Financial Structure and the Profitability of Croatian Banks

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Abstract: Banks can be differed considering their size, cost and revenue structure, which together with macroeconomic conditions influences their profitability. Goal of the paper is to detect to what extents specific characteristics of the bank and macroeconomic conditions influence bank's profitability. Results of the analysis indicated that in short run and stable macroeconomic conditions higher profitability is accomplished by the well-capitalized banks with larger market share, which are also efficient in managing their operating costs and are able to pass "non-interest" assets costs to their clients. Several forecasting methods are used to predict bank's profitability, and CR&T decision tree was the most efficient one with the lowest forecasting errors. Because of its simplicity CR&T decision tree could be used for "what-if" analysis in order to examine influence of different bank characteristics to its profitability.

Key words: financial structure, bank profits, forecasting, regression analysis, decision tree, neural networks

1. Introduction

Bank's primary goal is to bring results in profit. However, bank's profitability is important not only for directly interested parties (shareholders, management, employees, clients), but also for the entire economy. After transition period, bank sector in Croatia should be able to efficiently fulfill the role of the main resource allocator in economy. Croatian economy had the opportunity to experience what a bank crisis means, and how it affects a wide-range of people. As opposed to the companies that deal with non-banking activities, it's in the interest of the government to have a profitable bank sector. Therefore, efficiency of the banking sector raises two questions. What influences the banks profitability? Can the banks profitability be predicted?

The purpose of this paper is to establish the determinants of Croatian bank profitability, with special emphasis on environmental factors (gross domestic product, inflation, exchange rate) and factors which are specific for each bank (size, cost and revenue structure). Bank Scope database was used as an information resource. The determinants of profitability will be analyzed by regression method. A model for forecasting success of

each bank will also be designed, with the use of three methods: regression analysis, neural networks and ′decision tree′ methods.

The paper is organized like following. After the introduction some recent research about bank profitability is described. In the third section measures of bank profitability are described, as well as the factors of their profitability. In the fourth section the regression analysis of Croatian banks profitability is described, and the methodology is presented with the results. The last section of the paper contains the final discussion.

2. Recent research

Research about banking sector profitability can be divided into two groups: research that analyzes banking sector profitability in one country, and the research that do the same, but for a group of countries.

Researches which analyze bank profitability are mainly focused on American banking system [3], [5], that have shown the existence of the positive correlation between shareholder's equity of the bank and the capital/assets ratio, and the management efficiency. Several researches

have been conducted even in smaller countries. Barajas, Steiner and Salazar [4] have showed that the financial market liberalization had a positive effect on Columbian banks' profitability. Afanasieff, Lhacer and Nakane [1] use panel research to determine which factor have the highest influence on the interest revenue in Brazilian banks. Spathis, Kosmidou and Doumpos [20] have found out, using more-criteria analyzes, that the highest influence on the Greek banks profitability has the banks size. Smaller banks had higher profitability, but also a higher risk, which is contrary with the results of other researches of banks profitability [14], [5], [8]. There are several researches which analyze Croatian's banking sector profitability, but in different aspects. Kraft and Tirtiroglu [12] analyze the efficiency of bank institutions in Croatia, and Kraft with Hofler and Payne [11] conducts similar research, but in aspect of privatization and the entrance of foreign banks, with the stress on banks' cost efficiency.

The second group of research tries to determine the profitability of the banks on the sample of more countries. Demirguc-Kunt and Levine [7] have measured the influence of several independed variables on bank profitability on the sample of 43 countries and 2237 banks. After this research several similar ones were conducted (e.g. [16], [10]). Fries, Neven and Seabright [9] have analyzed business activities of the banks in transitional countries, and shown that the banking system reform the basic assumption of its stability.

3. Measurement and the factors of bank profitability

In this section we will describe the ways of measurement bank profitability, and the factors which influence the profitability. Bank Scope database was used as an information source, from which data about Croatian banks business activities in the period from 1999 until 2003 have been gathered. Information about the banks weren't complete in observed period, and only about 30 banks had the complete data. These data was used in the analysis.

3.1 Measurement of banks profitability

Banks efficiency is measured by the return on average assets (ROAA), and the return on average equity (ROAE). Based on these proportions which show the success of banks business activity in general and the certain components of their balance sheet, recommendations about more efficient managing in banking sector can be brought to the management. With this approach profitability is tried to be expressed with

one number, which follows duPond procedure of evaluation banking activities by analyzing proportion.

The return on average assets (ROAA) is calculated as a net profit/the average net assets ratio. Hence, it is the bank's profit per one *kuna*[1] of assets, and if the ROAA is larger than 1 it is assumed that the investment in this bank's shares is profitable.

The return on average equity (ROAE) is calculated as a net profit (after taxation) /average equity ratio. This measure shows the bank's owners how much profit the management achieved per one *kuna* of their share of the bank's capital. It is important to highlight that the bank's capital is expressed in its book-value, and not the price of one share. This indicator should equal the inflation rate at least, to preserve the value of the substance.

Correlation between the return on average assets (ROAA) and the return on average equity (ROAE) is significant. Both indicators are connected through the equity multiplier EM, which equals the net assets divided by net shareholder's equity. This indicator measures the financial leverage, and in the same time it is the measure of profit and risk. Since the ROAE can be calculated as a product of ROAA and the multiplier EM we can conclude that the ROAE can increase by increasing the assets profitability or by increasing the financial leverage. It is important to stress that the ROAE is very responsive to the ROAA, which means that the small change in return on average assets means a large change in the return on average equity.

In table 1 are shown the measures of banks profitability for the banks form the sample. The return on average assets (ROAA) has slightly risen in year 2000 in relation to year 1999, but is constantly decreasing in the next three years. The return on average equity (ROAE) slightly rose to the year 2001, after which is gradually decreasing[2].

Table 1 Profitability measures for the banks in sample

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[1] Kuna is Croatian currency.
[2] Shown average values differ form the data set for all the banks [15]. There is a difference, but due to the lack of original data it was not possible to check whether statistically significant difference between the population of all the banks and the used sample exists. National bank groups all the banks in four groups, and the calculated measures of profitability do not correspond to neither of the groups, which indicate that the sample is not biased in a way that it uses date of the banks with homogeneous characteristics.

Year	Indicator	ROAA	ROAE
1999	Number of banks	29	29
	Average	1,89	9,76
	Standard deviation	1,69	8,36
2000	Number of banks	29	29
	Average	1,97	10,52
	Standard deviation	1,68	8,20
2001	Number of banks	32	32
	Average	1,59	10,96
	Standard deviation	1,04	8,52
2002	Number of banks	30	30
	Average	1,40	10,31
	Standard deviation	0,90	6,51
2003	Number of banks	31	31
	Average	1,41	10,48
	Standard deviation	0,78	5,35

Source: Bank Scope

3.2. Factors of banks profitability

Factors of banks profitability can be divided into two basic groups: characteristics of a specific bank and environmental factors and they are mentioned by most researches listed in the previous section of the paper. Characteristics specific for a certain bank are: market share, capital/assets ratio, credit/asset ratio, operating expenses/assets ratio, and non-income assets/total bank's assets ratio[3].

Market share should have a positive influence on bank's profitability. Different hypothesis about market operations explain this fact on different ways. According to Relative Market Power Hypothesis only companies that are in a monopolistic position and have large market share, and highly differentiated products can achieve over-average profit margins. Efficient-structure Hypothesis starts from the statement that the most efficient companies achieve the largest market shares. Berger [5] tested these two theories on banking market, and showed that the size of the bank is connected to profitability, and the same have showed Frame and Kamerschen [8]. On the other hand, according to Smirlock, Gilligan and Marshal [20] the majority of empirical studies have shown a weak connection between market share and the size of a company's profit. According to them, concentration is not a priori connected with superior efficiency of leading companies, but the companies which have comparative advantage become large and precedes large market shares.

Bank's profitability should be positively connected to the capital/assets ratio. Well capitalized banks with high share of capital in their assets have minor possibility of expected bankrupt, and the cost of financing of the bank should be lower, which should have an influence on a higher profitability.

Credit/assets ratio should also have a positive influence on profitability. Bank which approves more bank credits, earns more on the interest, which increases profit. However, this connection is not completely linear, because profitability growth is not proportional to the credit growth if the approved credits are too risky.

A bank which has a higher share of non-profit assets in its asset should be less profitable than the bank which does not have that. This kind of asset represents a cost to a bank, but sometimes it does not have to. A bank which pays rent on real estate can have higher cost than a bank which has its own building, and in this case connection should be negative. Also, if a bank succeeds to "transfer" this cost to its clients, the connection can be negative.

According to traditional argument efficient companies earn extra profits [19], which are confirmed by research which measure efficiency by operating cost/assets ratio. So the operating costs/assets ratio should be negatively connected with profitability, which means that the growth of this ratio diminishes bank's profitability, and vice versa.

The values of these indicators per year for the banks from the sample are shown in table 2. Average market share is decreasing in the past five years together with the standard deviation, which means that the concentration falls. Capital/share ratio is also decreasing, but is still relatively high, which means that the banks are lowering the share of the capital in their assets, but are still quite careful because of disbelief in banking system stability. Credit/assets ratio is growing, which supports the well known claim about credit expansion. Non-interest assets/total assets ratio is stagnating in its permanent position, and the same is valid for operating costs/assets ration.

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[3] Non-income assets are for example cash and real estate.

Table 2 Bank's characteristic as a factor of bank profitability

Year	Indicators	Market share	Capital/ assets ratio	Credit/ assets ratio	Non-profit asset/ total assets ratio	Operating costs/ assets ratio
1999	Number of banks	29	29	29	29	29
	Average	3,45	53,96	24,29	1,86	2,68
	Standard deviation	5,95	12,05	16,19	1,22	1,75
2000	Number of banks	29	29	29	29	29
	Average	3,45	23,01	50,97	2,76	5,00
	Standard deviation	6,15	15,32	13,02	1,72	2,57
2001	Number of banks	32	32	32	32	32
	Average	3,13	17,37	50,41	2,03	4,15
	Standard deviation	5,47	12,93	12,42	1,12	1,91
2002	Number of banks	30	30	30	30	30
	Average	3,33	15,24	55,52	2,29	3,74
	Standard deviation	5,48	8,91	8,94	3,27	1,60
2003	Number of banks	31	31	31	31	31
	Average	3,13	15,44	57,65	2,02	4,19
	Standard deviation	5,52	8,97	7,15	0,96	2,03

Source: Bank Scope

Environmental factors are: gross domestic product growth rate, inflation, average exchange rate (Croatian currency to Euro), and gross domestic product per capita. Growth rate of gross domestic product should have a positive impact on bank profitability. Inflation can have a positive or a negative influence on profitability, depending on management's competency to efficiently manage bank's resources in case of inflation. Finally, the exchange rate should be negatively linked to bank's profitability, which is explained as following. In case of appreciation of domestic currency, Croatian companies become less competitive on the world market, which decreases gross domestic product and in that way has a negative impact on bank profitability. In last five years inflation decreased, GDP per capita and GDP growth rate increased, while exchange rate remained approximately unchanged.

4. Regression analysis of Croatian bank profitability

4.1. Methodology

Regression and correlation analysis are quantitative methods of determining relations (connections) between variables. To conduct regression analysis it is important to precisely define which variable is depended (variable that is being explained) and which variable is independed (variable used for explanation). In doing so, there can be only one independed variable, but there can

also be several of them. It is also necessary to select functional form of link between variables.

Regression and correlation analysis determines the direction, intensity and format of the link between variables, and evaluates model's representatives, to determine existing validity between variables and the possibilities of assessment the level of depended variable for presumed level of independed variable. Prior the analysis it is useful to draw scattering scheme, to retrieve preliminary conclusions about direction, intensity and format of the link between the variables.

Regression model is a simplified image of relation of observed variables. Regression model is stochastic because it includes deviation variable (accidental component). The model of simple linear regression is applied if the movement of the depended variable is observed depending on the movement of one independed variable, and if the form of the link is linear. The model of multiple regression is applied if the movement of depended variable is observed depending on the movement of two or more independed variables, and if the form of the link in linear. General model of linear regression model with estimated parameters is:

$$\bar{Y}_i = \alpha + \sum_{j=1}^{k} \beta_j x_{ji} \qquad (1)$$

Whereat:
Y – Regression value of the depended variable
α - constant term
β_j - regression coefficients
x_j – j-th independed variable
k – the number of independed variables

In this case this is a panel research which uses data about banks through a longer time period. Parameters of the two regression equations will be estimated, with different depended variables (the return on average assets, and the return on average equity), but with the same independed variables (capital/assets ratio, credit/assets ratio, non-profit assets/total assets ratio, gross domestic product per capita, operating costs/assets ratio, market share, gross domestic product growth rate, average exchange rate, inflation).

4.2. Results

In parameters estimation the method of minimum quadrants was used by the statistic software Statistica. The results are shown in the table 3. Both models are statistically significant with level of 1% probability (F-test), but have quite low adjusted R^2, what means that some other variables exist, which are not included in this research, and which have a significant influence on Croatian bank profitability [6].

Return on average assets is under influence of only two variables – capital/assets ratio (statistically significant with 1%), and non-profit assets/total assets ratio (statistically significant with 5%). Both estimated values of regression parameters are positive, which means that there is a positive link between return on average assets and these variables.

Macroeconomic indicators have no influence on these measures of bank profitability, which is probably the result of using too short time series. The same factors of bank profitability are also statistically significant in the research which was conducted by Demirguc-Kunt and Levine [7], but on their much larger sample and in longer time series, all macroeconomic indicators have statistical significance.

Non-profit assets/total assets ratio (statistically significant with 5%) has a positive influence on return on average equity, which probably means that the bank manage to transfer the cost of non-profit assets to their clients. The market share is positively linked to return on average equity (statistically significant with 1%), as in accordance to the most of recent research, whereat under market share we assume the bank's assets in the total

assets of banking market. Therewith it is confirmed that typically the largest banks have the highest profits. Finally, the parameter besides operating costs/assets ratio has a negative algebraic sign, which means that minimizing operating costs increases bank profitability. Again, macroeconomic indicators have no statistical significance on this measure of bank profitability.

Table 3 The results of the model of multiple linear regression[4]

Independed variables	Depended variables	
	Return on average assets	Return on average equity
Capital/assets ratio	0,426485 (0,001003)*	-0,248516 (0,058631)
Credit/assets ratio	0,198024 (0,053559)	-0,090354 (0,388535)
Non-profit assets/total assets ratio	0,426056 (0,000002)*	0,214325 (0,016115)**
Gross domestic product per capita	0,089061 (0,839333)	0,195860 (0,664226)
Operative costs/assets ratio	-0,165891 (0,079673)	-0,252380 (0,009879)*
Market share	0,135303 (0,074635)	0,320918 (0,000057)*
Gross domestic product growth rate	0,132142 (0,689563)	-0,122394 (0,718612)
Average exchange rate	0,040951 (0,785159)	-0,016202 (0,916346)
Inflation	0,193573 (0,514039)	0,167179 (0,583039)
F-test	6,224070 (0,00000)	5,087226 (0,000006)
Adj R2	0,23743777	0,19588905

* statistically significant with the level of 1% probability
** statistically significant with the level of 5% probability

5. Forecasting Croatian banks profitability

Forecasting of bank profitability is used for the purpose of maintaining the stability of banking system. The goal is to design a system for forecasting Croatian banks

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[4] In the table are estimated values of regression parameters, and in the brackets are p-values which are result of testing a hypothesis about parameter significance.

profitability, using which we could project characteristics of the banks and environmental factors that could lead to decreasing profitability. This forecasting model would be useful to bank's management, which could use the model as a system for early warning.

5.1. Methodology

Input and output variables of the Croatian banks profitability forecasting system are continuous, numerical variables described at the beginning of the paper, and three methods will be used: multiple linear regression, neural networks and regression CART decision tree. The efficiency of forecasting using different methods will be compared using suitable indicators. Multiple linear regression model was described in the previous part of the paper. Other used methods will be described in short.

Neural networks

Neural networks are the method of artificial intelligence, structured by the human brain. Although the neural networks can be treated as simplified simulations of human brain, they are often used as technology systems for complex information analysis, where they behave much better than the statistic methods because of the possibility of analyzing information that are not "clean" (lack in information, inaccurately entered date), and the possibility of learning on information from the past. On the other hand, for parameter neural networks there are no tests on statistical significance as in the regression analysis, and there is no standardized way of determining the architecture of the neural network which is the best for defined purpose. Also, unlike regression analysis, neural networks do not provide the model that can be used to explain the relation of entrance and exit variables.

The basic units in the model of neural network are neurons which can be in two or more layers or groups. They are connected so that the output of every neural presents the input in one or more other neurons, whereat their connection can be unidirectional or both-way.

Neurons are grouped in layers, and there are three kinds of them: input, hidden and output. The input layer downloads input data (independed variables), which are processed in the hidden layer. The result of the analysis is sent in the form of result (estimated values of depended variables) in the output layer. The results are compared with the real values of depended variables, and the designing of the hidden layers is repeated until the value of output reaches the closest value of depended variable.

The result of designing a neural network is architecture of the network which with great certainty forecasts the value of depended variable based on input, independed variables.

Decision trees

Decision tree can be used for classification and regression problems, and unlike neural networks, decision tree generates the model that can be explained in the form of the rules. Rules generated like this can be expressed in the form of SQL commands and simply build in the program solution.

In order to be solved by decision tree, problem must have following characteristics: (1) Data must be described in the form of finite attribute numbers, e.g. for each bank attributes exist; (2) The number or attributes is known in advance and a finite number, e.g. it is precisely known how many attributes can each bank have; (3) If the decision tree is classification decision tree, each data should belong to only one class; (4) A lot of data is required – at least a couple of hundreds, but the data can be incomplete and can include errors.

Measuring the efficiency of the forecasting model

In most practice situations of forecasting, the accuracy of the forecasting model is treated as necessary criteria of forecasting method usage. The obstacle is that one universally accepted measure of accuracy does not exist.

The evaluation of adequacy of the chosen methods and models is based on observing differences between real values of profitability indicators and the anticipated values in given periods. A large number of different methods and procedures are used to evaluate accuracy of forecasting values, and the simplest ones are the graphic methods. More accurate information about the characteristics of forecasting values provides numerical methods.

The most frequently used indicators are mean absolute deviation (MAD) and the root mean square error (RMSE). If the calculated forecasting errors are smaller, the accuracy of the method is higher. It is important to stress that the high forecasting accuracy of the model in the past is not a guarantee that the same model will generate the same accurate prognosis in the future.

5.2. Results

For forecasting banks profitability already developed models of multiple linear regression described in the previous section of the paper have been used. Beside this method CR&T tree, CHAID tree and neural networks have been used. All the methods are processed using Statistica software, which with help of Intelligent Problem Solver software agent analyses large number or neural networks, and chooses five best ones.

Table 3 Accuracy indicators of Forecasting return on average assets (ROAA)

Accuracy indicators		MAD	RMSE
Linear regression		0,82	1,08
Decision trees	C&RT	0,74	1,03
	CHAID	0,85	1,18
Neural networks	RBF 10:10-3-1:1	0,98	1,3
	Linear 9:9-1:1	0,87	1,15
	Linear 8:8-1:1	0,87	1,15
	MLP 9:9-7-1:1	0,84	1,1
	MLP 5:5-7-1:1	0,82	1,12

Table 4 Accuracy indicators of Forecasting return on average equity (ROAE)

Accuracy indicators		MAD	RMSE
Linear regression		4,85	6,48
Decision trees	C&RT	4,8	6,37
	CHAID	4,95	6,51
Neural networks	MLP 2:2-6-1:1	5,25	6,8
	Linear 8:8-1:1	5,21	6,78
	MLP 5:5-8-1:1	4,95	6,54
	RBF 10:10-6-1:1	5,68	7,17
	RBF 10:10-12-1:1	5,32	6,74

The results are shown in tables 3 and 4. Even on the first sight it is obvious that the C&RT method is the best according to all criteria. This method generates the lowest errors for all profitability measures. The method can be shown in the form of SQL instructions, and analyze what-if scenarios in which can be studied what would happen if the parameters characteristic for bank's business activities or environmental factors change.

6. Conclusion

Empirical results of regression model show that in the observed period form 1999 until 2003 Croatian banks profitability depended primarily on characteristics specific to each bank. Return on average assets (ROAA) is positively linked to capital/assets ration and non-profit assets/total asset ratio. Return on average equity is positively linked to non-profit assets/total assets ratio, operating costs/assets ratio, and the market share. Neither of macroeconomic variables had no statistic relevancy on banks profitability, but it needs to emphasize that it was dealt with quite short time series, and that the observed period was rather stable. We can conclude that in short period and stable macroeconomic conditions, more profitable are the banks with higher market share which controls operating costs efficiently, and manage to transfer the cost of non-profit assets to their clients.

The possibility of forecasting banks profitability using three methods: linear regression, decision trees and neural networks, was tested, and it was shown that the CR&T tree was the best method in forecasting banks profitability. Those are rather simple trees, whose usage would enable management to make their own "what-if" analysis, which could test the influence of changing certain bank characteristics to its profitability. Although the results of decision trees and regression analysis cannot be directly compared, we can still notice that the same variable appear in explaining bank profitability as in regression analysis, which increases the confidence in the results of the research.

In valuating this paper it is necessary to take in consideration that data was used only for those banks that had complete indicators for a certain year. In further research it should be tested which of the replacement of missing information algorithms [2] would be the most appropriate for business analysis. In this case a longer time series could be used, which would increase the reliability of the results, and in that case it would be able to test the influence of macroeconomics variables on banks profitability more accurately.

7. Literature

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