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MANAGEMENT OF APPLICATION OF BANKING MODELS FOR INTERNAL CREDIT RISK MEASUREMENT

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Abstract: *In this paper, we shall analyze the application of banking internal credit risk measurement models for the purpose of calculating the minimum regulatory capital. The Basel Committee established proposals for an internal rating based approach (IRB approach - internal rating based) for credit risk. This type of approach can ensure two key objectives: the first is additional risk sensitivity, in which there are capital requirements based on internal ratings to credit risk drivers of economic losses in the banking sector. The second is the one where the right structure of the RBI approach can provide a framework that encourages banks to continue to improve their internal risk management practices. This is based on internal ranking aims to improve safety and soundness in the financial system.*

Keywords: *measurement, management, credit risk, banking models, capital requirements, default, probability.*

1. INTRODUCTION

The paper presents the basic features of the rating system. The probability of non-payment (RD - probability at default) and other risk elements LGO (loss given default - losses

in case of non-payment) and EAO (exposure at default - exposure to losses) are the basic criteria for calculating regulatory capital. These are the most important factors that are analyzed in the control process

Especially important is the assessment of losses, which give a percentage of the exposure that banks can lose in case of lenders' mistakes. This is about the percentage of losses in the event of an error. In the base model, a credit loss occurs only if the borrower does not pay his obligations within a certain time.

There are no credit losses until default becomes a reality. In the event that the borrower defaults, the loss resulting from the loan is calculated as the difference between the initial credit exposure and the present value of future net inflows.

The future value of the loan is not certain. It would be dependent on the borrower's defaults over a defined time horizon. In the case of loan payments, the future value is calculated as the bank's credit commitment at the end of the time horizon (adjusted to recover any payment made over the time period). In case of non-payment, the future value of the loan is calculated as the loan minus the LGD. Using the credit risk model, it is concluded that the current value of the loan is known, but the future value is unknown.

The basic minimum requirements refer to the most important parts of the internal process that carry out a significant risk assessment of the debtor through exposures, security and discipline of assessment of individual parts of risk and clarity of the rating system and the way of making decisions.

Stress assessment tests are analyzed, which should be an integral part of every bank's risk analysis. In order to apply stress tests, the most important role is the management of the bank as the main factor in the stress test program. Stress testing serves to predict future portfolio investments in order to assess possible losses. It allows a combination of statistical analysis and the opinion of banking analysts to predict possible unexpected losses. In the framework of the bank's overall risk management, stress analysis is an important segment of the entire risk management process.

Stress testing provides important information to the bank's management on how the necessary capital could reduce the losses that will occur due to unforeseen market events. In addition to performing these tests that help the bank respond to the market's sudden economic problems, the bank can take additional actions to mitigate the increased level of risk. Stress testing is a tool that complements other risk measurement approaches.

1.1. Significance and topicality of the research

"Modalities of implementation of internal risk measurement systems" economic and social importance because it offers a great advantage to banks and allows them to, by applying internal processes and risk measurement models, calculate their own capital needs and thus, potentially, not only reduce reserves, but also directed towards the activities that give the highest returns to the individuals who take the risk. Such an approach directly leads to an increase in the value of banks.

There are many reasons that support the topicality, importance and necessity of research on this topic. As currently set up the RBI model allows banks to use many of the internal risk assessment models to successfully address capital requirements. Internal rating systems are key internal parameters of many credit risk models, so data quality and validation are both important for an internal rating approach and for credit risk modeling.

The characteristics and development of the internal rating system and internal estimates of default losses, as key tools of risk management, are affected by a broad management approach. Banks will move from a standardized approach to an approach based on internal rating when they have adequate systems in place. In accordance with the internal ranking approach, banks are expected to move from the basic to a more advanced methodology, in line with the improvement in their risk management practices.

1.2. Facts and research methods

In the research, special attention was paid to the hypothesis and research methodology. First of all, the facts of the research are defined, which includes a preliminary and theoretical determination of the subject of the research, and it is formulated as follows: in light of the needs of Basel II, banks and their supervisors, adequate assessment and convenience of credit risk measurement, development of methodologies for validation of external and internal rating system is of great importance.

Based on the general fact set in this way, these facts were derived :The need for numerous financial resources) to evaluate credit risk used to develop numerous parameters to credit risk;

- The reality and quality of the applied methodology is a very important issue and requires a good knowledge of the rating system;
- Banking risk managers and banking supervisors must become well acquainted with the approach to assessing the quality of work in this area;
- Banks and supervisors should know different rating calculation methods in order to spot possible weaknesses in the system and improve and assess the quality of work.

Verification of the validity of the formulated hypotheses is ensured by using the appropriate scientific and research methodology.

The methodological framework of this working paper consists in the application of general methods and techniques of research that enabled access to relevant data and information, which defined the correct course of conclusions about the subject of research.

General scientific methods such as:

- Analytical-synthetic method,
- Method of abstraction and concretization,
- Classification method,
- Method of induction and deduction.

Also, in order to achieve certain results and scientific contribution, appropriate research techniques were applied.

2. APPROACH TO THE ASSESSMENT OF THE METHODOLOGY THAT MEASURES THE PROBABILITY OF NON-PAYMENT)

2.1. Rating and methodology for assessing the probability of default

Banks should evaluate their debtors, their future situation and real liquidity in the future period. All methods of risk assessment and realistic possibilities of debt repayment to the bank by individual debtors, as well as all applied ratings, serve the bank to realistically assess the economic and financial status of its debtors.¹

The main elaboration of the principle of the rating system can be described as “a better grade, a lower proportion of debtors and a higher proportion of non-debtors who are marked with this grade”.² The discriminative power of a rating system refers to its ability to discriminate ex-ante between debtors who are in default and those who are not.

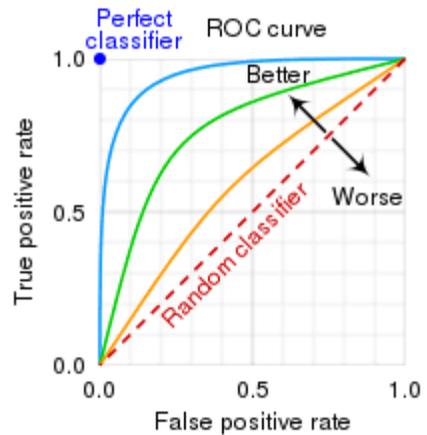
2.1.1. Discriminatory power (performance)

There are different statistical methodologies for evaluating discriminatory power³. Below are suggested methodologies that are popular in the banking sector⁴:

The overall accuracy score is known as the Gini curve or power curve or Lorentz curve. It represents an assessment whose graph can be easily drawn if two representative samples are available that relate to all types of debtors.

There are powerful tests for comparing the ROC (Receiver Operating Characteristic Curve) measure across rating systems in random ratings and in comparing two or more rating systems. Also the confidence interval characteristic of ROC measures can be estimated from available statistical software packages (AdaMSoft, ADMB).

The Pietra index is element of the debtor’s status analysis. It reflects half of the maximum distance from the ROC and the diagonal in unit square. This way is checked for the difference between ratings and random ratings and is included in almost all statistical software. These methods are not ideal and



1 .Samuels J., (2010), Management of company Finance, Champan&hall, London
 2 Basel Committee on Banking Supervision: Studies on the Validation of Internal Rating Systems. Revised version, maj. 2005
 3 Current research results indicate that due to the concavity of the risk curve, the discriminative power of the rating system shows a tendency to increase capital requirements within Basel II. There is, to a certain degree, an incentive for banks to apply higher-powered rating systems.
 4 Basel Committee on Banking Supervision: Studies on the Validation of Internal Rating Systems. Revised version, maj. 2005

cannot predict with certainty the quality of the rating system, but they are very useful and reveal a lot to us, so they are an indispensable part of the analysis of the rating system in order to assess the debtor's liquidity.

Lower p values (probability values) in such tests represent indicators with superior discriminatory power. However, in the banking sector, the largest number of rating systems will show a p value slightly higher than zero.

The error rate depends on the total PD in the portfolio. In many cases, the magnitude is much more important when treating the probability of a misidentified debtor who is actually out of default as a debtor in default, than in the case of no detection of a debtor in default.⁵ In practice, therefore, the error rate is often applied with an imaginary 50 percent probability.

Entropy is a system from information theory that refers to the exclusion of uncertainty in an experiment. Observing a debtor in time with the intention of making a decision about his solvency status can be analyzed as an experiment. In such a case, the concept of entropy, which is applied to all values of the default probability of the rating system, will contribute to high figures, since the contribution of information to the final observation of the debt status will be large.

Minimization of entropy measures such as Kuhlbachleibrer distance, conditional entropy, and information value is therefore the most accepted criterion for a high-performing rating system.⁶ However, these measures have limited utility and serve only for verification purposes.

Accuracy ratio AR (Accuracy ratio) or the ROC measure seem to have much greater importance than the other mentioned indicators precisely because of their statistical properties.

A shadow rating can be established when the available database contains accounting information on a sufficient number of externally ranked debtors. The probability of default in shadow ratings will be derived from statistics for external ratings.

In the case of samples of debtors for which both external ratings and shadow ratings are available at the same time, the degree of concordance of the two rating systems can be measured on the basis of ranking statistics, i.e. Kendall tests.

2.2. Calibration

Proving that rating systems have quality measurements is much more difficult than proving procedures that measure the discriminative power of rating systems. There are several established statistical methods for determining the value of the probability of losses based on the rating system.

5 Basel Committee on Banking Supervision: Studies on the Validation of Internal Rating Systems. Revised version, maj. 2005

6 Greuning H., (2013), Analyzing and Managing Banking risk, Second Edition, The World Bank,

The default probability value for a given rating step is then calculated as the mean value of all default probability values of each individual obligor assigned to each step. The second method consists in evaluating these score distributions for debtors in default on the one hand and debtors out of default on the other.⁷

Systematic underestimation of the value achieves a critical assessment from the point of view of experts, since in that case the calculated capital requirements of the bank will not be adequate to the resulting risk. The observations of the amount underline the need for an adequate assessment of the compliance of the bank's estimates of the probability of default.

When considering degree of freedom of the default in the portfolio, the binomial test can be applied in order to test the correctness of predicting the single probability of default.⁸ The binomial test can be applied to category ratings over time. If, for example, 20 categories are tested at a 5 percent significance level, one incorrect rejection of the null hypothesis "correct prediction" should be expected.

Cross dependencies are acceptable. Simulation studies have shown that the quality of the normal approximation is modest and exhibits a conservative bias. Type 1 errors tend to be lower, which means that the proportion of wrongly rejecting the default probability magnitude prediction will be lower than expected from the formal confidence level of the test.⁹

To a certain degree, this test even seems to be robust enough to violent assumptions about the nature of default as a time-independent event. However, the power of the test is moderate and mostly applicable to short time series (eg up to 5 years).¹⁰

The proposed version of the traffic light approach is (unlike the normal test) completely independent of any assumptions about the consistency or almost complete constancy of the size of the default probability over time. This traffic light approach is conservative in terms of contributing to a relatively higher number of false alarms that will not detect malpractice.

CONCLUSION

Internal ranking methods may be done in a number of different ways. The Basel Committee expects more and more banks to move from a standardized approach to more modern approaches and expects that they will do so once they have the necessary systems in place. Second, banks are expected to move from using basic to more advanced methodologies in line with improvements in their risk management practices.

7 Calculating the size of the value of the probability of default as the size of the slope of the CAP curve can be considered as one variant of this approach.

8 Basel Committee on Banking Supervision: Studies on the Validation of Internal Rating Systems. Revised version, maj. 2005

9 Basel Committee on Banking Supervision: Studies on the Validation of Internal Rating Systems. Revised version, maj. 2005

10 Basel Committee on Banking Supervision: Studies on the Validation of Internal Rating Systems. Revised version, maj. 2005

In this paper we have concluded that the assessment of the quality of measurement procedures by banking institutions includes two important components - the assessment of the quality of the rating system's violation and the assessment of the risk components and the assessment of the quality of the value of the rating process aimed at the application of the rating system.

The assessment of the quality of the value of the procedures of individual rating systems can be broken down into two components: the evaluation of the creation of the rating system or the creation of a model and the assessment of risk components.

Banks will be required to have a robust system for assessing the accuracy and consistency of the rating system, process, and internal assessment of risk factors. Historical time frames for data used in assessing the degree of data correlation should be as long as possible, ideally covering a complete business cycle. Also, banks must have clear stress testing available the processes they use in assessing capital adequacy.

The testing must contain the identification of future changes in economic conditions and possible events that could adversely affect bank assessments of default (debtor's default) and therefore the overall level of capital adequacy. Stress testing must be conducted at least once every six months. The results of the testing should be submitted periodically through a report to the bank's senior management.

The research confirmed that the definition of default according to Basel II is based on 2 sets of conditions - first, that the banks consider that the debtor is reluctant to pay, and second that the debtor is more than three months in arrears on any credit obligations .

To estimate the probability of default, external rating data and internal estimates of the probability of default, the definition of default events and the resulting definition of the default rate (estimate of default) must be similar. If there were certain differences in the calculation of the default rate, the main differences would be in the definitions of the default event, e.g. differences in types of default, differences in qualitative criteria of default, number of days of non-payment that will lead to default.

LITERATURE

1. Alastair L., (2013), *Mastering Risk Modeling*, First Edition, London, England,
2. Bessis J, (2012), *Risc Management in Banking*, Amacom, London,
3. Brealey R., (2011), *Principles of Corporate Finance*, Mc Graw-Hill, New York,
4. Gitman L., (2011), *Principles of Managerial Finance*, Harper Collins Publishers, New York,
5. Greuning H., (2013), *Analyzing and Managing Banking risk*, Second Edition, The World Bank,
6. Matz L., (2007), *Liquidity Risk Measurement and Management*, John Wiley Sons,
7. Mishkin F., (2020), *Banking and Financial Market*, Third edition, Collins Publishers,
8. Samuels J., (2010), *Management of company Finance*, Chapman&hall, London