Comparison of a Bank's Financial Ratios Using the Analytic Hierarchy Process

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Abstract: *The purpose of this paper is to show how to use a multi-criteria decision making method called the Analytic Hierarchy Process (AHP) to compare a bank's financial ratios. Within this study, the AHP model for the comparison of a bank's financial ratios was developed and validated. The application for comparing bank's financial ratios has been developed using Microsoft Office Excel and Visual Basic programming language. It enables comparison of financial ratios of up to 15 banks, using a developed AHP model and providing objective's (criteria and sub-criteria) relative significance and priorities of the alternatives (banks) as a result of the comparison. In the paper a developed application is used to compare 15 largest banks in Croatia according to the total value of assets as of 30thth June 2009.*

Keywords: bank, financial ratios, Analytic Hierarchy Process

1 Introduction

In our paper we will show the possibility of using multi-criteria decision making method called the Analytic Hierarchy Process (AHP) in comparing a bank's financial ratios.

The specific objectives of this paper are:

- to identify the objectives (criteria and sub-criteria) relevant to the comparison of banks
- to present a developed hierarchy structure of the AHP model for the comparison of bank's financial ratios
- to present a developed application for the comparison of bank's financial ratios and its validation
- to analyse the results of banks comparison supported by the developed application.

Bank financial ratios are used to analyse a bank's performance and to estimate its level of solvency and liquidity and can be used by the bank's clients, partners, investors or other interested parties.

The Analytic Hierarchy Process that will be used for banks comparison is one of the most widely exploited decision making methods in cases when the decision is based on several tangible and intangible criteria and sub-criteria.

The application for comparing a bank's financial ratios is developed using Microsoft Office Excel and Visual Basic programming language. It enables the comparison of financial ratios of up to 15 banks, using a developed AHP model and providing objective's (criteria and sub-criteria) relative significance and priorities of the alternatives (banks) as a result of the comparison.

2 State of the Art

The application of the AHP has received considerable attention in the recent literature. Vaidya and Kumar [7] present a literature review of the applications of the AHP. The AHP is a multiple criteria decision-making method that has been used in almost all the applications related to the decision-making: selection, evaluation, benefit–cost analysis, allocations, planning and development, priority and ranking. It is observed that the AHP is being predominantly used in the theme area of selection and evaluation. As far as the area of application is concerned, most of the times the AHP has been used in engineering, personal and social categories.

The implementation of the AHP for comparison of a bank's financial ratios has not been reported yet, including the development of the application for comparing bank's financial ratios.

Arber and Orgler [1] describe the application of the AHP to the evaluation of a bank Mergers and Acquisitions (M&A) strategy. The model developed for this important problem was tested with the assistance of the board of directors of a billion dollar bank holding company. The authors concluded that the AHP provides a useful, simple and powerful tool for dealing with strategic planning in banking.

Che, Wanga and Chuanga [3] present a fuzzy AHP and DEA (Data Envelopment Analysis) approach for making bank loan decisions for small and medium enterprises in Taiwan. This article explores small and medium enterprises, by using Fuzzy Analytic Hierarchy Process in order to choose an important index in loaning evaluation, establish one complete and efficient loaning decision-making module with its weights and Data Envelopment Analysis, and make an effective protection against high ratio of overdue loaning.

Javalgi, Armacost and Hosseini [5] show how to use the Analytic Hierarchy Process for bank management and analysis of consumer bank selection decisions. The suitability of the AHP in examining bank selection by consumers for managerial decision making is demonstrated using an empirical analysis in a major metropolitan area.

Hunjak and Jakovcevic [4] present the model for ranking and comparing banks according to several criteria. The developed model is based on the AHP and DEA method and enables the integration of quantitative and qualitative criteria in banks comparison.

3 Problem Statement

National economy is strongly dependent on business banks because, together with central banks they create conditions in which companies operate. There is a huge interest in bank business and there are many bank stakeholders, from the government to ordinary people. Each of them is interested in specific bank business segment and each of them requires specific information on bank business. There are many situations where the most suitable bank has to be chosen.

Among the most important sources of information on bank business are financial reports. Financial reports are generated yearly by the accounting department of a bank and present a synthesized picture of all business processes of a bank during the period of one year. Information presented in financial reports can be used for banks comparison and decision making on the most suitable bank according to the defined criteria. That information can be even more exploitable through financial ratios. Financial ratios are the product of financial reports and can be calculated from the data presented in financial reports. Financial ratios are widely used to analyse a bank's performance, specifically to gauge and benchmark its level of solvency and liquidity. In addition, annual financial reports are public in most cases and stakeholders can easily access them.

Within this study, the AHP is used to develop and validate a model for the comparison of financial ratios of banks. Furthermore, a special Excel-based application for comparing financial ratios of banks through the proposed AHP model is developed. The use of application will be shown to compare 15 largest business banks in Croatia. Users can express their preferences comparing the banks based on the qualitative and quantitative criteria and the results of these comparisons (calculated weights of the criteria and priorities of the alternatives) can greatly contribute to the higher quality of stakeholders' decisions.

4 Research Methodology - the Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is a powerful and flexible decision making process which is helpful in setting priorities and making the best decision when both qualitative and quantitative aspects of a decision need to be considered [6].

The AHP is one of the most widely exploited decision making methods in cases when the decision (the selection of given alternatives and their prioritizing) is based on several criteria (sub-criteria). Complex decision problem solving, which this method uses, is based on the problem decomposition into a hierarchy structure which consists of the goal, the criteria, the sub-criteria and the alternatives [6].

The method application can be explained in four steps [2]:

1. The hierarchy model of the decision problem is developed in such a way that the goal is

positioned at the top, with criteria and sub-criteria on lower levels and finally alternatives at the bottom of the model.
2. After the hierarchy has been determined, the decision makers begin the procedure of prioritising in order to determine the relative importance of elements on each level. On each hierarchy structure level, the pair-wise comparisons should be done by comparing all possible pairs of the elements of this level, starting with the top of the hierarchy and working this way to the lowest level. A pair-wise comparison is the process of comparing the relative importance, preference or likelihood of two elements with respect to another element (the goal) in the level above.
3. On the basis of the pair-wise comparisons, relative significance (weights) of elements of the hierarchy structure is calculated. The calculation of relative priorities for each decision making element through a number of numerical calculations are made. Finally, these results are eventually synthesised into an overall priority list of alternatives. Decision maker is allowed to change preferences and to test the results if the inconsistency level is considered high.
4. The results are priorities of the alternatives in the form of a priority list of alternatives and a hierarchy tree with objectives' relative significance. The sensitivity analysis is also carried out. Sensitivity analysis is used to determine the sensitivity of the alternatives to changes in the objectives' priorities.

5 The AHP model for comparison of a bank's financial ratios

It is important to note that financial ratios of banks can be compared without any model. An expert can make comparisons of financial ratios of two or more banks and bring valuable conclusions. This is because financial ratios are absolute values and can be interpreted by experts. The problem arises when someone wants to compare banks according to more than a few financial ratios. It is easy to conclude which bank is better or best according to one financial ratio, but it is slightly more difficult to determine which bank is better or best in certain business segment or in general. The problem is considerably more complex when someone needs to compare several banks according to their businesses during several years and also express his demands and preferences. For such complex problems a model has to be developed.

In this paper we propose a model based on the Analytic Hierarchy Process. Besides tangible, the AHP enables comparisons of intangible criteria. That attribute is used to enable users to express their demands on businesses of banks.

A fundamental difficulty widely acknowledged in decision-making is the measurement of intangibles. The practice so far has been to ignore intangibles and focus only on tangibles but it is obvious that most problems are a mix of physical and psychological events, the tangible and the intangible. When faced with intangibles, we have no scales of measurement to begin with and need a way to derive priorities directly. The AHP provides the answer to how these priorities need to be derived from numerical comparisons. The judgements are expressed on a cardinal scale of numbers i.e. an absolute scale. The numbers in an absolute scale cannot be transformed to other numbers (such e.g. as kilograms to pounds in ratio scales). Absolute numbers are invariant under the identity transformation and cannot be transformed to any other numbers. The AHP is a general theory of measurement that is in contrast with using a scale with an origin and an arbitrary unit. It is a theory of relative measurement with absolute scales applied to measure both tangible and intangible criteria that are homogeneous based on the judgements of experts. This is a main reason why we used the AHP. Other strengths of the proposed approach using the AHP include the following: it generates better decision-making through structure, consistency and repeatability; it is ideal for individual or group settings, providing integrated analysis and reporting capabilities; decision makers can personally indicate their opinions, ideas and knowledge; it ranks choices in the order of their effectiveness in meeting conflicting objectives; it combines tangibles and intangibles, individual values and shared values and it detects inconsistent judgements.

The AHP model is developed according to the groups of financial ratios of banks. As it was mentioned above, financial ratios are calculated from the data presented in annual financial reports, mainly a balance sheet and an income statement. Also the data about company shares market prices are required to calculate some financial ratios (Market Ratios). Groups of financial ratios are formed to present information

about specific business segments of a certain company, in this case – a bank.

The banks are specific economic subjects and the classification of their financial ratios is different from the classifications of financial ratios of other economic subjects. The AHP model for comparing financial ratios of banks is developed according to the classification that puts financial ratios into four groups and several subgroups [8]:

1. Balance Sheet Ratios
   - Liquidity Ratios
   - Indebtedness Ratios
   - Fixed Assets Investments Ratios
2. Income Statement Ratios
   - Economic Effectiveness Ratios
   - Non-Interest Activities Ratios
3. Profitability Ratios
   - Cost-Effectiveness Ratios
   - Margins and Average Interest Rates Ratios
4. Market Ratios.

There are several financial ratios in each group and subgroup that have common characteristics and give information about specific segment of bank business. Balance Sheet Ratios measure the business security and offer information about financial position of a bank. Income Statement Ratios measure the business success of a bank. Profitability Ratios measure the return of an invested capital. Market ratios measure the success of an investment into shares of banks.

In a developed application the total of 34 financial ratios can be calculated. The proposed AHP model consists of 4 criteria – groups of financial ratios and each of them consists of several sub-criteria – financial ratios [8]. Criteria and sub-criteria of the AHP model are presented in Table 1.

The application for comparing financial ratios of banks is developed in Microsoft Office Excel 2007 and Visual Basic programming language. It enables comparison of financial ratios of up to 15 banks, using proposed AHP model and providing various ranking tables and charts as a result. Besides adjusting application settings, the user must enter data from the balance sheet, income statement, shares market prices and some additional data from financial reports (3 years in a row). Evaluation of the criteria and sub-criteria is conducted by pair-wise comparisons, which is typical for the AHP. The screenshot of the criteria comparison supported by the application is shown in Fig. 1. This procedure is supported by Saaty's fundamental scale of absolute numbers [6] by which the ratios of relative importance are presented. On the basis of the pair-wise comparisons, local importance (weights) of criteria (groups of financial ratios) and sub-criteria (financial ratios) are calculated.

Finally, these results are synthesized into an overall priority list of alternatives. The application uses a special algorithm to calculate local importance of banks (alternatives) based on values of the financial ratios and ponders which the user assigned to each of the years included.

The application calculates financial ratios for each bank for 3 years in a row. Thus, financial ratios of a specific bank are absolute values. Absolute values of financial ratios enable that local priorities of alternatives can be calculated by normalization and there is no need for pair-wise comparisons like it is on other levels of the AHP model. The global importance of banks presents the final ranking of banks according to the values of their financial ratios and judgments of a particular user – stakeholder.

There are two types of financial ratios (maximum and minimum type). The application enables users to adjust the type of financial ratios if this is needed because the default types of financial ratios are set by definition. In the first case, when the financial ratio is a maximum type, a bank with the highest value of certain pondered financial ratio is assigned with the highest local priority of that ratio. In the second case, when the financial ratio is a minimum type, a bank with the lowest value of certain pondered financial ratio is assigned with the highest local priority of that ratio. The application provides a lot of ranking tables to show relations between financial ratio values and weights. It also offers a lot of graphs for visual presentation of the results. Unfortunately, it does not support the sensitivity analysis that can be used to determine the sensitivity of the alternatives to changes in the objectives' priorities.

Table 1. Criteria and sub-criteria in the AHP model and their local and global weights

Criteria	Weight	Subcriteria	Local. Weight	Global Weight
Balance Sheet Ratios	0,368	Current Ratio	0,134	0,0493
		Ratio of Credits and Received Deposits	0,134	0,0493
		Ratio of Current Assets and Credits	0,033	0,0121
		Ratio of the Capital and Total Assets	0,134	0,0493
		Ratio of Total Liabilities and Total Assets	0,134	0,0493
		Ratio of the Capital and Received Deposits	0,0516	0,019
		Clients Self-Financing Rate	0,1448	0,0533
		Ratio of Credits and Total Assets	0,1273	0,0468
		Ratio of Received Deposits and Total Assets	0,0516	0,019
		Fixed Assets Investments Rate	0,033	0,0121
		Fixed Assets and Shares Investments Rate	0,0227	0,0084
Income Statement Ratios	0,2108	Total Economic Effectiveness	0,2829	0,0596
		Ratio of Interests Revenues and Interests Expenses	0,1091	0,023
		Ratio of Total Revenues and Operating Expenses	0,0647	0,0136
		Ratio of Total Revenues and Operating Expenses and Value Adjustments	0,1091	0,023
		Ratio of Total Revenues and Employers Expenses	0,1091	0,023
		Rate of Net Fee Revenues in Total Revenues	0,2829	0,0596
		Rate of Other Net Non-Interest Revenues in Total Revenues	0,0422	0,0089
Profitability Ratios	0,3502	Return on Equity (ROE)	0,1985	0,0695
		Return on Assets (ROA)	0,1985	0,0695
		Net Return on Assets	0,0814	0,0285
		Return on Investment	0,0491	0,0172
		Interest Margin	0,1985	0,0695
		Fee Margin	0,0814	0,0285
		Non-Interest Revenues Margin	0,031	0,0109
		Operating Expenses Margin	0,0814	0,0285
		Average Asset Interest Rate	0,0491	0,0172
		Average Liability Interest Rate	0,031	0,0109
Market Ratios	0,071	Earnings per Share (EPS)	0,25	0,0178
		Dividends per Share (DPS)	0,25	0,0178
		Share Cost-Effectiveness	0,0833	0,0059
		Dividends Share Cost-Effectiveness	0,0833	0,0059
		Price/Earnings Ratio (P/E)	0,25	0,0178
		Dividend Payout Ratio	0,0833	0,0059

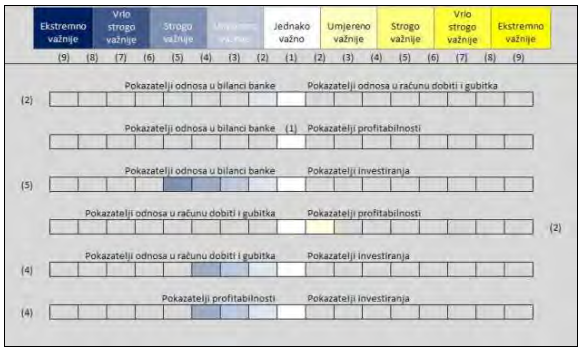

Figure 1. Criteria comparison supported by the application

6 Validation of the AHP model for comparison of a bank's financial ratios

A developed application can be used to compare financial ratios of up to 15 banks, using developed AHP model and providing objective's (criteria and sub-criteria) relative significance and priorities of the alternatives (banks) as a result of the comparison. To validate the proposed model, the application is used for comparing 15 largest banks in Croatia according to the total value of assets on 30th June 2009 (Table 2).

Table 2. Banks compared through a developed AHP model

Bank	Value of Assets in thousands HRK (June 30, 2009)
Zagrebačka banka d.d., Zagreb	91.476.312
Privredna banka Zagreb d.d., Zagreb	62.220.109
Erste & Steiermärkische Bank d.d., Rijeka	47.705.969
Raiffeisenbank Austria d.d., Zagreb	38.177.818
Hypo Alpe-Adria-Bank d.d., Zagreb	37.193.956
Société Générale – Splitska banka d.d., Split	27.325.594
Hrvatska poštanska banka d.d., Zagreb	15.079.440
OTP banka Hrvatska d.d., Zadar	12.495.163
Volksbank d.d., Zagreb	7.872.750
Međimurska banka d.d., Čakovec	2.810.033
Podravska banka d.d., Koprivnica	2.617.156
Jadranska banka d.d., Šibenik	2.264.103
Istarska kreditna banka Umag d.d., Umag	2.187.335
Karlovačka banka d.d., Karlovac	2.167.385
Banco Popolare Croatia d.d., Zagreb	2.001.400

In this research, comparisons of criteria (groups of financial ratios) and sub-criteria (financial ratios) are made from the standpoint of a central bank. To conduct the comparisons properly, three members of the Department for Economy of the Faculty of Organization and Informatics, University of Zagreb, experts in business of banks, evaluated the model.

Financial ratios, in general, indicate business security and business success. The central bank slightly prefers business security. Consequently, the most important criteria according to the central bank are Balance Sheet Ratios. The second most important criteria are Profitability Ratios. The following criteria are Income Statement Ratios and the less important criteria are Market Ratios. The weights of the criteria

(relative significance) are shown in Fig. 2 and their local and global weights in Table 1.

Weights of sub-criteria are also calculated upon pair-wise comparisons from the standpoint of the central bank (Table 1). When it comes to the Balance Sheet Ratios, the most important sub-criterion is Clients Self-Financing Rate. The sub-criteria with the highest weight among sub-criteria of the Income Statement Ratios are Total Economic Effectiveness and Rate of Net Fee Revenues in Total Revenues. The most important sub-criteria of the Profitability Ratios are Return on Equity (ROE), Return on Assets (ROA) and Interest Margin. The most important sub-criteria of the Market Ratios are Earnings per Share (EPS), Dividends per Share (DPS) and Price/Earnings Ratio (P/E). According to the weights of criteria and sub-criteria and the local importance of every alternative, the application generates the overall priority list of banks (Fig. 3).

The results of the validation show that the highest overall priority has Volksbank d.d.. The main reason for such a result is the highest local priority of the Balance Sheet Ratios, which were recognized as the most important criteria from the standpoint of the central bank.

It is a great indicator that the Analytic Hierarchy Process enables users to have significant impact on final results in cases where both tangible and intangible criteria are involved. Volksbank d.d. has the best values of seven out of 11 sub-criteria of the criteria Balance Sheet Ratios. In the balance sheet of Volksbank d.d. we can notice greater value of the capital in proportion to other values and that is mainly why Volksbank d.d. has better values of ratios in the balance sheet than other banks involved. Most of its activities Voksbank d.d. is financing from its own capital, which is the sign of high business security. Therefore, it is intelligible that the Volksbank d.d. is the best business bank from the standpoint of the central bank. In Fig. 3 the overall outcome - rank of compared banks is shown.

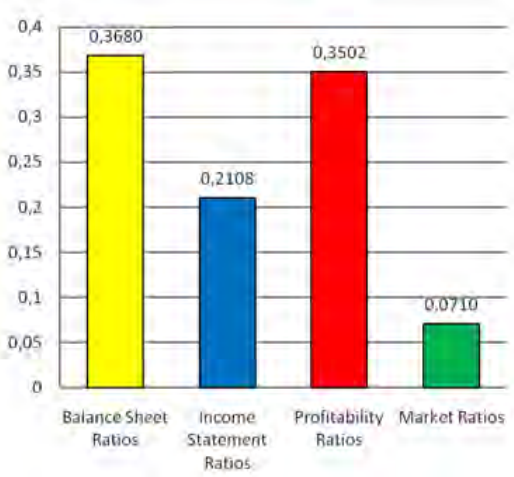

Figure 2. Outcome – relative significance of the criteria

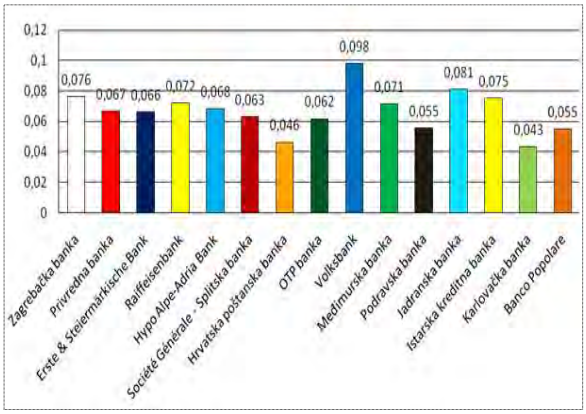

Figure 3. Overall outcome – rank of alternatives

7 Conclusion

In our research we developed an application for bank's financial ratios comparison based on the multi-criteria decision analysis method called the AHP. We identified objectives (criteria and sub-criteria) relevant to the bank's comparison and developed a hierarchy structure of the AHP model for the bank's financial ratios comparison. As a result we obtained the model for prioritizing banks that can be used as a tool for deciding which bank is better in respect to the criteria/sub-criteria from the model.

We tried to manage all the important criteria and sub-criteria for problem solving in the process of the bank's financial ratios comparison. Such a model for decision making enables multi-criteria analysis, increases and systemizes the knowledge of the problem and speeds up the decision-making process by making it less expensive.

The validation we performed shows that in the case of comparing 15 largest banks in Croatia according to the total value of assets on 30th June 2009, the Volksbank d.d. is the best business bank from the standpoint of the central bank (criteria and sub-criteria from the model).

The model presented here can be further developed and modified to reflect different environments and supporting systems.

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