# Evaluation of Banking Performance Based on the Rate of Return on Equity and the Total Capital Ratio

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*Abstract: In the financial-banking field, rational behavior is explained by maximizing return at an assumed level of risk or vice versa, maximizing risk at an expected return in order to maximize the value of the economic entity. The performance of a credit institution is no longer defined by the traditional profit, but by the profit that shows a real increase in the value of the economic entity, of the shareholders' equity. Peter Drucker[1] says that "Management gives up its traditional master - profit, it now engages, more and more meaningfully, in the service of value". We agree with this opinion, demonstrating that a credit institution can obtain this profit by properly managing their banking assets and liabilities from a temporal, value and financial standpoint, as well as by keeping track of the bank's liquidity and solvency at the microeconomic level. Performance and risk are two essential components of the management of credit institutions. Starting from the fact that in recent years the economic crises have generated the emergence of new risks and vulnerabilities, we utilized the regression method to better analyze the financial performance based on banking performance ratios, and thereby revealed the correlations between return on equity and risk, as well as the form and strength of the correlation.*

*Keywords: banking performance; return on equity, capital risk; regression equation; total capital ratio*

## 1. Introduction

Financial theory is built around a fundamental concept: maximizing the value of the economic entity. The banking performance is aimed first of all at determining the bank's soundness, the degree of its exposure to the various categories of risk and then its level of efficiency. For these reasons, the financial diagnosis of banking activity has two components: the diagnosis of profitability (return on own capital, economic profitability); risk diagnosis (operating risk, financial risk, bankruptcy risk).

Hughes & Mester[2] identify two broad approaches in measuring the performance of banks i.e. non-structural and structural approaches. Non-structural approaches use different performance measures (e.g. ROE, ROA, net interest margins, Tobin's q-ratio among others) while structural approaches are based on theoretical models of banking behavior such as efficient and profit frontiers.

In terms of non-structural approaches, performance can be quantified through indicators, namely rate of return on assets (ROA) which is obtained by reporting net income by total assets reflects the profitability of the entire capital invested in the bank, while the rate of return on equity (ROE) reflects the fruit yield of the equity of the bank and measure reporting net profit to equity. In literature this indicator is met as the financial return that measures the return on investment made by shareholders. The Modigliani-Miller model[3] represents the first

[1] P. Drucker "Managing the Non-Profit Organization" Butterworth – Heinmann, 1990
[2] Hughes, J., & Mester, L. (2015). Measuring the performance of banks: theory, practice, evidence and policy implications. In The Oxford Handbook of Banking (Second ed., pp. 247-270). Oxford University Press.
[3] F.Modigliani, M.Miller "The Cost of the Capital Corporation Finance and the Theory of Investment", American economic Review, XLVIII, No. 3, June 1958

substantiation of the rate of return on equity expected by the shareholders, under the given conditions of the taxation rate. In addition to the return on the economic assets of the company, the shareholders request to be remunerated with a risk premium for holding shares of the indebted company. The risk premium is based on the difference between the rate of return on assets and the market interest rate and based on the level of indebtedness of the company (leverage). Shareholders of a credit institution are focused on increasing the return on their shares, the return on equity, but a high debt ratio puts pressure on the bank's capital, i.e. it decreases it. The result of an excessive indebtedness is a higher return to shareholders, however, this also leads to a decrease in the bank's capital and a decrease in profit. By limiting those investments, shareholders can achieve a higher rate of return on investment, allowing them to generate the same amount of net profit while investing less per unit, thus increasing the income per investment unit.

This article follows the analysis of the economic dependence of bank profitability on the level of the main risk factors, especially on capital risk through the analytical model of unifactorial regression.

## 2. Models for evaluating banking performance

There are a variety of primary and secondary, essential and non-essential factors that influence social-economic phenomena, and they are all interconnected. Using statistical and economic mathematics, different techniques and approaches can be applied to analyze the tangible links between different elements, quantify them, and determine the strength of the correlations.

It is essential to utilize these analysis methods for economic research, as when dealing with mass economic matters such as those in the banking industry, not all correlations are expressed with the same strength, in the same direction and free of any influence from each other.

The increasing intricacy of the elements that constitute banking operations enlarges the count of variables that cannot be observed directly or can only be estimated through specific statistical conventions. There can be functional or statistical correlations between economic phenomena and processes.

The first category corresponds to causal correlations, i.e. one of the phenomena uniquely determines the change of the other.

The functional correlation between the cause-characteristic string and the effect-characteristic string is such that a single value from the former is associated with a single value from the latter, and any change in the quantity of the first characteristic will be accompanied by a similarly-measured change of the same type in the second.

This mathematical function can be used to model such correlations:

$Y_i = f(x_1 , x_2 , .....x_p)$

Where $x_1 , x_2 , .....x_p$ are the factors that act together on the result variable "y" and which also include a random component.

Statistical correlations between stochastic, or uncertain, phenomena are often observed in economic processes. These links are usually associated with the uncertainties that impact banking operations and outcomes. The defining feature of this correlation is that a factor "x" (independent, exogenous or cause) impacts another factor "y" (dependent, endogenous or effect), often referred to as the factorial characteristic and resulting characteristic, respectively.

In statistical correlations, a certain value of "x" corresponds to a distribution of values for the resulting characteristic "y". This is because "y", the dependent characteristic, is also affected by other factors which, in what regards the correlation between "x" and "y", are deemed random.

The degree to which the values of the result characteristic vary in comparison to the changes of the factorial characteristic will depend on the conditions in which the causal relationships are expressed.

Statistical correlations, specific to banking processes, can be classified according to the following criteria:

a) based on the number of characteristics being studied:
   - simple correlations: when it is considered that there is a single essential factor feature that determines a result feature, and the other factors are constant, interpreted as residual factors. example: the relationship between the number of profit centers and the banking assets value
   - multiple correlations: when more than two factor features are taken into account and interpreted. example: e.g. the influence of “n” risks on banking profitability

b) based on the direction of the correlations or variations determined:

- direct correlations: when the variation of the result feature has the same direction (either increases or decreases) with the modification of the factor feature values.
- inverse correlations: when an increase in the values of one factor feature corresponds to a decrease in the other feature.

c) based on the analytical expression of the correlations:
- linear correlations: synthetically expressed by the equation of the straight line
- nonlinear or curvilinear correlations: expressed by equations of the curve (parabola, hyperbola, exponential function, etc.).

## 2.1 Regressive analysis method for researching banking performance

A qualitative approach is used first to analyze the correlations between economic (banking) phenomena, followed by the use of quantitative methods that are tailored to the statistical approach, in order to identify the factors, assess the shape and strength of the correlation.

Of these, we used the regression analysis method to research banking performance.

Regression analysis is a statistical technique that is used to examine the correlation between two or more variables by fitting a function (called a regression function) to the observed data.

Where "y" is the dependent variable and "$x_1$ , $x_2$ , …….$x_n$" are the independent variables, the regression equation can be expressed as:

$Y_i = f(x_1 , x_2 , …….x_n)$

Because of the unpredictable nature of financial-banking operations, the theoretical model mentioned above has been replaced by a statistical dependence model:

$Y_i = f(x_1 , x_2 , …….x_n) + \varepsilon$

Where ε represents a random error (a residual variable) with constant dispersion and a mean of zero.
Depending on the number of factors ($x_1 , x_2 , …….x_n$) that influence the resulting feature (Y), we could use:
- Unifactorial or simple regression, if the function includes one factor;
- Multifactorial or multiple regression, if the function includes several factors.

One of the most well-known single-factor regression models is the linear model according to which, if it is deemed that the correlation between "y" and "x" is linear, then:

$y = \alpha + \beta x + \varepsilon$

We define the single-factor regression model through a mathematical relationship that assumes that the variable Y is the result of two categories of factors:
- an essential factor, X
- several non-essential factors, specified by a random disturbance variable ε

This theoretical model is estimated by an average trend equation that can be written as follows:

$y = \alpha + \beta x_i + \varepsilon$

The linear dependence between "y" and "x" is considered a stochastic dependence in which several "y" values can correspond to one "$x_i$" value.
There is a function *f* such that the variable *X* explains the variable *Y* through the function *f*, $Y = f(X)$, a linear function $f(x) = \alpha + \beta \cdot x$.

The linear regression model is $Y = \alpha + \beta X + \varepsilon$.
The variables X and Y are observable variables, that is, their values can be measured.

The variable ε is called random error or error term or disturbance variable and represents the effect of all factors, except factor X, which affect Y and which are considered unobservable. The variable ε captures the measurement errors of the variable values and the random nature of human behavior. The error term ε represents that part of the value of the Y variable that cannot be measured through a systematic relationship with the X variable.

**The coefficients of the simple linear regression model**

For each of the three years, the values of the two variables, *X* and *Y*, were noted, thus obtaining the data series $\{(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)\}$ or $\{(x_i, y_i), i = \overline{1,n}\}$. Based on this sample we will determine the estimators *a* and *b* of the parameters $\alpha$ and respectively, $\beta$ of the regression model. Estimators *a* and *b* represent the solution of the system **of normal equations**:

$$\begin{cases} na + b\sum_{i=1}^{n} x_i = \sum_{i=1}^{n} y_i \\ a\sum_{i=1}^{n} x_i + b\sum_{i=1}^{n} x_i^2 = \sum_{i=1}^{n} x_i y_i \end{cases}$$

Solving the system using the method of determinants: $a = \frac{\Delta_a}{\Delta}$ and $b = \frac{\Delta_b}{\Delta}$,

where $\Delta = \begin{vmatrix} n & \sum_{i=1}^{n} x_i \\ \sum_{i=1}^{n} x_i & \sum_{i=1}^{n} x_i^2 \end{vmatrix}$ is the determinant of the matrix of the system of equations,

and $\Delta_a = \begin{vmatrix} \sum_{i=1}^{n} y_i & \sum_{i=1}^{n} x_i \\ \sum_{i=1}^{n} x_i y_i & \sum_{i=1}^{n} x_i^2 \end{vmatrix}$, $\Delta_b = \begin{vmatrix} n & \sum_{i=1}^{n} y_i \\ \sum_{i=1}^{n} x_i & \sum_{i=1}^{n} x_i y_i \end{vmatrix}$ are the minors corresponding to the two unknowns.

$$\begin{cases} a = \frac{\Delta_a}{\Delta} = \frac{(\sum_{i=1}^{n} y_i) \cdot (\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i) \cdot (\sum_{i=1}^{n} x_i y_i)}{n \cdot (\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2} \\ b = \frac{\Delta_b}{\Delta} = \frac{n \cdot (\sum_{i=1}^{n} x_i y_i) - (\sum_{i=1}^{n} x_i) \cdot (\sum_{i=1}^{n} y_i)}{n \cdot (\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2} \end{cases}$$

$a = \frac{\sum y - b \sum x}{n}$

The coefficient "a", which can take both positive and negative values, represents the coordinate at the origin, respectively it is the value of "y" when "x" is equal to zero.

Coefficient "b", called regression coefficient, shows the extent to which the dependent characteristic changes if the independent characteristic changes by one unit.

Depending on the sign of the regression coefficient, we can appreciate the type of correlation:

- in the case of direct correlation, the coefficient has a positive value;
- in the case of inverse correlation, the value of the regression coefficient is negative;
- if b = 0, it is deemed that the two variables ("x" and "y") are independent.

The value of the regression equation is computed for every size of the characteristic "x" using the parameters "a" and "b". The regression equations' values are regarded as the theoretical values for the characteristic "y" based on "x". The process of substituting the actual terms of "y" with the theoretical values is known as "adjustment"[4].

### 2.1.1 Applying the performance evaluation model at the level of the banking system

The objective of analyzing the economic dependence of banking profitability on the primary risk factors, particularly the capital risk, prompted us to employ the unifactorial regression analytical model to express these correlations. It adjusts the variable effect-rate of return on equity based on the independent variable – the total capital ratio (the former solvency ratio). Following the prudential framework in effect at the EU level, which is directly applicable at the national level, credit institutions are required to fulfill the subsequent minimum capital requirements at all times: 8 percent for the total capital ratio, 6 percent for tier 1 capital ratio and 4.5 percent for the common equity tier 1 capital ratio.

Regression analysis is frequently employed to determine how changes in the independent variable impact the dependent variable, which is one of the most common use cases.

Next, we will evaluate the model using data pertaining to the banking industry in Romania between 2019 and 2021. Due to objective reasons, the entire banking system was considered as a whole, rather than a specific bank being taken into account. This approach does not change the results obtained, in principle.

| Item no. | Ratios | 2019 | 2020 | 2021 |
|---|---|---|---|---|
| 1. | Net profit | RON 6.4 billion | RON 5.02 billion | RON 8.27 billion |

[4] T Baron, E.Biji et al."Statistica teoretica si economica" Didactica si Pedagogica Publishing House,| 1996, ISBN:| 973-30-4025-8 p.168

| | | | | |
|---|---|---|---|---|
| 2. | Total capital ratio (the former solvency ratio) | 22% | 25.1% | 23.3% |
| 3. | ROE (Annualized net profit / Average equity) | 12.2% | 8.7% | 13.3% |
| 4. | ROA (Annualized net profit / Average total assets) | 1.3% | 1% | 1.4% |
| 5. | The leverage effect | 10.2 | 10.3 | 8.6 |

As the complexity of the phenomena inherent in banking activities grows, the number of factors involved increases, making it more challenging to identify and measure causal relationships.

Initially, assuming that other factors (risk categories) exert a constant and negligible impact on the rate of return on equity (ROE), we examine the effect of capital risk, measured by the total equity ratio, on ROE using the unifactorial regression method.

**In our study, the variables** are:

*X* – total capital ratio (the former solvency ratio)

*Y* – ROE

To determine the regression equation based on banking performance ratios, we calculate the regression coefficient "b". The evolution and adjustment of the ROE ratio depending on the total capital ratio is presented in the table below.

The calculations are presented in the table below:

| **Adjusted values Linear model y= - 6.66 + 30x** | **Period** | **$x_i$ values of variable *X*** | **$y_i$ values of variable *Y*** | $x_i$ | $(y_i)^2$ | $x_i \cdot y_i$ |
|---|---|---|---|---|---|---|
| *-0.06* | *2019* | $x_1$=0.22 | $y_1$=0.122 | $(x_1)^2$=0.0484 | $(y_1)^2$=0.0148 | $x_1 \cdot y_1$=0.0268 |
| *0.87* | *2020* | $x_2$=0.251 | $y_2$=0.87 | $(x_2)^2$=0.0630 | $(y_2)^2$=0.7569 | $x_2 \cdot y_2$=0.2183 |
| *0.33* | *2021* | $x_3$=0.233 | $y_3$=0.133 | $(x_3)^2$=0.0542 | $(y_3)^2$=0.0176 | $x_3 \cdot y_3$=0.0309 |
| | | $\sum_{i=1}^{3} x_i = 0.704$ | $\sum_{i=1}^{3} y_i = 1.125$ | $\sum_{i=1}^{3} x_i^2 = 0.1656$ | $\sum_{i=1}^{3} y_i^2 = 0.7893$ | $\sum_{i=1}^{3} x_i\ y_i = 0.276$ |

We obtain: $a = \frac{\Delta a}{\Delta} = \frac{1.125 \cdot 0.1656 - 0.704 \cdot 0.276}{3 \cdot 0.1656 - 0.704^2} = -6.66$

$b = \frac{\Delta b}{\Delta} = \frac{3 \cdot 0.276 - 0.704 \cdot 1.125}{3 \times 0.1656 - 0.704^2} = 30$

The value of the regression equation was computed for every size of the characteristic "x" using the parameters "a" and "b".

Therefore, the regression line is the equation $y = a + bx$ = - 6.66 + 30x.

It follows that the equation of the linear model is $Y_i = \alpha + \beta X + \varepsilon$ = - 6.66 + 30x + $\varepsilon$, i = $\overline{1.3}$

and the adjusted values of the observations $Y_i = \overline{1.3}$ by regression are

$Y_i = a + bx$ = - 6.66 + 30 $x_i$, i = $\overline{1.3}$

After drawing up the correlation table, we observe an uneven change in the dependent variable (ROE) under the influence of the change in the independent variable (total capital ratio).

Moreover, the value of the regression coefficient b is positive (b = 30) and indicates an increasing regression.

The estimated regression equation (- 6.66 + 30x) shows that the correlation between the two ratios is direct.

Estimation by confidence interval for the error variant[5]

$S_e^2 = \frac{\sum_i \varepsilon_i^2}{n-2} = \frac{\sum_i (Y_i - a - bx_i)^2}{n-2}$

Error calculation

| $Y_i$ | $Y_{xi}$ | $\varepsilon_i$ | $\varepsilon_i^2$ |
|---|---|---|---|
| 0.122 | -0.06 | 0.182 | 0.033 |
| 0.87 | 0.87 | 0 | 0 |
| 0.133 | 0.33 | 0.97 | 0.940 |
| | | | 0.973 |

$\varepsilon_i = Y_i - Y_{xi}$

Estimation of the error variant

$S_e^2 = \frac{\sum_i \varepsilon_i^2}{n-2} = \frac{0.973}{3-2} = 0.973$

The level of the rate of return on equity depends on the size of the risks (in our case the capital risk) that the banking system is willing to manage.

Bank profitability increases by assuming high risks, but decision-makers within credit institutions seek to obtain increased returns for certain assumed risks.

## 3. Conclusions

The rate of return on equity represents the most important ratio of bank profitability, because it is influenced by the bank's performance in relation to each profit category (depending on the source or specific activity), as well as due to the fact that it indicates the bank's ability to compete for private sources of capital from the national economy.

The existence of equity and its adequate sizing (in relation to risk-weighted assets) represent the third line of defense for banks after profits and provisions.

An excessive capitalization is generally associated with economic inefficiency for shareholders, a too high capital adequacy index contributing to the reduction of dividends. It is true that the banks establish the size of capital according to the regulations in force domestically and internationally and in accordance with the requirements of economic efficiency. However, regulatory constraints often conflict with shareholders' wishes for greater capital leverage and higher revenues.

If we were to assess the trend based on the evolution of the ratios from the last three years, with the exception of 2020, we notice that, in the case of ROE, the trend is increasing. The decrease in the ROE level for 2020 is mainly due to a lower level of net profit. The net profit of the banking system decreased in 2020 by RON 1.2 billion (19.5%) compared to the previous year, due to provisions for potential non-performing loans caused by the coronavirus crisis, according to statistical data provided by the National Bank of Romania (NBR). The decrease in profit was caused by the increase by RON 680 million (8.7%) of provisions for potential losses from non-performing loans (adjustments for expected losses, according to the rules of the European Banking Authority (EBA), up to almost RON 8.5 billion.

The provisions were of a preventive type, for the period after the expiry of the moratoriums on deferring loan installments, given that the rate of non-performing loans fell to 3.83% in 2020, from 4.06% in 2019.

If in industrial enterprises the ROA must be higher than the inflation rate in order for it to maintain its economic substance, in a banking unit, this is the result of the rotation of banking assets and of the unit's net profit obtained from the entirety of collected revenues. At the end of 2020, the assets of the banking system increased by about RON 65 billion (+13%) compared to December 2019, reaching a new record level of RON 560 billion, while the rate of return on assets (ROA) decreased to 1% in the context of reporting a lower profit during the Coronavirus pandemic. In this situation, the evolution of this ratio is the result of the forecast dynamics

[5] Analiza de Regresie Simpla | PDF (scribd.com)

of the profit ratio (with an increasing trend) and less of the forecast dynamics of asset turnover. As in the case of ROE, ROA recorded an upward evolution in 2021 compared to 2019.

The level of the total capital ratio recorded in the period under review had a slight decrease in 2021. On December 31, 2021, the total capital of credit institutions, Romanian legal entities, reached a level of RON 57,895.2 million, down 1.0 percent compared to the end of the previous year, while the total value of the exposure at risk increased by 6.7 percent, up to a level of RON 248,280.0 million. This decrease is due not only to the increase in the total value of the risk exposure at a rate higher than that recorded by the capital, but also due to the incorporation of part of the profit related to the year 2021 and the decision of the credit institutions to distribute dividends from the reserves constituted from the profits of the previous years (2019 and 2020), according to the decision of the General Council of the National Committee for Macroprudential Supervision (CNSM) not to extend the period of application of Recommendation no. R/2/2021 after September 30, 2021. Although the capital requirements based on the value of risk exposure are required for the correct sizing of capital in relation to unexpected losses, they are not sufficient to ensure a prudential behavior on the part of credit institutions, which may be tempted to assume excessive and unsustainable risks through an excessive level of indebtedness. Thus, the set of capital adequacy assessment ratios, calculated based on the total value of risk exposure, was completed by the leverage effect ratio. "Starting with June 28, 2021, the requirement regarding the leverage effect ratio, of at least 3 percent, entered into force, according to the provisions of Regulation (EU) no. 876/2019 amending Regulation (EU) no. 575/2013. On December 31, 2021, the leverage effect for credit institutions in Romania was 8.6 percent, according to the transitional definition, and 8.1 percent, according to the full definition, being below the level recorded in December 2020, of approximately 10.3 percent, in the case of the transitional definition and 10.0 percent in the case of the full definition"[6].

According to NBR data for the first three quarters of 2022[7], the net profit of the entire banking industry was RON 7.6 billion, fueled by the accelerated dynamics of lending in 2022 and the increase in net interest income. Regarding performance ratios, in September 2022, ROE reaches the level of 16.6 percent and ROA of 1.5 percent.

We tested the model on the aggregated data related to the banking industry in Romania. The results we obtained showed that the increase in ROE implies the assumption of a greater capital risk.

Considering that the analyzed ratios have a favorable trend, the application of the linear model is questionable. If the evolution had been unfavorable, according to the linear model we could have said that one or several banks within the banking system may face insolvency. However, we must not omit the fact that at the level of the banking system there are a number of vulnerabilities, among which the possible increase in the risk of non-payment of loans granted to the manufacturing industry in the context of deteriorating macroeconomic conditions, uncertainties regarding future developments, but also an increase in debt service through the increase interest rates.

In conditions of uncertainty at the macroeconomic level, the market value of banks is dependent on variables that they cannot control (the interest rate on the money market, the price of assets), thus making it difficult to distinguish insolvent banks from solvent ones[8].

The analysis and study of the performance ratios, their evolution over time, as well as the correlations between the ratios, contribute to the improvement of the activity and the achievement of an improved level of banking efficiency.

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