis (Case) were selected to fulfill the requirements of theoretical sampling. Unlike the sampling done in qualitative investigations, theoretical sampling cannot be planned before get on a Case study. The sampling decisions progress during the research process itself (Strauss and Corbin, 1990).

Robert Yin (2003) suggested three principles of data collection that helps in establishing the construct validity and reliability of the case study research. These principles are (1) Use of multiple sources of evidence, which converge at same set of facts; (2) Creation of case study database; and (3) Maintain a chain of evidence.

**Phase-2**

***Step 3: Develop Accurate Data Collection Protocol for Case Study Research***

For this study the primary data was collected from the Assistant General Manager, General Manager, Chief Manager, Branch Manager and loan processing officers of commercial dealing with retail assets.

Triangulation was used to ensure research reliability by obtaining same results from different sources: interviews, internal documents, internet sources, newspaper article,, images, videos and bank advertising brochures. An initial pilot interview was taken to ensure that the loan employees from commercial banks aware about the phenomena under study.

***Step 4: Entering the Field***

Once the pilot study is over, the next step followed to carry the credit scoring study is to initiate field research. The field research includes selecting the area and respondents. Researcher used interview schedule for conducting interview with AGM, CM, BM and loan processing officers. The main goal of interview was to know the credit scoring methods used by three commercial banks, details assessed while scoring the credit application form and factors which have effect on credit score of customer.

**Step 5: Data Ordering**

The fifth step is data ordering, where data is arranged in proper order. The primary interview data and data from secondary sources are arranged in a sequence, based on the questions asked by the researcher.

**Table 2**Work Plan of the study

| Task Name | Quarter 1 | | | Quarter 2 | | | Quarter 3 | | | Quarter 4 | | | Quarter 5 | | | Quarter 6 | | | Quarter 7 | | | Quarter 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Definition Phase** | **M1** | **M2** | **M3** | **M4** | **M5** | **M6** | **M7** | **M8** | **M9** | **M10** | **M11** | **M12** | **M13** | **M14** | **M15** | **M16** | **M17** | **M18** | **M19** | **M20** | **M21** | **M22** | **M23** | **M24** |
| Review of literature | | | | | | | | | | | | | | | | | | | | | | | | |
| Collecting the list of defaulters from newspaper | | | | | | | | | | | | | | | | | | | | | | | | |
| Pre-Pilot Study interview | | | | | | | | | | | | | | | | | | | | | | | | |
| Review of related literature | | | | | | | | | | | | | | | | | | | | | | | | |
| Statement of the Problem | | | | | | | | | | | | | | | | | | | | | | | | |
| Establish the feasibility of study | | | | | | | | | | | | | | | | | | | | | | | | |
| Finalizing the research work plan | | | | | | | | | | | | | | | | | | | | | | | | |
| Ist Pilot meeting for Interview Schedule | | | | | | | | | | | | | | | | | | | | | | | | |
| Ist interim report and models | | | | | | | | | | | | | | | | | | | | | | | | |
| **Stage 1: Measuring Tool Selection** | | | | | | | | | | | | | | | | | | | | | | | | |
| Short Listing of Bank Branches | | | | | | | | | | | | | | | | | | | | | | | | |
| Short listing of measuring tool | | | | | | | | | | | | | | | | | | | | | | | | |
| **Stage 2: Qualitative Assessment of Branches** | | | | | | | | | | | | | | | | | | | | | | | | |
| Short listing of Branches | | | | | | | | | | | | | | | | | | | | | | | | |
| Short Listing of Personal finance products | | | | | | | | | | | | | | | | | | | | | | | | |
| Participation and Selection of loan officers | | | | | | | | | | | | | | | | | | | | | | | | |
| Participation and Selection of Manager | | | | | | | | | | | | | | | | | | | | | | | | |
| Participation and selection of AGM, CM | | | | | | | | | | | | | | | | | | | | | | | | |
| Final Report Stage 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| **Stage 3: Conducting field Survey** | | | | | | | | | | | | | | | | | | | | | | | | |
| Interviewing public, private and foreign bank employees | | | | | | | | | | | | | | | | | | | | | | | | |
| Final Report Stage 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| **Stage 4: Compilation of Data and Report writing on Stage 2** | | | | | | | | | | | | | | | | | | | | | | | | |
| Editing and Coding of Data of public, private and foreign banks | | | | | | | | | | | | | | | | | | | | | | | | |
| Final Report Stage 3 | | | | | | | | | | | | | | | | | | | | | | | | |
| **Stage 5: Final Research Project Management** | | | | | | | | | | | | | | | | | | | | | | | | |

Sources: Prepared by Rais Ahmad Itoo and A. Selvarasu

**Table 3**Phases and Steps followed in adopting Grounded Theory for this Study

| Phase | Steps | Description | Research Activities Followed in this Study | Output |
|---|---|---|---|---|
| **Phase 1:** Research Design | Step 1 | Preparation | Literature review, credit scoring methods, details used for credit scoring, factors affecting credit scoring, FMECA | Research Problem |
| | Step 2 | Case Selection | Selected the commercial bank branches for knowing the credit scoring methods, details used for credit scoring, factors affecting credit scoring. | Credit dept employees |
| **Phase 2:** Data Collection and Data Ordering | Step 3 | Develop Accurate Data Collection Protocol for Case Study Research | Data Collection from: Direct interview with AGM, CM, BM and Loan officers work for credit department in commercial banks, Archival records of commercial banks, central bank as well as credit bureaus, documentation from internal report and external sources newspaper articles, journals, banking magazines, advertising broachers, images and video clips. | Inventory of available data sources |
| | Step 4 | Entering the Study area (Field) | Data Collection from different sources (Primary as well as secondary), interviews with AGM, CM, GM and loan officers of commercial banks. | Transcription of data |
| | Step 5 | Data Ordering | Arrangement of data (Events and information) to facilitate easier data analysis. | Data Collected |
| **Phase3:** Data Analysis | Step 6 | Data Analysis Open Coding Axial Coding Selective Coding Memoing | Developed Concepts from data through coding and categorized the codes. Relationship between categories and sub categories were developed. Theoretical framework was built by integrating core categories. Write-up of ideas about codes and their relationships; this process was continued from data analysis till compellation of the study. | Memos |
| | Step 7 | Theoretical Sampling | Determine whether to find additional data to develop the emergent theory. Re-interview original participants and complete the additional interviews until no new properties or aspects could be identified. | Define scope and saturation of categories |
| **Phase3:** Data Analysis | Step 8 | Constant Comparison | Compare new to previous interviews and compare events to other sources of information for similarities and differences. | |
| | Step 9 | Theoretical Saturation | Saturation is reached when further data gathering and analysis from data added little to the conceptualization. | |
| | | Theoretical sorting memos | Sorting of written Memos, theoretically propositions were derived from the findings. | Proposition and Emergent Theory |
| | Step10 | Theoretical coding | Initial coding/Axial coding/ Substantive Coding | Codes/ Sub-Categories/ Categories/ Core Categories |
| **Phase 4:** Literature Comparison and Write up | Step11 | Integrating the Literature | Compared the evolving theory with existing literature | Proposition and Emergent Theory |
| | Step12 | Validation of Theory | Validating the evolving theory<br>Repetition back to step 2 for data collection and data analysis to check theoretical fit, relevance, workability and modifiability. | Confirmed core categories |
| | Step 13 | Write up of Theory | Writing research report | Final Thesis |

Sources: Prepared by Rais Ahmad Itoo and A. Selvarasu

**Table 4**Data Sources

| Data Sources | Data Collection Method | Data Content |
|---|---|---|
| Bank Employees | In-depth interview with<br>Assistant General Managers<br>Chief Managers<br>Branch Managers<br>Loan Processing Officers | Credit scoring methods used by commercial banks,<br>Details assessed while scoring the credit application form, Factors which have effect on credit score of customer, Response characteristics used for FMECA, Processing fee, Processing time, Weightage of details assessed while scoring the application, Reasons for loan rejection. |
| Archival Records | Presented By: Reserve bank of India, Private sector banks, Public Sector Banks, Foreign banks, CIBIL, Equifax, Experian, High Mark | Guidelines given by central bank, private sector banks, public sector banks, foreign banks and credit bureaus were coding |
| Images | Printed material available on internet | Advertising images used by commercial banks for home loans, personal loans and vehicle loans |
| Videos | Interviews given by management of credit bureaus, commercial banks and Reserve bank of India. | The interviews given by the higher management of commercial banks and credit bureaus |
| Newspaper Articles | Articles published in newspapers related to loan, credit scoring of commercial banks. | the data related to the loan rates, level of NPA, credit bureaus were coded from the newspaper articles |
| Banking Magazines | Articles published in Banking magazines | Banks related information given in the banking magazines |

**Sources:** *Prepared by Rais Ahmad Itoo and A. Selvarasu*

**Phase-3**

***Step 6: Initial Data Analysis***

***Coding and Categorizing Data***

All the data sources collected were categorized to identify the concepts through open coding, axial coding and selective coding. In each step of coding the output of previous step is input for next step. The tool used for data analysis id QSR NVivo.

***Open Coding***

Open coding is the initial phase of analysis in grounded theory approach to qualitative research. Open coding includes identification, naming, labeling, description and categorization of phenomena suggested by the data (Glaser, 1978). The core concepts of multiple data sources were summarized using codes. In this study 298 codes were identified using open coding. The words which are repeatedly used by the AGMs, CMs, BMs, Loan processing officers and subject experts were coded using QSR NVivo.

***Axial Coding***

Axial coding is used to build the relationship between the codes generated from open coding. In this study researcher linked the initial codes (Sub-categories) and formed 18 categories in NVivo.

***Selective Coding***

Selective coding is used for creating theoretical scheme, using of categories and sub-categories. Similar to the open coding, selective coding also use a process of constant comparison. In contract, however, to open coding which uses original quotes or statements, selective coding uses analytical and abstract codes leading to conceptual labels for categories (Glaser, 1978). Researcher identified the credit scoring methods used by commercial banks, factor which affect the credit score and credit information report and details assessed while scoring the loan applicant by selectively coding the 18 categories derived at the stage of axial coding.

***Memoing***

The writing up of memos is the core stage in the process of generating grounded theory. Researcher wrote memos after selective coding is over. These memos provide flexibility and enhance creativity in developing the overall framework.

***Step 7: Theoretical Sampling***

In theoretical sample, the emergent theory is used as reference to know where from and how to collect and code additional data. Based on the coding done, researcher decided that where and how to collect next data sources. Researcher analyzed data at the end of every interview from bank employees. In theoretical saturation it was need to have in depth interview to have data on credit scoring followed by commercial banks for personal finance products.

***Step 8: Constant Comparison***

Constant comparison is the method by which different data sources are compared or new data source is compared with the previous. This process addresses the risk bias from the researchers' characteristic starting perspective and limitations in conceptualization. Constant comparison emphasized on consistency and relevance of concepts derived from in depth interviews, images, newspaper articles, banking magazines, videos. Multiple sources of data were used in studying credit scoring of personal finance for validation of data and data analysis.

***Step 9: Theoretical Saturation***

The data was analyzed and coded until no new conceptual insights were generated. In case researcher needed more data, then data collection would take place.

***Step 10: Theoretical Sorting Memos and Theoretical Coding***

**Theoretical Sorting Memos**

For presentation and writing, theoretical sampling is the key to develop theory (Glaser, 1992). During sorting process, relations between credit scoring categories and properties were developed. Credit scoring models for public, private as well as foreign banks was drawn to develop to formulate credit scoring theory for all the three sectors of commercial banks and their personal finance products.

**Theoretical Coding**

Once the categories formulation have saturated, the next step followed is theoretical coding. Theoretical codes conceptualized the interrelation of substantive codes by generating hypothesis to be integrated into the theory. Theoretical codes are developed from open coding and theoretical memos.

**Phase-4**

***Step 11: Literature Comparison***

The emergent theory was compared with the existing literature and similarities as well as differences were also assessed with a view on how they arose. In this study the literature related to credit scoring methods used for personal finance of commercial banks, factors which affect the credit score as well as credit information report of borrower and factors and their Weightage used while scoring the credit applicant was reviewed.

***Step 12: Validation of the Theory***

Validation check was done for the emergent theory by checking its fitness, relevancy, workability and modifiability. In order to check the fitness of theory, an evaluation was made on how well concepts represent the observed phenomena. By relevance, a view is formed on how meaningful the concepts are to participants or to the group they represent. By workability, the applicability of concepts across the range of

**Table 5** Personal Loan for Private, Public and Foreign Banks

| Common | | | Private Sector Banks | | | Public Sector Banks | | | Foreign Banks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Items** | **Source** | **Ref** | **Items** | **Source** | **Ref** | **Items** | **Source** | **Ref** | **Items** | **Source** | **Ref** |
| Address | xxx | xxx | **Amount** | xxx | xxx | Balance transfer | xxx | xxx | Apply | xxx | xxx |
| Age | xxx | xxx | Booking fee | xxx | xxx | Additional charges | xxx | xxx | Benefits | xxx | xxx |
| Relationship | xxx | xxx | Costs | xxx | xxx | Amount | xxx | xxx | Documents | xxx | xxx |
| Current Balance | xxx | xxx | Disbursement | xxx | xxx | Apply | xxx | xxx | Eligibility | xxx | xxx |
| Customer Details | xxx | xxx | Eligibility | xxx | xxx | Details Updation | xxx | xxx | EMI | xxx | xxx |
| Customer Profile | xxx | xxx | EMI Calculation | xxx | xxx | EMI | xxx | xxx | Interest rate | xxx | xxx |
| Dependents | xxx | xxx | EMI Repayment | xxx | xxx | Fee | xxx | xxx | Loan amount | xxx | xxx |
| enquiry ac | xxx | xxx | Fee | xxx | xxx | Information Updation | xxx | xxx | Repay | xxx | xxx |
| Experience | xxx | xxx | Interest rate | xxx | xxx | Offer | xxx | xxx | Tenure | xxx | xxx |
| Gender | xxx | xxx | Late fee | xxx | xxx | Prepayment | xxx | xxx | Purpose | xxx | xxx |
| Income | xxx | xxx | Loan Balance | xxx | xxx | Repay | xxx | xxx | | | |
| Marital Status | xxx | xxx | Loan Statement | xxx | xxx | Security PDC | xxx | xxx | | | |
| | | | Monthly Payments | xxx | xxx | Tenure | xxx | xxx | | | |
| | | | Outstanding Balance | xxx | xxx | Time | xxx | xxx | | | |
| | | | Partial Disbursement | xxx | xxx | Track | xxx | xxx | | | |
| | | | Pre Close | xxx | xxx | Purpose | xxx | xxx | | | |
| | | | Processing time | xxx | xxx | Foreclosure | xxx | xxx | | | |
| | | | Redraw | xxx | xxx | Sick, lose job | xxx | xxx | | | |
| | | | Repayments | xxx | xxx | Collateral | xxx | xxx | | | |
| | | | Security | xxx | xxx | | | | | | |
| | | | Update | xxx | xxx | | | | | | |
| | | | Fixed rate | xxx | xxx | | | | | | |
| | | | Purpose | xxx | xxx | | | | | | |
| | | | Variable Interest rate | xxx | xxx | | | | | | |

**Table 6** Home Loan for Private, Public and Foreign Banks

| Common | | | Private Sector Banks | | | Public Sector Banks | | | Foreign Banks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Items** | **Source** | **Ref** | **Items** | **Source** | **Ref** | **Items** | **Source** | **Ref** | **Items** | **Source** | **Ref** |
| Address | xxx | xxx | General information | xxx | xxx | General information | xxx | xxx | Apply | xxx | xxx |
| Age | xxx | xxx | Disbursement | xxx | xxx | Apply | xxx | xxx | Documents | xxx | xxx |
| Relationship | xxx | xxx | Eligibility | xxx | xxx | Availing | xxx | xxx | EMI | xxx | xxx |
| Current Balance | xxx | xxx | Eligibility factor | xxx | xxx | Eligibility | xxx | xxx | fixed interest rate | xxx | xxx |
| Customer Details | xxx | xxx | EMI | xxx | xxx | Emi | xxx | xxx | interest rate | xxx | xxx |
| Customer Profile | xxx | xxx | Installments | xxx | xxx | Interest rate | xxx | xxx | loan amount | xxx | xxx |
| Dependents | xxx | xxx | Interest rate | xxx | xxx | Loan amount | xxx | xxx | processing fee | xxx | xxx |
| enquiry ac | xxx | xxx | Loan amount | xxx | xxx | Prepayment | xxx | xxx | refund processing fee | xxx | xxx |
| Experience | xxx | xxx | Tenure | xxx | xxx | Processing fee | xxx | xxx | Repayment | xxx | xxx |
| Gender | xxx | xxx | Pre EMI interest | xxx | xxx | Purpose | xxx | xxx | sanctioning time | xxx | xxx |
| Income | xxx | xxx | Repay | xxx | xxx | Reduce interest rate | xxx | xxx | Tenure | xxx | xxx |
| Marital Status | xxx | xxx | Security | xxx | xxx | Repayment | xxx | xxx | variable interest rate | xxx | xxx |
| | | | Agreement of sale | xxx | xxx | Repayment charges | xxx | xxx | Requirement | xxx | xxx |
| | | | Co applicant | xxx | xxx | Tenure | xxx | xxx | Co-applicants | xxx | xxx |
| | | | Pledge | xxx | xxx | Co applicant | xxx | xxx | loan top up | xxx | xxx |
| | | | Property Insurance | xxx | xxx | Collateral | xxx | xxx | Collateral | xxx | xxx |
| | | | | | | Insurance | xxx | xxx | Insurance | xxx | xxx |
| | | | | | | Security type | xxx | xxx | | | |
| | | | | | | Tax benefits | xxx | xxx | | | |
| | | | | | | Title issues | xxx | xxx | | | |
| | | | | | | Transfer | xxx | xxx | | | |

**Table 7** Vehicle Loan for Private, Public and Foreign Banks

| Common | | | Private Sector Banks | | | Public Sector Banks | | |
|---|---|---|---|---|---|---|---|---|
| **Items** | **Source** | **Ref** | **Items** | **Source** | **Ref** | **Items** | **Source** | **Ref** |
| Address | xxx | xxx | De-pledge | xxx | xxx | General information | xxx | xxx |
| Age | xxx | xxx | Documents | xxx | xxx | amount | xxx | xxx |
| Relationship | xxx | xxx | Fee | xxx | xxx | apply | xxx | xxx |
| Current Balance | xxx | xxx | Tenure | xxx | xxx | Eligibility | xxx | xxx |
| Customer Details | xxx | xxx | Standard instructions | xxx | xxx | EMI | xxx | xxx |
| Customer Profile | xxx | xxx | Guarantor | xxx | xxx | Income Clubbing | xxx | xxx |
| Dependents | xxx | xxx | Loan amount | xxx | xxx | Interest rate | xxx | xxx |
| enquiry ac | xxx | xxx | NEFT | xxx | xxx | Interest calculation | xxx | xxx |
| Experience | xxx | xxx | Pledge | xxx | xxx | Prepayment | xxx | xxx |
| Gender | xxx | xxx | Post date cheque | xxx | xxx | Processing fee | xxx | xxx |
| Income | xxx | xxx | PDC | xxx | xxx | Repayment schedule | xxx | xxx |
| Marital Status | xxx | xxx | Queries | xxx | xxx | Security | xxx | xxx |
| | | | Repayment | xxx | xxx | Vehicle type | xxx | xxx |
| | | | RTGS | xxx | xxx | | | |
| | | | Security | xxx | xxx | | | |
| | | | Selling vehicle | xxx | xxx | | | |
| | | | Insurance | xxx | xxx | | | |
| | | | Form 35 | xxx | xxx | | | |
| | | | Amortization | xxx | xxx | | | |
| | | | Accident | xxx | xxx | | | |

scenarios is understood. With modifiability, the theory can be extended and adapted when new insight is generated through comparison with further data.

**Table 8** Categories

| Category | Items | Sources | Ref |
|---|---|---|---|
| **Credit Bureaus** | Information Verification | xx | xx |
| | Market Place (MP) | xx | xx |
| | Market place access | xx | xx |
| | Market Place Help | xx | xx |
| | Market Place Products | xx | xx |
| | MP requirement | xx | xx |
| | Records | xx | xx |
| | Report update | xx | xx |
| | Score | xx | xx |
| | Score Range | xx | xx |
| | Transunion score | xx | xx |
| **Credit Information Report** | Advent of CIR | xx | xx |
| | CIR | xx | xx |
| | Account Information | xx | xx |
| | Contact Information | xx | xx |
| | Details | xx | xx |
| | Dispute | xx | xx |
| | Dispute Request | xx | xx |
| | Employment Information | xx | xx |
| | Enquiry Information | xx | xx |
| | Error | xx | xx |
| | Issues | xx | xx |
| | Login | xx | xx |
| | Mistakes | xx | xx |
| | Online | xx | xx |
| | Personal Information | xx | xx |
| | Purchase | xx | xx |
| | Rectifying | xx | xx |
| | Time | xx | xx |
| | Update | xx | xx |
| **Credit Scoring** | Credit Facility | xx | xx |
| | Dispute Request | xx | xx |
| | Identity theft | xx | xx |
| | Updation of CIR | xx | xx |
| | Factors | xx | xx |
| | Judgment | xx | xx |
| | Method | xx | xx |
| | Software | xx | xx |
| | Internal credit history | xx | xx |
| | Internal credit scoring | xx | xx |
| | Internal Credit Scoring | xx | xx |
| **Loan Processing** | Loan Department | xx | xx |
| | Application Screening | xx | xx |
| | Loan Process | xx | xx |
| | Loan Processing fee | xx | xx |
| | Loan Processing time | xx | xx |
| | Loan rejection | xx | xx |
| | Loan sanctioned | xx | xx |
| | Rejection reasons | xx | xx |
| | Credit Judgment | xx | xx |
| | Credit Policy | xx | xx |
| **Behaviour** | Closed loan account | xx | xx |
| | Default reported | xx | xx |
| | Doubtful account | xx | xx |
| | Overdue | xx | xx |
| **Credit Score** | Credit Behaviour | xx | xx |
| | Credit score | xx | xx |
| | Credit score Cost | xx | xx |
| | Credit Score Importance | xx | xx |
| | Credit score Improve | xx | xx |
| | Online issues | xx | xx |
| | Credit score purchase | xx | xx |
| | Credit score time | xx | xx |
| | Credit score validation | xx | xx |
| | Credit Worthiness | xx | xx |
| | Credit score cut off | xx | xx |
| | Credit score Online | xx | xx |
| | Higher Authority Decision | xx | xx |
| | Low Balance | xx | xx |
| | Low Score | xx | xx |
| | NOC | xx | xx |
| | Utilization of Credit | xx | xx |
| **Credit Scoring Factors** | Score Categories | xx | xx |
| | Loan Score | xx | xx |
| | Loan Scoring types | xx | xx |
| | Credit Cards | xx | xx |
| | Credit Limit | xx | xx |
| | Credit Mix | xx | xx |
| | credit percentage | xx | xx |
| | Credit Score factors | xx | xx |
| | Dues | xx | xx |
| | High Credit | xx | xx |
| | Improve Credit History | xx | xx |
| | Late Payments | xx | xx |
| | Many Accounts | xx | xx |
| | Negative Impact | xx | xx |
| | New Credit | xx | xx |
| **Loan Characteristics** | Banking | xx | xx |
| | Base Points | xx | xx |
| | Fixed Interest rate | xx | xx |
| | Floating interest rate | xx | xx |
| | Interest Rate | xx | xx |
| | Loan Amounts | xx | xx |
| | loan security | xx | xx |
| | Loan Tenure | xx | xx |
| | Loan types | xx | xx |
| | Personal Finance | xx | xx |
| | Retail Loans | xx | xx |
| | Sanctioned Amount | xx | xx |
| | Security value | xx | xx |
| | Standard ac | xx | xx |
| | Sub Standard ac | xx | xx |
| | written off | xx | xx |

***Step 13: Writing the Research Report***

The final step of this research is to write the research report. The aim was to fulfill the research objectives, through core categories, subcategories and contributing foundation of codes and observations.

**Main Study**

The main study has been carried out and results are shown in tabular form. Researcher has adopted relevant summary of frequencies and FMECA framework for credit scoring of personal finance products. This section includes the frequencies of factors assessed while scoring the application of personal finance products by commercial banks and factors which has effect on the credit score of customer. These frequencies and reference counts of items are calculated using qualitative tool known as QSR NVivo. This section also includes the FMECA items which are used to calculated the risk priority number (RPN) based on the response collected from the employees dealing with credit scoring of personal finance in Public sector, Private sector and foreign banks.

The data collected from different sources has been coding in to 298 codes using open coding via NVivo software. Similar codes were grouped into categories using axial coding which resulted into 18 categories namely common loan factor, personal loan, home loan and vehicle loan categories for public, private and foreign banks, credit bureaus, Credit Information Report, Credit Scoring, Loan Processing, Borrower Behaviour, Credit Score, Credit Scoring Factors and Loan Characteristics. The codes included in each category are shown in table 5-8 and word cloud for Home, Personal and Vehicle loans in figure 3.

**Table 9** FMECA Frame work

| Characteristics | Irregular payments (S) | Priority of the failure (P) | Non-Repayment of Loan (L) |
|---|---|---|---|
| Residential Status | xxx | xxx | Xxx |
| Credit History | xxx | xxx | Xxx |
| Outstanding Loan | xxx | xxx | Xxx |
| Loan from other Banks | xxx | xxx | Xxx |
| Loan Amount | xxx | xxx | Xxx |
| Purpose of the Loan | xxx | xxx | Xxx |
| Property Value | xxx | xxx | Xxx |
| Property Location | xxx | xxx | Xxx |
| LTV ratio | xxx | xxx | Xxx |
| Loans Defaulted | xxx | xxx | Xxx |
| Collateral/ Guarantee | xxx | xxx | Xxx |
| Assets and Liabilities | xxx | xxx | Xxx |

Risk Priority Number (RPN) =S*P*L


**Home Loan**


**Personal Loan**


**Vehicle Loan**

**Figure 3** Word Cloud

**Limitation of the study**

The focus of the study is mainly based on the credit scoring of home loan, personal loan and vehicle loans by commercial banks. The limitation of this study is that it focused on interviews taken from the bank credit employees only. Many of banks being couldn't cooperate, because of their busy schedule and data confidentiality policies of the banks.

**Scope of the Study**

The population can be increased by including the proportion of all financial institutes. This study is based on the existing methods adopted by the banks and use of statistical as well as neural networking methods can be tested for developing new model by taking fresh data from banks as well as their customers. Similar study can be carried out for credit bureaus. The customer side of this study is not studied, which can be included to increase the data reliability for similar studies.

## CONCLUSION

The study focused to study the credit scoring methodology adopted by commercial banks in (Chennai) India. The study has focused on internal and external credit scoring methods followed by the commercial banks to assess the credit worthiness of personal finance products; consolidated the factors considered while scoring the personal finance application form. The factors effecting the credit scores as well as credit information reports prepared by credit bureaus and banks has been found through this study. A qualitative research strategy, case study has been adopted as appropriate for this particular research area. The primary data has been collected through interview schedules and secondary sources from the newspaper, images and video interviews of bankers as well as credit bureaus employees. All the data sources have been analyzed using the new qualitative software known as QSR NVivo. The internal credit scoring software used by the banks is loan originating software and externally the scores are generated through credit bureaus. The main factors which has effect on the credit information report and in turn on credit scores are payment history, high utilization of credit, higher percentage of personal loans and many new accounts opened recently.

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