
EVALUATING CREDIT RISK ASSESSMENT MODELS OF INDIAN PUBLIC SECTOR BANK

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ABSTRACT

The purpose of this paper is to evaluate the internal credit risk rating or credit-scoring models of the Indian public sector banks through the perceptions of their managers. The credit risk assessment score awarded by a bank to a business unit is a single point risk indicator of an individual credit exposure, which can measure and monitor credit risk. It becomes a tool in credit selection, risk-based pricing; and in terms of corporate, group or industry exposures, in tracking the quality of a bank's credit portfolio. The study statistically evaluates through ANOVA and Tukey's HSD post hoc tests, the responses of three categories of credit managers, managers in large and small public sector banks, managers in different experience groups and at different managerial levels, to find the perceptual differences within and between the groups. The results show that the banks have elaborate credit risk assessment models, and the managers of large public sector banks are more satisfied with internal credit rating framework. The study also found significant differences in managerial perceptions in different experience groups and at various hierarchical levels. Since credit rating is highly judgmental process, this may increase subjectivity in ratings.

Keywords – Risk-based pricing, Credit score, High safety, Stress testing, Sensitivity analysis.

JEL Classification - G02 G12 G21 G32

INTRODUCTION

A key aspect of credit risk management in banks is risk pricing of business loans, based on a risk measurement system. Credit ratings may be assigned based on Bank Loan Ratings (BLRs) given by external rating agencies like CRISIL, ICRA etc., and are a good indicator of default risk. However, external rating agencies provide limited input about their rating criteria. The rating information is made public, while the rating process itself remains non-disclosed (Kranhnen & Weber, 2001). Thus banks develop their internal credit risk assessment models, for risk

Segmentation of their borrowers, risk-based pricing, tracking rating transitions, loan reviews, and managing portfolio credit risk and non-performing assets. Further, for calculation of capital charge under advanced approaches of Internal Rating Based Approach of Basel II, Indian banks need to develop Basel compliant internal risk rating models.

The Indian banking industry is dominated by 26 public sector banks, and these banks have been mainly responsible for non-performing loans to business and industry. RBI observed, "Gross NPA ratio at system

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level increased mainly on account of deterioration in asset quality of public sector banks... The spurt in NPAs could be attributed to the slowdown prevailing in the domestic economy as well as to inadequate appraisal and monitoring of credit proposals." (RBI report on Trends and Progress of Banking in India, 2011-12, Para 4.29). Thus, there is a need to evaluate the credit risk assessment or credit appraisal systems of Indian public sector banks, for effective credit risk management.

LITERATURE REVIEW

Bank's internal credit risk evaluation systems go by a number of names, such as *expert systems*, *credit-scoring* or *credit risk rating* (Lehmann, 2003). Credit assessments are meant to help a bank measure whether potential borrowers will be able to meet their loan obligations in accordance with contractual agreements (Oesterreichische, 2004). Thus, it is possible to accelerate credit analysis, which may allow an increase in business volume (Selau & Riberio, 2011).

Credit rating is a tool of loan pricing. Rates on various loan types must be sufficient to cover the costs of funds, loan supervision, administration (including general overhead), and probable losses (Greuning & Bratanovic, 2009). Rate differentials may be deliberately maintained either to encourage some types of borrowers to seek credit elsewhere or to attract a specific type of borrower (Greuning & Bratanovic, 2009). However, the credit rating system should be reliable. The (ex-ante) probability of default should not be significantly different from the (ex-post) realized default frequency (Kranhnen & Weber, 2001). Ratings should reflect the risks posed by both the borrower's expected performance and the transaction's structure. (The Comptroller's handbook, 2001).

Wherever possible, credit assessment procedures must include all data and information relevant to creditworthiness (Oesterreichische, 2004). However, the factors determining creditworthiness will vary according to the type of borrower concerned, for example, the credit quality of a government depends largely on macroeconomic indicators, while a company will be assessed on the basis of the quality of its management, among other things (Oesterreichische, 2004).

Analyzing credit file data from four major German banks, Grunert & Weber (2005) found evidence that the combined use of financial and non-financial factors leads to a more accurate explanation of current and future default events than the single use of each of these factors respectively, also supported by Jayadev (2006).

Credit appraisal can involve a number of different techniques which can be used individually but are more often combined as part of the assessment process (Brown & Moles, 2012). Balcaen & Hubert (2004) gave an overview of a number of academically developed corporate failure prediction models. The use of models for credit risk forecasting eliminates the subjectivity of the analysis, by creating a standardized decision-making procedure that can be complemented with extra pieces of information that are not contemplated in the mathematical model (Selau & Riberio, 2011).

Abdou A. Hussein (2009) compared the traditional and new techniques and concluded that BNS 4- MLFN-5N (Neural Networks) was most reliable in terms of classification efficiency rate and the cost effectiveness, associated with misclassification errors. *Altman et. al. (1977) constructed a second generation model with several enhancements to the original Z-score approach, called Zeta model. (Bandyopadhyay,*

2006). Chijoriga (2011) findings have shown that using the multi discriminant analysis, commercial banks could have improved their objective decision making by correctly classifying the credit worthiness of a customer and assessing credit risk. Jain, Gupta & Mittal(2011) developed a credit scoring application framework, for SME borrowers, by classifying them into "good risk", 'foreclosed risk' and 'bad risk' categories, by using multinomial logistic regression technique.

Stress testing is an important risk management tool. Stress testing alerts bank management to adverse unexpected outcomes related to a variety of risks and provides an indication of how much capital might be needed to absorb losses should large shocks occur (Basel, 2009).

A comprehensive credit risk model must be based on a rating process that is sound and rigorous and that incorporates all relevant information, both public and proprietary (Hirtle, 2009).

Research Methodology

The purpose of this study is to find the main features of Indian public sector banks' internal credit risk assessment models for business loans to firms and corporates, and find whether the credit rating models of the bank are effective in capturing the credit risk, through perception of their managers.

The managerial perceptions regarding credit rating models have been studied through three groups of managers- the credit managers in large and small PSBs, the credit managers in different experience groups, and the credit managers at three levels of hierarchy, the junior, middle and senior levels; based on primary data collected through a structured questionnaire.

Sampling and Data Collection

The study uses a sample of six large and six small PSBs, thus covering 46 per cent of 26 Indian PSBs. The banks in large and small categories have been divided on the basis of their share in total assets of public sector banks, with a cut-off of 2.5 per cent. Based on 2011-12 annual reports, 14 public sector banks are classified as large banks and 12 as small banks. Sample banks in each category have been selected on judgment sampling method. Large banks in sample are the SBI, PNB, BOB, OBC, IDBI Bank, Syndicate Bank, and the small banks are the Vijaya Bank, Dena Bank, United Bank of India, Punjab and Sind Bank, Andhra Bank, and the State Bank of Bikaner and Jaipur.

Research Instrument

Data has been collected through a structured questionnaire, containing seven questions on 5-point Likert scale (except Qt. no. 3 & 4).

1. The bank is aware of strength and weaknesses of its risk management systems vis-à-vis, other banks.
2. Public disclosures of credit risk rating models shall be undertaken to match risk perceptions of lenders and borrowers.
3. Is the stress testing a part of credit risk models?
4. Is the sensitivity analysis a part of credit risk rating models?
5. Is the bank using any of the credit risk models- Altman's Z-score, KMV Credit Monitor, Credit Risk+, Mckinsey's Credit Portfolio View, Black & Scholes Option Pricing Model.
6. Should the banks rely on external credit ratings?

7. Credit rating models of the bank are effective in capturing the credit risk.

Respondents' Profile

The study is based on a survey of 337 credit managers working in credit and recovery departments of sample PSBs, in and around Delhi, polled through a structured questionnaire. The respondents are primarily dealing with SME and mid-corporate business loans, and have been selected through non-probability convenience sampling method. Out of 337 respondents, 172 are from large PSBs and 165 from small PSBs. The 39 per cent respondents have up to 7 years of banking experience, 25 per cent from 8 to 20 years, and 36 per cent have more than 20 years' experience. The 14.8 per cent respondents are junior managers, 53.4 per cent middle level managers, and 31.8 per cent senior level managers.

Data Analysis and Results

The data has been analyzed through frequencies, percentages, descriptive statistics, one way analysis of variance (ANOVA) and Tukey's HSD post hoc tests of pair-wise comparisons, at 95 % level of confidence, for three independent variables, i.e., credit managers in large and small banks, managers in three experience groups (up to 7 years, 8 to 20 years, above 20 years) and managers at junior, middle and senior levels, to find the statistical significance of mean differences. The dependent variables are responses to seven questions.

Based on unstructured personal interviews with credit managers, and analytical study of responses from a structured questionnaire, the following are the main features of the internal credit risk assessment models of the Indian public sector banks:

1. **Basel II Compliant Internal Credit Rating Models:** In compliance with RBI's Basel II guidelines, most of the Indian public sector banks have started developing internal credit risk rating models for risk differentiation, and for calculation of capital adequacy ratio under Foundation and Advanced approaches i.e., Internal Rating Based Approach of Basel II.
2. **Outsourcing of Credit Rating Framework:** Some banks like SBI and its associate banks, and United Bank of India have in-house credit rating framework but larger number of other public sector banks (PSBs) have vendor-developed credit risk assessment models, especially from CRISIL and ICRA.
3. **Segmentation of Borrowers:** For risk specialization, banks segment borrowers in many categories namely, Large Corporates, Mid-corporates, SMEs, Large Traders, Real Estate Developers, Large Brokers, Infrastructure Sector, Greenfield Projects etc. This segmentation helps in assessing the special risk characteristics of the counterparties.
4. **Entry Barriers:** Many public sector banks have created entry barriers for loan applicants. For example, borrowers whose management has doubtful integrity or who lack environmental clearances or who appear negative in RBI, CIBIL's defaulter lists are not assessed.
5. **Rating Grades:** The banks' internal credit rating models generate two-dimensional ratings i.e., borrower's rating indicating his risk category or Probability of Default; and transaction-specific or facility rating reflecting Loss Given Default. The composite

rating indicates Expected Loss on a loan transaction on the scale of 0-10 or 0-100 from highest safety to highest risk/caution/default levels. Based on composite ratings or scores, borrowers are divided into 8 to 16 risk categories indicating investment, sub-investment and non-investment grading for loan approvals and loan pricing. Large banks like SBI and its associates and PNB have 15-16 risk categories, and other banks have 8 to 10 categories.

6. **Risk Factors:** These rating models capture borrower's risk under four parameters, financial risk, industry risk, business risk and management risk, covering 30 to 80 risk factors by different banks. The weightage scheme for various risk parameters, and each risk factor differ considerably across banks. Though most banks assign 40% to 60% to financial risk parameters, and remaining to qualitative risk parameters like business, industry and management risk.
7. **Subjectivity in Assessment:** Financial risk assessment is based on annual financial statements and has objective assessment. Whereas assessment of other risk factors is based on subjective rationalization of risk-raters, risk-validators and credit analysts of these banks.
8. **Use of Statistical Models:** Since the credit rating models in Indian public sector banks are software-driven, the use of statistical tools in risk rating could not be established. The survey (Question no. 5), on kind of statistical tools used in their internal credit risk rating models, revealed that:

- 94% had no knowledge about use of Altman's Z-score model.
- 98% about KMV Credit Monitor model.
- 72% about use of Credit Risk + model.
- 92% about Mckinsey's Credit Portfolio View.
- 95.5% about Black and Scholes' Optio Pricing Model. In other words, these Theoretics l models are not part of credit risk rating by the Indian public sector banks, and if these are, it has not been disclosed by their vendors.

9. **Awareness of Other Banks' Risk Assessment Models.** The internal rating models are closely held by the public sector banks, but during consortium/multiple loans inter-bank meetings, and discussions with borrowers, their rating frameworks get widely known to all the stakeholders. During the aforesaid survey (Question no. 1), against the question "Is the bank aware of strength and weaknesses of its risk management system vis-à-vis, other banks", 92.28% of the respondents agreed/strongly agreed (Figure I). Since there is high competition among all banks to procure profitable loan proposals, knowledge of other banks' risk systems improved their competitive strength.

Bank is aware of strength and weaknesses of its risk management system vis-a-vis, other banks.

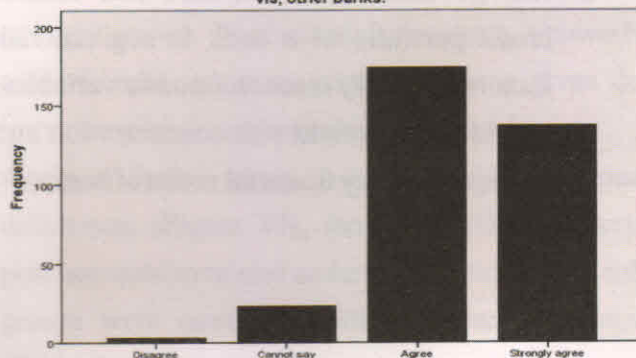


Figure I: Awareness of Other Banks' Risk Management Systems.

10. Public Disclosures of Rating Models:

Against the question (Question no. 2) whether public disclosures of credit risk rating models shall be undertaken to match risk perceptions of lenders and borrowers, only 62.91% agreed/strongly agreed (Figure II). Those who agreed were mostly the middle level managers. The purpose may be to avoid window dressing of credit requests by the borrowers.

Public disclosures of credit risk rating models shall be undertaken to match risk perceptions of lenders and borrowers.

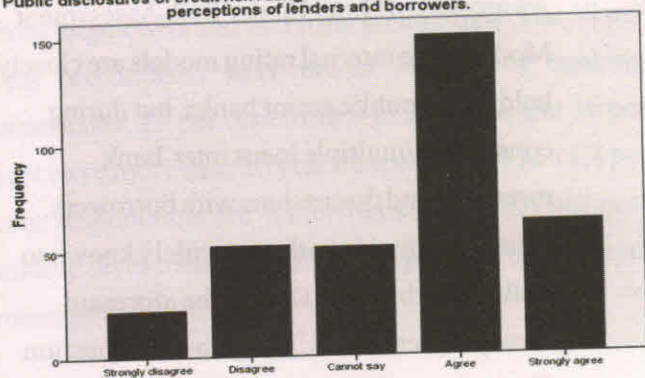


Figure II: Public Disclosures of Credit Rating Models.

11. Stress Testing of Credit Risk: Stress testing helps banks to estimate the likely credit losses under exceptional but plausible scenarios. It is an important tool of corporate risk governance, to measure and control credit portfolio of a bank to a given risk factor(s), mainly macroeconomic variables, and identifies credit risk concentration and its impact on key financial ratios of banks.

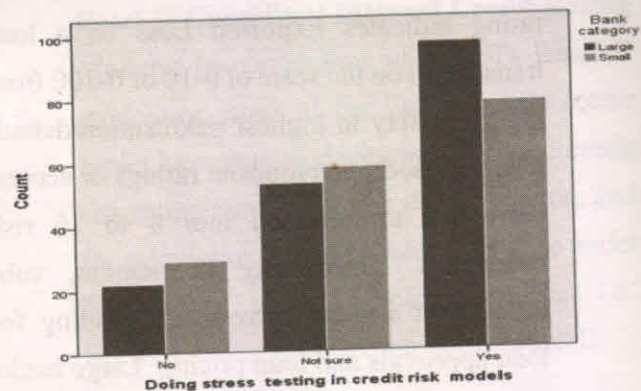


Figure III: Stress Testing by Public Sector Banks.

Only 51.93 % respondents agreed that the banks were doing stress testing on credit risk models. Those who agreed belonged more to large banks than the small banks (Figure III).

A further study was undertaken on mean scores (Figure IV & Tables I to III) to find significance of mean differences, through one way variance analysis (ANOVA), on three independent variables. Tukey's post hoc tests were also undertaken to find which sub-management group was causing significant mean score differences.

Table I : Descriptive Statistics (Large vs. Small Banks)

Bank category	Q3:Doing stress testing in credit risk models	Q4:Doing sensitivity analysis in credit risk rating models	Q6:Should the bank rely on the external credit ratings?	Q7:Credit rating models of the bank are effective in capturing the *credit risk.
Mean	2.44	2.78	3.84	3.72
Large N	172	172	172	172
Std. Deviation	.710	.560	1.028	.752
Mean	2.30	2.76	3.89	3.09
Small N	165	165	165	165
Std. Deviation	.751	.554	.969	.993
Mean	2.37	2.77	3.87	3.41
Total N	337	337	337	337
Std. Deviation	.733	.556	.998	.932

Note 1: * F statistic for mean difference is significant at the 0.05 level.

Table II : Descriptive Statistics (Experience Levels)

Banking Experience(years)	Q3:Doing stress testing in credit *risk models	Q4:Doing sensitivity analysis in credit risk rating *models	Q6:Should the bank rely on the external credit ratings?	Q7:Credit rating models of the bank are effective in capturing the credit risk.
Upto 7 years**	Mean 2.23 N 133 Std. Deviation .724	2.68 133 .691	3.82 133 .960	3.36 133 .956
8 to 20 years	Mean 2.46 N 82 Std. Deviation .773	2.80 82 .483	3.95 82 .942	3.56 82 .904
20 years and above**	Mean 2.46 N 122 Std. Deviation .694	2.90 122 .394	3.86 122 1.078	3.37 122 .920
Total	Mean 2.37 N 337 Std. Deviation .733	2.79 337 .556	3.87 337 .998	3.41 337 .932

Note 1: * F statistic for mean difference is significant at the 0.05 level.

Note 2: **Post hoc tests are significant only between this pair at the 0.05 level.

Table III : Descriptive Statistics (Management Levels)

Management Level	Q4:Doing stress testing in credit *risk models	Q5:Doing sensitivity analysis in credit risk rating *models	Q6:Should the bank rely on the external credit ratings?	Q7:Credit rating models of the bank are effective in capturing the credit risk.
Junior Managers**	Mean 2.22 N 50 Std. Deviation .764	2.60 50 .700	3.86 50 1.069	3.58 50 .883
Middle Level Managers	Mean 2.32 N 180 Std. Deviation .722	2.81 180 .550	3.84 180 .979	3.41 180 .955
Senior Level Managers**	Mean 2.51 N 107 Std. Deviation .719	2.85 107 .472	3.91 107 1.005	3.35 107 .912
Total	Mean 2.37 N 337 Std. Deviation .733	2.79 337 .556	3.87 337 .998	3.41 337 .932

Note 1: * F statistic for mean difference is significant at the 0.05 level.

Note 2: **Post hoc tests are significant only between this pair at the 0.05 level.

12. Sensitivity Analysis of Credit Risk:

Sensitivity analysis or what-if analysis is used in credit risk assessment to determine how projected performance of a borrower will respond to changed assumptions, for the tenure of the loan such as expected profits, sales, cash generation, stock position, working capital gap, net worth etc. Sensitivity analysis is undertaken by banks mostly at different levels of activity, production or sales, to understand borrowers' projected key financials.

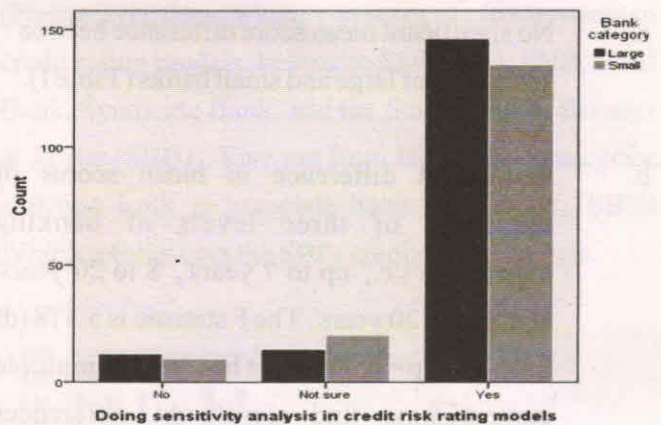


Figure V : Sensitivity Analysis by Public Sector Banks

The survey on sample credit managers on whether the banks are doing sensitivity analysis in credit risk rating models for business loans, found 83.4 % agreed/strongly agreed. Thus sensitivity analysis, a powerful tool of credit risk management, is being given due importance by the Indian public sector banks.

Again a further study was undertaken on mean differences (Figure VI), through ANOVA. Tukey's post hoc tests were also undertaken to find which sub-groups were causing significant mean differences (Tables I to III).

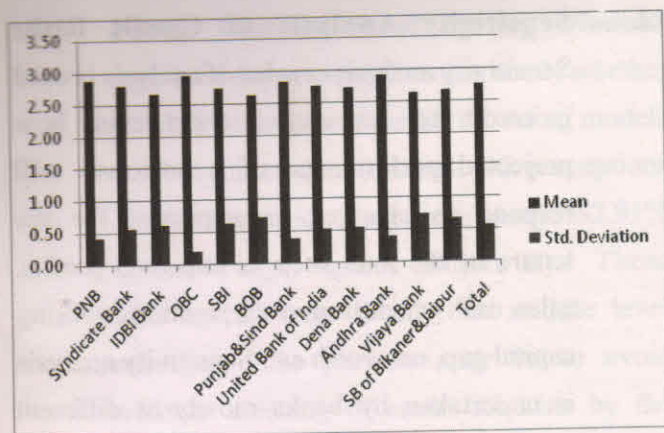


Figure VI : Sensitivity Analysis – Mean & Standard Deviation

ANOVA findings indicate:

- a. No significant mean score difference between managers of large and small banks (Table I).
- b. Significant difference in mean scores of managers of three levels of banking experience i.e., 'up to 7 years', '8 to 20 years' and 'above 20 years'. The F statistic is 5.378 (df 2, 334), at $p=0.005$. Post hoc tests of multiple comparisons, find significant differences between managers of 'up to 7 years' and 'above 20 years' experience groups only (Table II).
- c. Significant differences of mean scores of managers of three levels of management-junior, middle and senior levels. The F statistic is 3.674 (df 2, 334), at $p=0.026$. Post hoc tests find significant difference in perception of junior and senior managers only, and not between them with middle level managers (Table III).

13. **Importance of External Ratings:** Bank loan ratings by the external rating agencies accredited by the Reserve Bank of India like CRISIL, ICRA, SMERA etc. are considered

by banks in internal rating models. However, there are widely different practices among PSBs. Some banks like SBI do not add credit score for external ratings but consider them in loan sanctions. Few banks like PNB prepare variance reports between external and internal ratings with justifications.

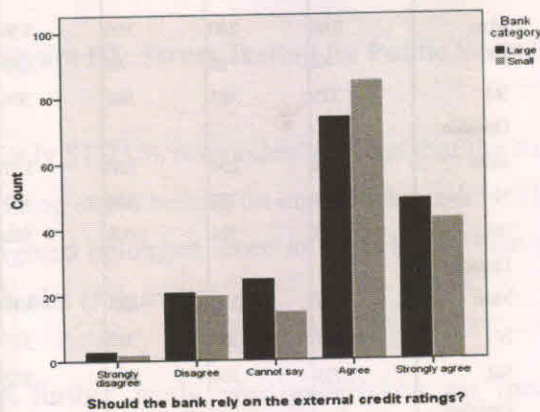


Figure VII: Importance of External Ratings.

The survey among credit managers on (Question no. 6), "Should the bank rely on external credit ratings?" revealed that 74.48 % agreed/ strongly agreed. In terms of large and small banks, their percentage ranged between 71.51 % and 77.58 %.

The ANOVA results indicated no statistical significant differences in mean scores of any of three independent categories of managers (Tables I to III), indicating only chance differences.

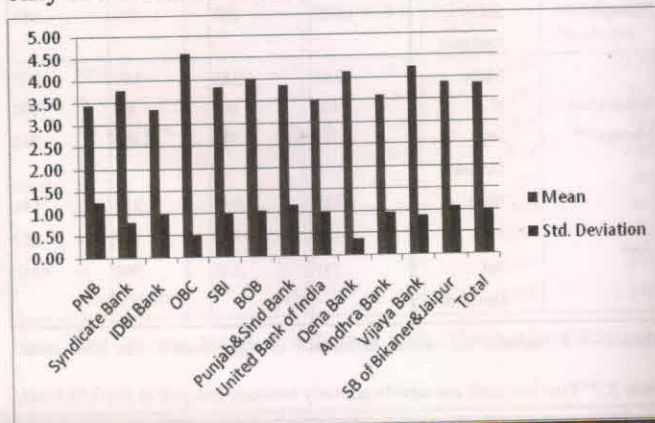


Figure VIII: Reliance on External Ratings - Mean & Standard Deviation

14. **Evaluation of Credit Risk Assessment Framework:** Against the question whether credit rating models of the bank are effective in capturing the credit risk, only 56.08 % agreed/ strongly agreed. Largest number of respondents who agreed/ strongly agreed belonged to large banks, middle level managers, and managers in the experience groups of 'Up to 7 years' and above 20 years' (Figures IX to XII).

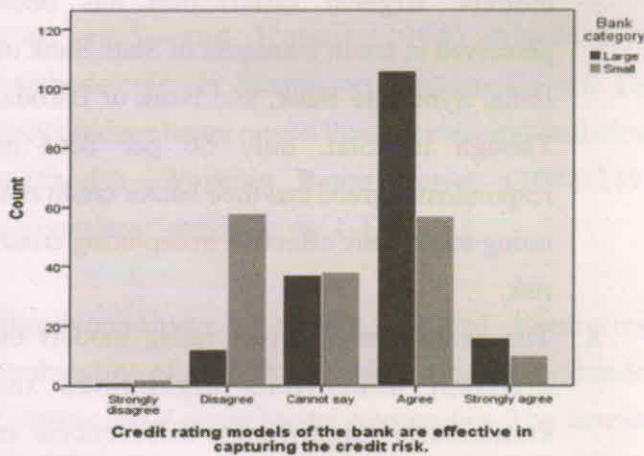


Figure IX: Credit Rating Models Evaluation- Bank Size Wise.

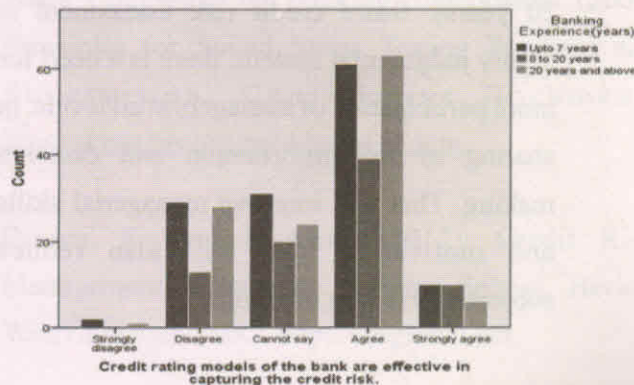


Figure X: Managers Experience-wise Evaluation of Rating Models.

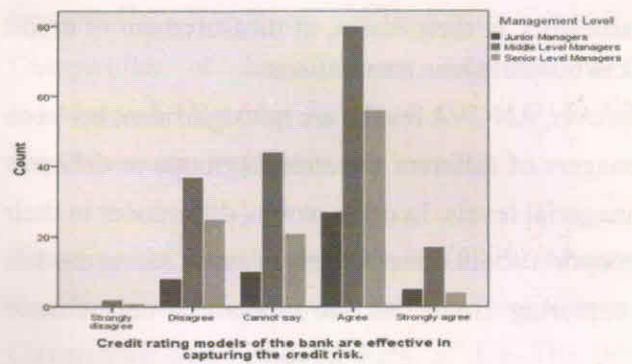


Figure XI: Evaluation of Rating Models by Management Levels.

In terms of mean scores and standard deviation values (Figure XII), those who are in favor of effectiveness of credit rating models, belong to SBI, BOB, PNB, IDBI Bank, Syndicate Bank, and the State Bank of Bikaner & Jaipur (SBBJ). Five are from large banks category, and one bank is associate bank of SBI i.e., SBBJ Which is following the SBI's credit rating models.

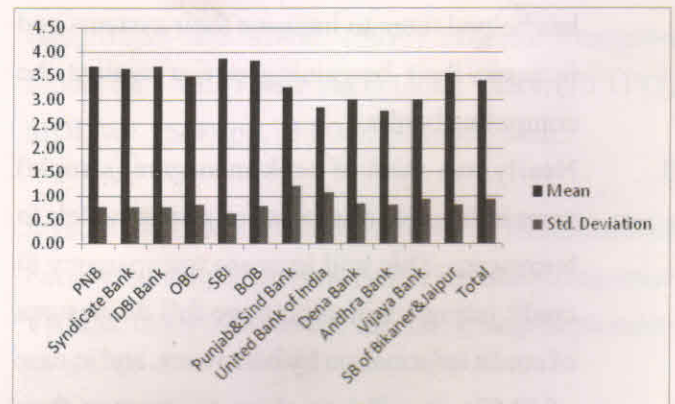


Figure XII: Evaluation of Credit Rating Models- Mean and Standard Deviation.

One way analysis of variance has been undertaken to test the statistical significance of mean score differences between and within three managerial groups. Results of ANOVA (Tables I to III) indicate significant difference in mean scores between large and small public sector banks with F statistic equal to 43.362 (d f 1,335), at p=0.000. The credit managers of large banks are more satisfied with credit risk rating

framework in their banks, in measurement of credit risk in business loan transactions.

However, ANOVA results are not significant between managers of different experience groups or different managerial levels. In other words, differences in their perception about effectiveness of credit rating models in capturing credit risk are random or only chance

CONCLUSIONS

1. Most of the Indian public sector banks have elaborate internal credit risk assessment models to measure transactional credit risk in business loans. However, use of theoretical or statistical models in credit ratings could not be established.
2. One of the positive aspects of credit risk assessment by the public sector banks is that they are aware of strength and weaknesses of other banks' risk management systems. This has helped them to improve their systems and increase their bargaining power against the competing banks.
3. Nearly two-third of bank managers (sample) were in favor of disclosure of rating models to borrowers. This will increase transparency in credit ratings, will encourage full disclosures of credit information by borrowers, and in case of SMEs, it will help them to improve their credit history and encourage them to have good accounting practices. Though there will also be problem of dressing or manipulation of credit information.
4. Only half of the respondents were aware of stress testing on credit risk models undertaken by the banks. This exercise is possibly undertaken by banks only at top management levels.
5. There was, however, more participation by credit managers at all levels, in undertaking sensitivity analysis in credit risk assessments.
6. Though about 75 per cent respondents agreed on importance of external ratings in credit risk measurement, statistical significance of differences in group responses could not be established.
7. Credit managers of large public sector banks are more satisfied with their credit risk rating models. Highest satisfaction has been perceived in credit managers of State Bank of India, Syndicate Bank, and Bank of Baroda. Though in total, only 56 per cent of respondents agreed that their banks' credit risk rating models are effective in capturing credit risk.
8. The evaluation of credit rating models on different dimensions highlighted the statistically significant differences in perceptions of junior managers and senior managers; and managers with low experience (up to 7 years) and high experience (above 20 years). Since credit risk assessment is highly judgmental system, there is a need for more participation of managers at all levels, in sharing of risk information and decision making. This will improve managerial skills and motivation, and will also reduce subjectivity or bias in ratings.

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