ANALYSIS OF THE EFFICIENCY OF BANKS IN MONTENEGRO USING THE AHP

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ABSTRACT

Montenegro is a very small country, therefore it is very important for us to have strong banks and a strong financial sector, in general. We have experienced some difficulties in our financial sector during the nineties of XX century, but the banking reform that started in 2001 and intensified in 2002 and 2003, has been warmly welcomed by the international community.

Measurement of bank's performances traditional is based on financial ratios, but still isn't developed model that will in total satisfying needs for analysis and measure efficiency of banking business. Montenegrin's low describing using CAMELS method for measurement bank's performances. However, CAMELS method measure quantitative and qualitative ratios, but quantitative ratios are turn to qualitative ratios on personal judgment of decision maker about identify problems.

The article shows the multicriterial methods for ranking and comparing banks. The main model is based on AHP method; it's used to compare Montenegrin banks, according to several criteria. Those criteria are quantitative and qualitative. Quantitative criteria are financial ratios, which are related to the performance of bank's businesses. Qualitative criteria are characteristics used in the existing system for evaluation and supervision of banks. Criteria model determines their weights for each bank. As the end result, according to the date, the model gave rang list.

Keywords: evaluating the bank's performance, financial ratios, AHP method, comparison of pairs.

1. Introduction

The major trends that characterized Montenegro in last two years were: high GDP growth, a budgetary surplus, a record inflow of foreign direct investments, an increase in the number of employed as well as the very dynamic development of the banking system.

The banking system has been developing intensively acting as one of the key factors of economic development of Montenegro. It consists of 11 banks which perform their activities through widened business network that includes 124 organizational units, and 5 micro credit financial institutions.

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In order to achieve better results, we need to find the better way to measure the performance of the banks. Stability of the banks and their performance is one of the main requirements of the successful financial system. In order to reach that goal, Central Bank of Montenegro has to constantly control performances of the banks. In the same time, banks themselves have to undergo thorough internal control. Both this measures provide possibility to react on time, if there occur any problems.

Control of banks is just one of the motives in search for better measurement of bank's performances. Firstly, it is motive of the Central Bank of Montenegro (CBM) as an institution, which takes care of the monetary policy and has responsibility to protect citizens and whole economy from possible problems in banking system. Secondly, it is motive of capital owners of the banks, who want to be able to compare their bank with other banks, and identify causes of its own inefficiency. Finally, it is motive of persons who want to protect themselves from risky business with risky banks.

Traditionally, the measurement of bank's performances is based on financial ratios, but the model that will totally satisfy needs for analysis and measurement of banking business efficiency is not yet developed. Montenegro's low suggests the use of CAMELS method for measurement of the bank's performances. However, even though CAMELS method measures quantitative and qualitative ratios, the quantitative ratios are turn into qualitative ratios on the basis of personal judgment of decision maker about identified problems.

The paper shows the multi-criteria methods for ranking and comparing banks. The main model is based on AHP method; it is used to compare Montenegrin banks according to several criteria. There are some models for ranking banks according to their assets, but none complex model with multi-criteria overview is not in use so far. The paper consists of five parts. In the second part we give overview of the most used methods for ranking the banks, with accent on AHP method. In the third part we present model for ranking and comparing banks, and in the fourth part we present the results of applying this model to Montenegrin banks. At the end, we give conclusions.

2. Models of a multi-criteria analysis

Multi-criteria decision-making has become one of the fast growing problem areas over the last two decades. The changes have been made not only in theory but also in practice where the way of making decisions has been affected. The responsibility for decision-making has been passed from one person (executive officer) and one criterion (profit) to multi-person and multi-criteria situations. Many various methods for the solution of decision-making problems have been recommended since the 1960s. In this paper three methods of a multi-criteria analysis we will be present.

Several models for bank comparison and ranking, including CAMELS, DEA and AHP methods, have been developed. Our legislation suggests the use of CAMELS method when comparing banks. However, this report can be exploited exclusively for internal purposes, i.e. it can be used exclusively by the management and the evaluator of the bank in order to review its market position. In this part of the paper we will present a short overview of the first two models, while the model AHP will be analyzed in greater detail.

2.1. CAMELS method

CAMELS method is one of the first methods developed by Federal Deposit Insurance Corporation (FDIC) for the purpose of earlier problem detection and solving in bank transactions. The very title of the method mentioned has been made out of the initial letters of the six components on the basis of which bank performances are evaluated. These components are: Capital Adequacy, Asset Quality, Management, Earnings, Liquidity and Sensitivity to market risk. The fourth component has been treated differently in diverse literature and some authors (Hunjak, Jakocevic, 2003) use the term Equity, instead of Earnings.

ACCION CAMELS method, which is based on the same assumptions as the previous CAMELS method, has recently been developed, the only difference being the inclusion of modern business instruments. Each of these components has its indicators which are subject to measuring, but since this not being the topic of this paper, we will just note that there is total of 21 indicators, the eight of which are quantitative amounting to 47% of the overall evaluation, and 13 qualitative adding to the remaining 53%. In the previously developed model (CAMELS) quality indicators amounted to almost 70% of the overall assessment.

The essence of this model is that bank performances are evaluated on the basis of the five mentioned components, each of them, with the exception of Management, having developed qualitative methods for their measuring. However, for the purposes of this method the above mentioned values are conveyed to qualitative, on the basis of subjective evaluation of an examiner or a manager concerning the seriousness of the problems detected. The ratings are assigned on the scale from 1 to 5, one (1) being the measure of the best rating. An alphabetic scale such as AAA, AA, A; BBB, BB, B; C; D, etc., can be used instead of a numeric one. The individual ratings are than synthesized into a single one, so that at the end of the evaluation each observed bank gets its CAMELS rank position on the above mentioned scale from 1 to 5. However, the cumulative ratings do not represent their mean value. In the process of determining of a bank cumulative ratings we start with the level of component ratings, their interrelations, as well as the level of the influence of individual components on the situation in the bank evaluated. The fact that there is no ready-made model to provide ranking data on equal basis, proves to be the limitation of this method, because of which subjective evaluation of the people in charge of supervision is to be considered final.

As mentioned before, the report based on CAMELS ratings is not meant for public use, but intended exclusively to the purpose of surveillance of bank transactions, being gathered as confidential information known to reviewers and managers only. On the basis of the ratings assigned the frequency of bank transaction supervision is defined. Banks with ratings of 3, 4, and 5 are to be supervised on a yearly basis, while banks with ratings of 1 or 2 can be supervised once in two years.

2.2. Data Envelopment Analysis – DEA

DEA method is a technique for measuring the relative efficiency of decision-making units, which are to be compared. These units are entities that use certain inputs in order to produce various forms of outputs. This fact, which makes the method suitable for the comparison of all the professions which have this characteristic in common, such as banks, schools, hospitals, etc. This method has developed quickly over the last fifteen years, and it has found its application in various areas. It has been used for solving diverse economic and managerial problems in private as well as in public sector. The mathematical basis of this method is presented below in the form of fractional linear programming, which has been established by a group of scientists (Charnes, Cooper, and Rhodes, 1978):

$$Max h_0 = \sum_{j=1}^{n} w_j y_{jk0} \tag{1}$$

as well as:

$$\sum_{j=1}^{m} v_i x_{ik0} = 1$$

$$\sum_{j=1}^{n} w_j y_{jk0} \le \sum_{j=1}^{m} v_i x_{ik0},$$

$$k = 1, \ldots, K \quad w, v \ge \varepsilon \tag{2}$$

where K represents the number of decision units, m is the number of inputs, n- the number of outputs. This model is called the primary DEA model. It enables deciding on the set of optimal weights w_j of the outputs marked with y_j and weights v_i for inputs marked with x_i for a certain unit, resulting in the maxim efficacy h_0. According to this model the unit observed is effective if only if the value of h_0 equals 1. There are many different DEA models in practice. The main condition of this method is that it can be applied only if there are a number of decision units, i.e., the number of entities to be compared have to be at least three times greater than the total number of inputs and outputs. As the purpose of comparison is to group similar characteristics, the problem arises when there are few entities to be compared.

This method finds its best application in comparison of bank, school, and hospital branch offices…While measuring bank branch offices efficiency as input values can be used some of the following: accounting inventory, material expenditures etc, whereas total deposits, total loans etc. can be considered output values. The purpose of this method is the assessment of the efficiency of the branch offices. In addition to that, the result obtained provides the information on possible steps towards enhancing the efficiency of certain, less successful offices as well as the information at what cost it might be feasible.

2.3. AHP – Analytic Hierarchy Process
AHP (Saaty, 1980a) is one of the best-known and most often used decision making models in cases when a decision is based on multiple attributes which are used as criteria. In this case study the decision relates to the choice of one of the alternatives (banks) available or their ranking. In the problem solving three components can be identified: 1) system decomposition 2) comparative assessment and 3) synthesis of priorities.

System decomposition is forming a hierarchical structure with the basic elements of the system, that is, with its goal, criteria (sub-criteria) and alternatives. The second component of the process is a mathematical model by means of which the priorities (weights) of the elements placed at the same level of the hierarchical structure are calculated. This mathematical model is the basis for generating the ranking scale. The third component of the model means that the generated local priorities of the criteria, sub-criteria and alternatives are synthesized into the total criteria alternative priorities.
At the beginning of the application of this method it is necessary to define the hierarchy model and its elements with the goal at the top, criteria and sub-criteria as sublevels in the middle and, finally, alternatives are placed at the bottom. The next step is generating a mathematical model. This model is based on mutual pairwise comparison. I.e. at each level of a hierarchy structure its elements are subjected to pairwise comparison. Decision makers' preferences are presented by a scale. The scale is defined as the ratio scale and is assumed that the intensity of preferences between each two alternatives can be represented using the scale. Saaty uses the scale which has 5 levels and 4 sub-levels, i.e. verbally described intensities and their respective numerical values in the range 1-9. Saaty's scale is presented in the Table 1.

On the basis of the mathematical model, and from the assessment of the relative importance of the elements of the corresponding level in the hierarchy structure local priorities, that is, weights of criteria and sub-criteria as well as alternatives are derived, and then synthesized in the total alternative priorities. In the end, the ranking list of the ranking values of the alternatives is obtained, so that the sensitivity analysis can be conducted.

Table 1. Saaty's scale

Intensity of importance	Definition	Explanation
1	Equal importance	Two alternatives contribute equally to the same goal
2	Weak importance	
3	Moderate importance	On the basis of experience and evaluation one alternative is slightly preferred to the other.
4	Moderate importance +	
5	Strong importance	On the basis of experience and evaluation one alternative is favored strongly over the other.
6	Strong +	
7	Very strong, demonstrated importance	One alternative is favored strongly over the other; its dominance demonstrated in practice.
8	Very, very strong	
9	Extreme importance	The evidence on the basis of which one alternative is favored of the highest possible order of an affirmation.
2,4,6,8	Sublevels	

Source: Saaty, T. (1980): "*The Analytic Hierarchy Process*", McGraw-Hill, New York, 54.

In order to explain the mathematical model, we are supposed to start with certain assumptions. If n represents a number of criteria or alternatives, and C_1, C_2, …, C_n a set of alternatives, the quantitative pairwise assessment of activities C_i, C_j is represented by nxn matrix

$$A = (a_{ij}), \qquad (I, j = 1, 2,…, n)$$

where the elements a_{ij} are defined by the following rules (Saaty, 1980b):

Rule1. If $a_{ij} = \alpha$, then $a_{ji} = \dfrac{1}{\alpha}, \alpha \neq 0$. This rule means that all the rows in the matrix are proportional to the first row and all of them are positive.

Rule 2. If it is estimated that C_i is equally important as C_j, then it follows that $a_{ij} = 1$, $a_{ji} = 1$, and $a_{ii} = 1$ for each i.

Therefore, the matrix is arranged as follows

$$A = \begin{bmatrix} 1 & a_{12} & ... & a_{1n} \\ \dfrac{1}{a_{12}} & 1 & ... & a_{2n} \\ \vdots & \vdots & ... & \vdots \\ \vdots & \vdots & ... & \vdots \\ \dfrac{1}{a_{1n}} & \dfrac{1}{a_{2n}} & ... & 1 \end{bmatrix} \qquad (3)$$

The set of alternatives and the elements of the matrix A having been defined, it is necessary to determine numerical weights (priorities) w_1, w_2, …, w_n , which will influence the assessment. The weights w_i is determined on the basis of the assessment of the values of their ratio which is defined as follows:

$$a_{ij} = \frac{w_i}{w_j} \qquad (4)$$

The matrix A can be given as follows:

$$A = \begin{bmatrix} \dfrac{w_1}{w_1} & \dfrac{w_1}{w_2} & \cdots & \dfrac{w_1}{w_n} \\ \dfrac{w_2}{w_1} & \dfrac{w_2}{w_2} & \cdots & \dfrac{w_2}{w_n} \\ \vdots & \vdots & & \vdots \\ \vdots & \vdots & & \vdots \\ \dfrac{w_n}{w_1} & \dfrac{w_n}{w_2} & \cdots & \dfrac{w_n}{w_n} \end{bmatrix}$$

The matrix A, in case of consistent assessment, where $a_{ij} = a_{ik} a_{kj}$, fulfils the equation

$$Aw = nw \qquad (5)$$

The matrix A has special properties defined by the rules 1 and 2, due to which only one of its eigenvalues is different from 0 and equals n. In practice, however, it often happens that matrix A contains non-consistent assessments, so that the previous equation cannot be valid. In such a case, weight vector w is obtained by solving the following equation:

$$Aw = \lambda_{max}w \qquad (6)$$

under the condition $\sum w_i = 1$. λ_{max} represents the greatest eigenvalue of the matrix A Due to the properties of the matrix, it follows that $\lambda_{max} \geq n$. Small changes in values of a_{ij} initiate small changes in λ_{max}, the deviation in relation to n is the measure of consistency. It enables us to measure precision of our scale in relation to an unlimited scale, which we want to assess. Therefore, consistency index

$$CI = \frac{\lambda_{max} - n}{n - 1} \qquad (7)$$

can be taken as our indicator of an "approximate, precise consistency". By means of consistency index the consistency ratio is calculated.

$$CR = CI/RI \qquad (8)$$

where RI is the random index (the consistency index of a randomly generated n-th order pairwise comparison matrix. In Table 2. calculated values are presented).

Table 2. Calculated values

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0,52	0,89	1,11	1,25	1,35	1,40	1,45	1,49	1,51	1,54	1,56	1,57	1,58

If CR for the matrix A is bellow 0,10, the assessments of the relative importance of the criteria are considered acceptable. If it is not the case the reasons for such a high inconsistency are to be found.
In this paper a model for bank ranking based on AHP method will be shown. The reason for choosing this model is the fact it consists of a great number of criteria, not all of which of the same importance. In addition to this, a high quality computer system/software Super Decision has been developed. It is used in assisting the development of the model and enables a detailed sensitivity analysis of the final ranking list on the change of the values which are assessed subjectively.

3. AHP model for bank ranking and comparison

In order to make an AHP model it is necessary to define the goal, criteria, sub-criteria and alternatives. The goal of this model is ranking of the banks in Montenegro from the best to the worst; the criteria have been divided into two groups – qualitative and quantitative. Quantitative criteria are financial ratios which display characteristics of certain bank performances. When choosing financial ratios in the model, the experience of many different experts in the field have been used. (Yeh, 1996) Financial ratios are divided into four groups: liquidity, efficiency, profitability and capital adequacy. Within each group sub-criteria have also been defined. Liquidity sub-criteria are:

1) L1 = money + money equivalents + investments / total deposits;
2) L2 = total approved loans / total deposits;
3) L3 = Liquid assets / total assets

Efficiency sub-criteria are:

1) E1 = operational expenditures / operational income;
2) E2 = provision costs / net interest rate income;
3) E3 = operational income / total number of employees.

Profitability sub-criteria are:

1) P1 = Profit before tax /equity;
2) P2 = Profit before tax / total assets;
3) P3 = Profit before tax /operational income.

And for the last group – capital adequacy, the sub-criteria are:

1) C1 = total obligations / equity;
2) C2 = equity / total loans;
3) C3 = total deposits / equity.
4) C4= capital adequacy = risky capital / sum of risk weighted assets.

Qualitative factors are owners' support, the importance of a bank in the financial system of Montenegro (significance), management and the bank maturity. These criteria could not be described by any of qualitative methods, so we use verbal descriptions. Alternatives are represented by 11 Montenegrin banks.

In order to use this model for bank ranking, we need to determine the weights of the main criteria and sub-criteria, and then for each criteria at the bottom level of the hierarchy structure to define the intensities for the evaluation of the relevant bank performances. The weights of criteria and sub-criteria are calculated by the help of Super Decision software on the basis of the pairwise comparison of relative criteria and sub-criteria importance. For quantity criteria, the intensities are defined on the basis of the five-level scale of intensities (excellent, very good, good, satisfactory, weak), which have been derived on the basis of the range in which their values have fluctuated. The values of the indicators for all banks are shown in chart 2, and chart 3 shows the range of particular intensity levels.

As for the qualitative criteria, we have used the same evaluation as in CAMELS method, so the intensity scale for each category has been generated. For example, the scale for owners support is defined as: excellent, very good, good, satisfied and bed; the importance of the bank as: excellent, very good, good, satisfied and small; the management: excellent, very strong, strong, average, weak and, finally, the maturity of the bank is assessed as: more than 10 years, from 5 to 10 years, and less than 10 years. It has been stated earlier that CAMELS method has 5 levels for each criteria, but due to the deficiency of precise and quality information, it has not been possible to recognize some subtler levels, as can be performed by the examiners for the bank monitoring who are entitled to have access to all the necessary information.

Structure of AHP model for bank ranking and comparison is presented in Figure 1.
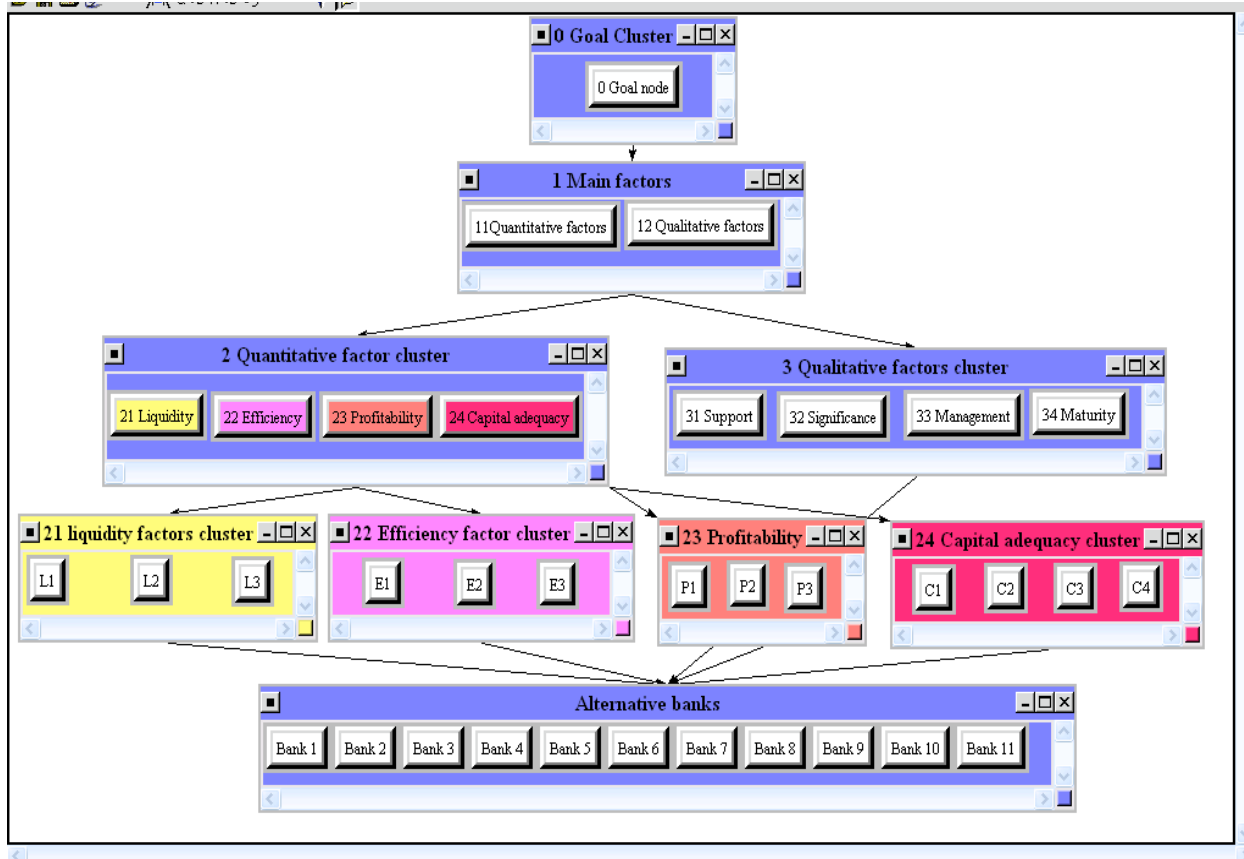
Figure 1. Structure of AHP model for bank ranking and comparison

4. Empirical verification of the model

The model for ranking and comparing banks is applied on Montenegrin banks. The data on bank performances refer to the previous year (2008) and are selected from annual reports. Values of financial ratios are presented in Table 3. Table 4. contains intensities or marginal values of quantitative criteria. With those values we fill model, calculated by the Super Decision software. Graphical illustration of ranks is shown in Table 5. Weights for quantitative criteria are presented in Table 6.

Model gives a lot of possibilities. For example, we can rank banks according to liquidity criteria. Similarly, valuations can be given for every criterion that is included in model, according to most interest or most significant aspect for the decision maker. Model gives possibility for sensitive analysis. We can change priority of the several criteria, and observe what is going on with banks in that case. Using this possibility, we can foresee and prevent possible problems.

Table 3. Values of financial ratios

	Criterion												
	L1	L2	L3	E1	E2	E3	P1	P2	P3	C1	C2	C3	C4
BANK 1	1,214	0,873	0,277	0,643	0,387	156	0,187	0,007	0,158	25	0,358	21	13,25
BANK 2	1,16	0,83	0,25	0,252	0,68	36,55	0,065	0,013	0,25	4,04	109	3,78	20,67
BANK 3	1,404	1,063	0,227	0,366	0,273	36,18	0,049	0,0062	0,112	6,881	0,777	5,245	14,44
BANK 4	4,25	3,667	0,138	0,591	2,37	72,23	-0,494	-0,025	-0,734	18,342	0,078	4,583	16,16
BANK 5	4,462	0	0,914	0	0	0	-0,045	-0,034	0	0,331	0	0,272	17,22
BANK 6	1,35	0,833	0,376	0,12	0,524	23,59	0,064	0,015	0,311	3,169	0	3,035	26,8
BANK 7	1,1	0,967	0,121	0,493	0,691	111,69	0,159	0,009	0,249	16,857	3,065	16,11	8
BANK 8	1,22	0,749	0,374	0,169	0,063	86,89	0,38	0,038	0,369	8,882	1,363	7,85	17,4
BANK 9	1,443	1,167	0,189	0,457	0,359	77,24	0,153	0,009	0,172	15,46	0,3087	11,294	11,09
BANK 10	1,735	1,45	0,165	0,324	1,038	26,008	0,056	0,015	0,332	2,812	2,788	2,214	37,7
BANK 11	4,715	2,358	0,347	0,172	0,896	25,58	0,013	0,01	0,249	0,286	165,065	0,196	76
Criterion	max	max	max	min	min	max	max	max	max	min	max	min	max
Best value	4,715	3,667	0,914	0,12	0,063	156	0,38	0,38	0,369	0,286	165.065	0,196	76
Worst value	1,1	0	0,121	0,643	2,37	23,59	-0,494	-0,34	-0,734	25	0,078	21	8

Table 4. Values of intensities

Criterion	L1	L2	L3	E1	E2	E3	P1	P2	P3	C1	C2	C3	C4
Type	max	max	max	min	min	max	max	max	max	min	max	min	max
Excellent	(4.51 - 5.0)	(3.51 - 4.0)	(0.86-1.0)	(0.0-<0.1)	(0.0 -<0.3)	(136-160)	(0.35-0.40)	(0.036-0.04)	(0.35-0.4)	(0 -<4)	(91-170)	(0 - <2)	(70 - 100)
Very good	(3.61-<4.50)	(2.61-<3.50)	(0.66-<0.86)	(0.11-<0.25)	(0.31-<0.80)	(101-<135)	(0.26-<0.34)	(0.026-<0.035)	(0.26-<0.34)	(4 - <9)	(51-<90)	(2 -<7)	(50 - <70)
Good	(2.41-<3.60)	(1.41-<2.60)	(0.36-<0.65)	(0.26-<0.45)	(0.81-<1.60)	(61-<100)	(0.15-<0.25)	(0.013-<0.025)	(0.14-<0.25)	(9 - <17)	(9-<50)	(7 -<17)	(20 - <50)
Satisfied	(1.51-<2.40)	(0.51-<1.40)	(0.16-<0.35)	(0.46-<0.60)	(1.61-<2.20)	(26-<60)	(0.06-<0.14)	(0.005-<0.012)	(0.06-<0.13)	(17 - <22)	(3-<8)	(17 - <23)	(11 - <20)
Bed	(1.0-<1.50)	(0.0-<0.5)	(0.0-<0.15)	(0.61 - 0.70)	(2.21-2.50)	(0-<25)	(0.0-<0.05)	(0.0-<0.005)	(0.0-<0.05)	(22 -25)	(0-<2)	(23 -25)	(8 - <11)

Table 5. Graphical illustration of ranks

Graphic	Ratings Alternatives	Total	Ideal	Normal	Ranking
	Bank 1	0.5071	1.0000	0.1318	1
	Bank 2	0.2090	0.4121	0.0543	11
	Bank 3	0.3454	0.6811	0.0898	7
	Bank 4	0.3944	0.7777	0.1025	4
	Bank 5	0.3658	0.7214	0.0951	6
	Bank 6	0.2533	0.4995	0.0658	8
	Bank 7	0.2255	0.4447	0.0586	10
	Bank 8	0.3888	0.7668	0.1011	5
	Bank 9	0.4987	0.9835	0.1296	2
	Bank 10	0.2361	0.4655	0.0614	9
	Bank 11	0.4226	0.8335	0.1099	3

Table 6. Weights for quantitative criteria

The inconsistency index is 0.0227. It is desirable to have a value of less than 0.1

21 Liquidity		0.443509
22 Efficiency		0.122220
23 Profitability		0.122220
24 Capital adequacy		0.312051

5. Conclusion

There are several arguments for ranking and comparing banks. Banks, can be observe trough measurement of bank's performance. The measurement of bank's performances is based on several criteria and those criteria are quantitative and qualitative. Quantitative criteria are financial ratios which are selected from annual reports of banks. As for the qualitative criteria we have used scale of intensities for each category.

Measurement of bank's performance is very complex problem, so we need to develop a model that could reply to different situation and accommodate different angles of observing decision makers who compare banks. The paper shows that AHP method is very appropriate for the development of such model. The showed model is better then the other models (for example CAMELS method), which can be used for comparing banks, because:
- It consists of a great number of criteria, not all of which of the same importance;
- It is convenient for ranking a few entities (banks in this case) according to several criteria;
- It gives possibility for measurement of consistency of personal judgment and
- Possibilities of sensitivity analysis of the final ranking list on the change of the values which are assessed subjectively.
However, putting the above said in contest of Montenegro financial system, we think that applying AHP method along with CAMELS method, will contribute to more objective measurement of bank's

performance in Montenegro. Possibility of using model that based on AHP method is various. Future research should be directed to the model specialization for specific purpose, such as assessment of banks investment on capital market, client selection for giving credit, etc.

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