Software

A Multicriteria Bank Rating System

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1. Introduction

Banks have a prominent role in the financial and business environment. The increasing risks that banks face, have led to the introduction of the new regulatory framework of Basel II, which defines the core principles for financial risk management in banking institutions. One of the pillars of this framework involves the banking supervision process. The central banks that are responsible for supervising the banks in each country use rating systems to assess the soundness of the banks. According to Sahajwala and Van den Bergh (2000), the emphasis is put on the development of formal, structured and quantified assessments taking into account the financial performance of banks as well as their underlying risk profile and risk management capabilities. Such assessments support the supervisors and examiners in identifying changes in banks' condition as early as possible.

Due to lack of sufficient historical data about bank defaults, bank rating systems usually implement empirical assessment techniques, which are based on a broad set of criteria selected from the CAMELS categories (Capital, Assets, Management, Earnings, Liquidity, and Sensitivity to market risk).

Several multicriteria techniques have also been used (mainly at the academic/research level; cf., Mareschal and Brans, 1991; Raveh, 2000; Zopounidis et al., 1995). This short paper presents the DSS implementation of a multicriteria bank rating approach. The proposed methodology is based on the PROMETHEE II method (Brans and Vincke, 1985). The bank evaluation criteria are selected in cooperation with expert analysts from the Bank of Greece. The selected criteria comply with the CAMELS framework and include both qualitative and quantitative measures. Special emphasis is put on the sensitivity of the results with regard to the relative importance of the evaluation criteria and the parameters of the PROMETHEE method. Analytic sensitivity analysis techniques are used for this purpose, together with Monte Carlo simulation.

2. Problem context and methodology

The main output of bank rating models is the classification of the banks into ordinal risk grades (groups). The number of risk groups is usually defined to be equal to 5, with group 1 indicating low risk/high performance banks and group 5 indicating high risk/low performance banks. The overall performance is decomposed into partial scores (for each individual evaluation criterion).

In accordance, with the CAMELS model which used by the Bank of Greece, a multicriteria methodology has been implemented that enables not the only definition of the required risk grades, but also the development of an overall performance index that enables comparisons on the relative performance of the banks. The methodology is based on PROMETHEE II. The workflow of the methodology is given in Figure 1.

The PROMETHEE II method is widely used to rank a set of alternatives on the basis of pairwise comparisons. In the proposed methodology, PROMETHEE II is also used to perform an absolute evaluation of the banks in comparison to a pre-specified reference point, which is selected by the bank analyst either as the ideal or the anti-ideal bank. The system incorporates several tools for supporting user in the specification of the evaluation parameters (weights, type of preference functions and the associated parameters) and provides detailed results on the overall score of the banks (net flows), its decomposition into partial scores (unicriterion net flows), and the implied risk ratings.

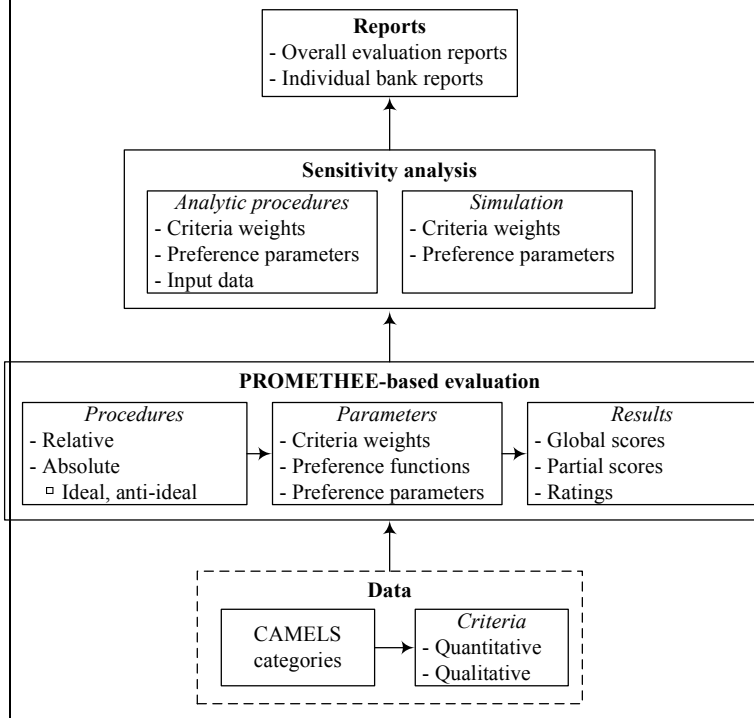

Figure 1: Modeling methodology

Special emphasis is also put on the sensitivity and robustness of the results. To this end, analytic procedures and Monte Carlo simulation are used. Analytic procedures are employed to define intervals for the criteria's weights, the parameters of the preference functions and the banks' data, within which the ratings of the banks remain unchanged. On the other hand, Monte Carlo simulation is

used to explore how different scenarios for the weights of the criteria and the preference functions affect the rating of the banks.

3. An illustration of the DSS

The DSS has been installed at the Bank of Greece, where it is currently in use. Multiple individual analysts can use the DSS simultaneously, in their local PCs, all having access to a shared database, which has the information on the criteria and the banks. Senior analysts have full access to the database and they are able to make permanent changes, by modifying the set of evaluation criteria, their weights and the corresponding type/parameter of the preference functions. Lower-level users have full access to all the capabilities of the system, but they are only allowed to make temporary modifications to the database, which are discarded upon exit from the system.

In its initial form 31 criteria (financial ratios and qualitative criteria) have been included in the system, covering all aspects of the CAMELS framework. The system, however, allows the user (senior analyst) to modify the set of criteria. The weights of the criteria have been defined by the senior analysts of the Bank of Greece. The weights are defined for each main category of criteria, as well as for the criteria in each category. Estimates of the criteria importance are also given using the rank-order centroid (ROC) and rank-sum (RS) approaches (Jia et al., 1998) as shown in Figure 2.

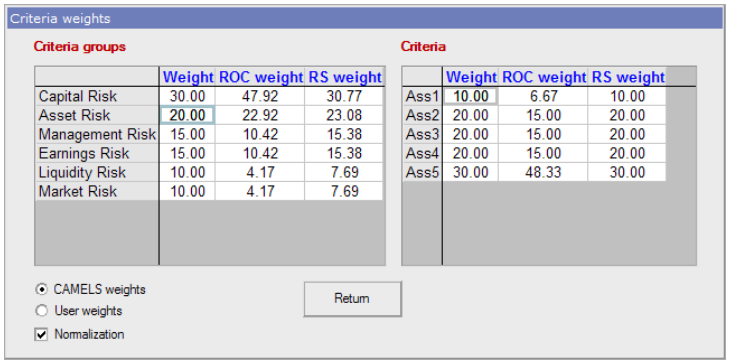

Figure 2: Definition of the criteria's weights and their ROC and RS approximations

For the specification of the preference functions of the criteria (i.e., the generalized criteria in PROMETHEE) and the corresponding parameters, the system provides a visual representation that supports the user. Through the screen of Figure 3, the analyst can specify the form of the preference function (Gaussian or linear), the corresponding parameter and the resulting unicriterion net flows for the banks in the database are illustrated in a graph. All net flows are rescaled in a [0.5, 5.5] interval in accordance with the overall 5-point rating scale. With this rescaling, lower net flows indicate better performance and lower risk. The rescaling is based on the ideal and anti-ideal values of the criteria, which are defined by the analyst. This visual representation helps the user to understand the effect of the individual preference parameters on the partial scores (unicriterion flows) of the banks.

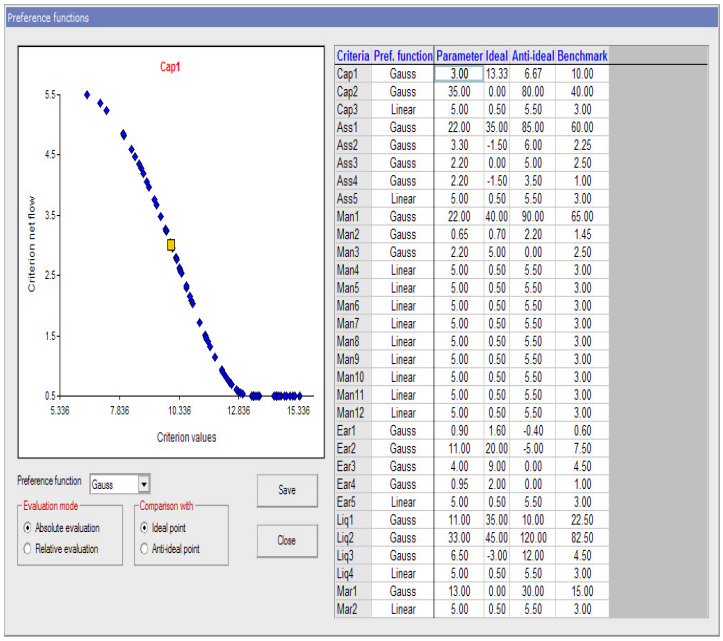

Figure 3: User-inputs for the partial preference functions (generalized criteria)

The results from the application of the PROMETHEE II method are presented through the screen of Figure 4. The overall net flows (rescaled in the aforementioned [0.5, 5.5] scale) are shown for each year and each bank. Interactive sensitivity analysis is available. The user can modify the weight and/or the parameter of the preference function for a selected criterion and the net flows are updated automatically. Analytic sensitivity results are also available in separate sheets, with regard to the weights of the criteria and the parameters of the corresponding preference function (e.g., Figure 5). Individual detailed reports on evaluation of a specific bank and the sensitivity of its ratings with respect to the parameters of the evaluation are also available.

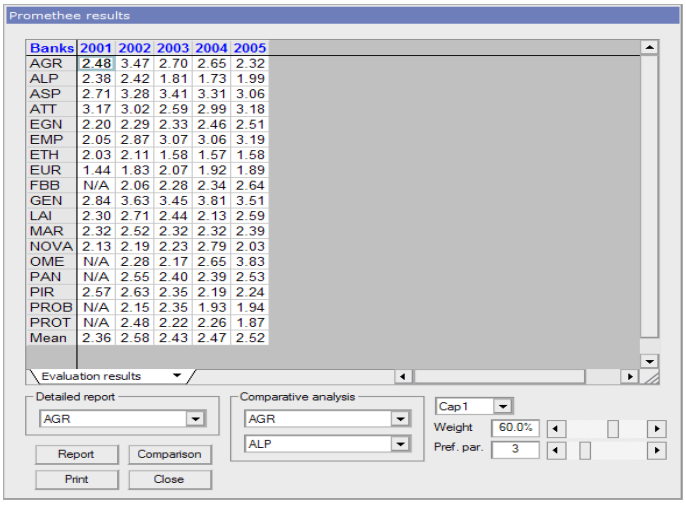

Figure 4: Presentation of the overall evaluation results

The user also has the capability to perform a Monte Carlo simulation involving the parameters of the evaluation process (weights, preference parameters). The scenarios for the simulated parameters are either completely random but additional information from the analysts can also be taken into consideration (e.g., the ranking of the criteria in terms of their relative importance). This kind of scenario analysis provides useful statistics on the performance (net flows) of the banks (e.g., means, medians, standard deviations, 95% confidence intervals). Detailed results are also given for each bank as shown in Figure 6. This kind of report provides information on the distribution of the ratings for the selected bank (across all scenarios), the variability of its net flow (Box plot). Information is also provided on the relation of the simulated parameter (weights) with the evaluation results, which supports the identification of the strengths and weaknesses of the selected bank.

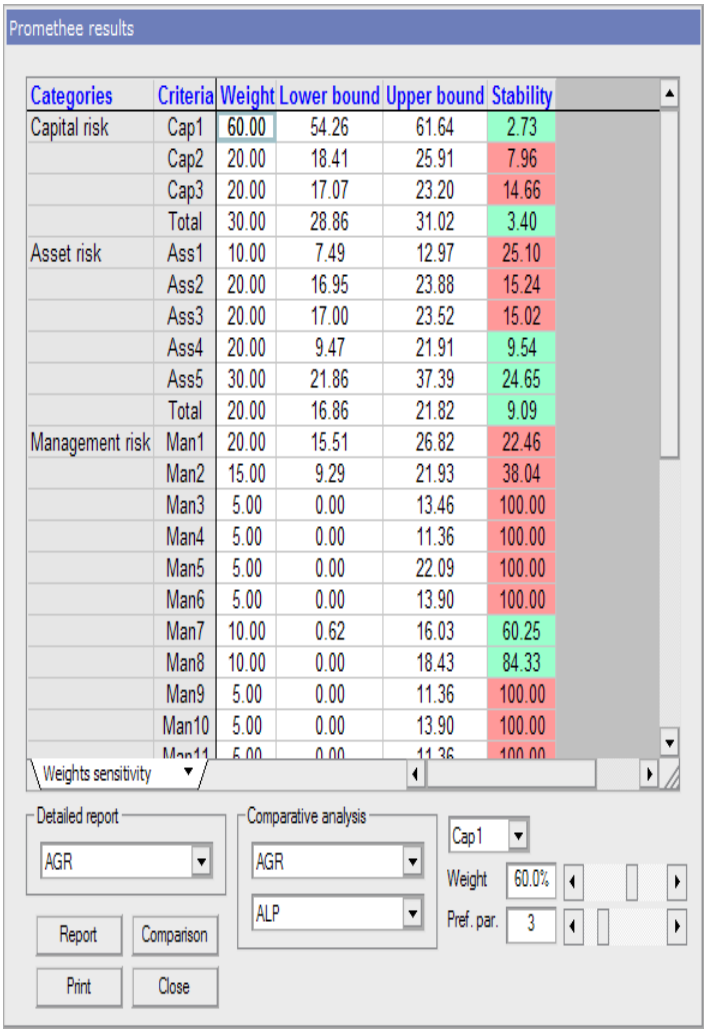

Figure 5: Sensitivity analysis results for the weights of the criteria

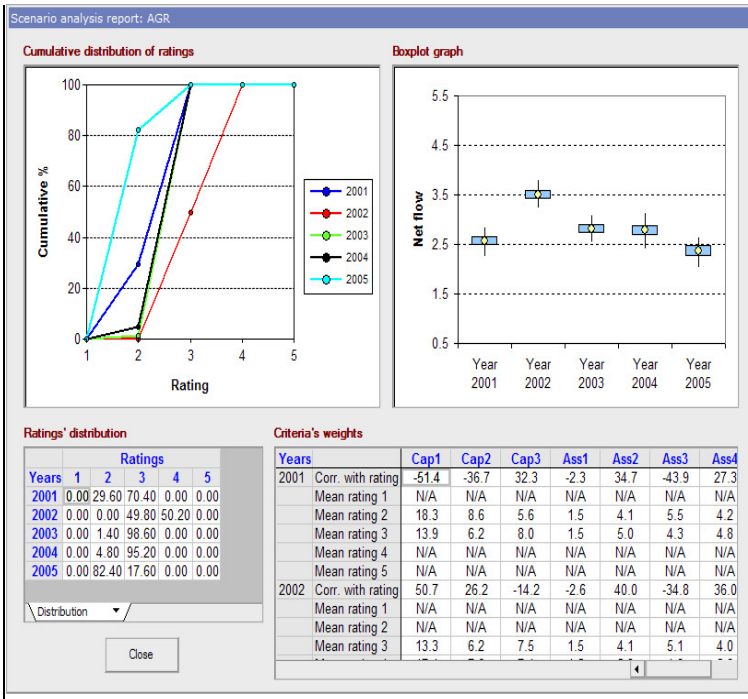

Figure 6: Scenario analysis report for a specific bank

4. Conclusions

The bank rating system presented in this short paper, has been developed to act as a supporting tool for the analysts at the Bank of Greece. It provides a rich set of evaluation options, visualization, and reports that enable the analysts to identify the strengths and weaknesses of the banks. Further enhancements are explored towards building early warning models, the extension to cooperative banks, as well as the specification of appropriate criteria regarding the investments made by Greek banks abroad.

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