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APPLICATION OF FACTOR ANALYSIS TO IDENTIFY THE ECONOMIC AND FINANCIAL KEY PERFORMANCE INDICATORS IN BANKING INSTITUTIONS*

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ABSTRACT

This study aims at identifying the most relevant economic and financial indicators for evaluating the performance of banking institutions by using the factor analysis. A total of 118 banking institutions with activities in Brazil over the years of 2011 to 2014 are covered. Quantitative and Descriptive study is carried out in this research. Statistical technique of factor analysis was used for data analysis. In the application process of that technique, the overall appropriateness of the model and of each variable were verified, in order to identify key indicators that will compose the analysis of banks. The study is developed from an initial set of 17 indicators employed to analyze the economic and financial performance of such institutions. Following the criteria of factor analysis techniques, the indicators that explain the maximum variance from the smallest possible number of variables were selected. The results show that the most relevant indicators for evaluating the performance of such institutions are: Return on Total Investment, Net Margin, Return on Equity, Ratio of Capital to Deposits, Loans/Deposits Ratio, Immediate Liquidity, Voluntary Fit and Interest Rate Sensitivity. These 8 indicators can also be replaced by 3 factors, which explain about 89,23% of the overall data range. The factors "Cost Effectiveness and Profitability", "Capital and Liquidity" and "Fitting and Interest Sensitivity" allow us to classify and compare the performance of banking institutions.

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1 INTRODUCTION

Financial banking institutions play an important role in a country's economy and are the main channel of financial mediation (Zha, Liang & Bian, 2016). Due to the specific characteristics of this mediation, the economic and financial management of such institutions have some peculiarities. The development of models that contribute to the performance analysis and allow the comparison between different financial institutions is important for the decision-making process both for internal agents and for those external to these institutions.

A methodology widely used to analyze the economic and financial performance of organizations is the creation of indicators through the analysis of financial statements. The main purpose of the financial statements analysis is to obtain information favoring the decision-making. Using the indicators, the analyst is able to extract trends and to compare the indexes with pre-established patterns (Matarazzo, 2010). According to Brigham and Ehrhardt (2016), to make a standardized comparison of companies is possible by analyzing the indicators, since the financial indicators are developed to extract information that may not be obvious when reviewing the financial statements.

The performance evaluation of companies in the banking sector can also be carried out by analyzing the financial statements. Some authors propose specific indicators for financial institutions, considering the specificities of this type of organization. In this context, Assaf (2012) presents a set of 17 indicators adapted to this type of institution, divided into three groups: "solvency and liquidity", "capital and risk" and "cost effectiveness and profitability". According to Matarazzo (2010), after the individual assessment of each index, it is also possible to carry out a joint verification of the indicators, by analyzing their relations so as to generate a general framework of the company's performance and management.

Although the indicators are widely used, some limitations are present. According to Silva (2016), the amount of indicators to be used in the analysis of a company is an important point: a great number of indicators may even confuse the user, while a very small amount may not be enough to draw conclusions about the financial health of the business. Callado, Callado and Mendes (2015) argue that the definition of the indicators to be used is part of a logical sequence of procedures for the implementation of a performance evaluation system.

The evaluation of the indicators shall be done jointly, as well as the definition of which are the ones that most impact the result of the company, in addition to establishing weights for such indicators. Bezerra and Corrar (2006) state that this definition usually involves a great degree of subjectivity, while through the statistical technique of factor analysis it is possible to determine more objectively the relevance of each indicator in the results of the company.

The factor analysis aims to reduce the complexity of a large number of variables in a smaller arrangement, considering the correlations between the original variables (Mendez & Rondon, 2012). The application of this technique to economic and financial indicators is exemplified by Bezerra and Corrar (2006), who address the indicators of insurance companies, as well as by Carvalho and Bialoskorski (2007), who include agricultural and livestock cooperatives. The study conducted by Borges, Benedicto and Carvalho (2014) also uses a similar approach, but applies the factor analysis to evaluate the performance of rural credit cooperatives. In this sense, as highlighted by Louzada, Oliveira, Silva and Gonçalves (2016), it is observed that the use of statistical techniques is important in the construction of a set of indicators that allow to evaluate the performance of an entity.

Given the above, this article aims to identify, through statistical factor analysis, the most relevant economic and financial indicators for the evaluation of the performance of the banking institutions.

Therefore, the question that this research aims to answer can be summarized as follows: what are the most relevant economic and financial indicators for evaluating the performance of Brazilian banking institutions?

When analyzing financial indicators, we notice that it is possible to group these indicators into factors that allow the understanding of the behavior of the original data. According to Pereira (1999), instead of subjectively proposing the creation of an indicator, it is possible to subject the data to a factor analysis, and the results shall objectively point to such measure aggregation

Thus, the research contributes to increase the capacity of interpretation of the economic and financial indicators that is used to assess the performance of the banking institutions, allowing the use of the less subjective criteria and identification and consideration of the most important variables.

2 THEORETICAL REFERENCE

In this section, we find the theoretical framework that supported the study. Initially, we address the financial banking institutions and discuss the analysis of economic and financial indicators. Subsequently, the analysis of indicators for banking institutions and the application of the factor analysis in studies evaluating financial indicators are discussed.

2.1 Financial Banking Institutions

The financial banking institutions are responsible for the financial mediation, focusing mainly on seeking the satisfaction of the various economic agents. According to Assaf (2012), on the one hand are the lessees, who seek to increase their amount of real assets, and on the other side are the lessors, which aim to keep the equity in assets that value in a stable way and with a minimum risk. Therefore, the basic functions of these institutions relay in the collection and application of resources. Further, according to the same author, the banks seek their results by fundraising at a certain rate and applying the same at higher rates. The difference between such rates is called the *spread*.

These institutions are important to the economy. They help in the transformation of the risk and the creation of liquidity. For Cleary and Hebb (2016), whenever these institutions obtain demand deposits, the resources are raised with high liquidity and low risk; but, when returning with these funds to the market in the form of loans, the institutions invest in assets with low liquidity and high risk. This way, according to the authors, the risk and the liquidity of the financial mediation operation are taken in by the banking business (Cleary & Hebb, 2016).

According to Saunders (2000), this type of institution shall have special regulations, once any deviation in its functions or services may have negative effects on the economy. Other entities providing public utility services are also subject to specific surveillance, such as electricity, telephone and water companies. Accordingly, banking institutions shall operate within the guidelines regulated by public surveillance agencies, given their specific functions and the important services they offer to society.

The Central Bank of Brazil (BCB) is one of the bodies responsible for such regulation. Among other duties, it is the responsibility of the Central Bank to institute and disclose the specific accounting and statistical standards to be observed by the banking sector. In 1987, BCB established the Accounting Plan for Institutions in the National Financial System - COSIF (BCB Memorandum No. 1,273, 1987). The creation of this plan aimed at unifying the several accounting plans existing at the time, as well as standardizing the procedures for recording and preparing financial statements, which eased the monitoring, the analysis, the performance evaluation and the control of the institutions that make up the National Financial System (Central Bank of Brazil [BCB], 2015). Accordingly, COSIF sets forth the criteria and accounting procedures to be observed by the banking institutions and the structure of accounts and models of documents.

According to Jayaraman, Srinivasan and Arunachalam (2014), the banking sector faced significant changes around the world since the beginning of the 1980s, due to the impact of technological evolution and globalization. Still according to the authors, an important aspect of this process is the consolidation of the banking institutions through mergers, acquisitions or restructurings. In emerging countries, this change was driven by the restructuring of banking system proposed by governments, aimed at greater regulation and competitiveness.

Lee, Hsieh and Yang (2014) argue that the competitiveness in the banking sector has encouraged financial institutions to develop new products in order to meet market demands, increasing competitiveness and expanding the volume of services offered. Given this scenario, in which the banking institutions are inserted, the analysis of the financial statements awakes the interest both for managers (internal to the company) and for the various segments of external analysts. According to Assaf (2012), this type of analysis is considered one of the most important in the financial management, because its main objective is to evaluate the economic and financial performance of organizations.

2.2 Analysis of economic and financial indicators

The modern management of organizations has as fundamental characteristic the creation of managerial models that allow the analysis of the performance of the company. Such models are vital in the context of globalization and competitiveness of the current markets (Borges et al., 2014). Castro (2015) argues that performance evaluation allows for the identification of the strengths and weaknesses of an organization

According to Matarazzo (2010), the analysis of the financial statements aims to study the economic and financial performance of a company in a certain period, in order to determine its current position and to produce results that serve as basis for forecasting future trends.

In order to analyze the economic and financial performance, a widely used methodology is the creation of indexes through the analysis of the financial statements. These indicators relate two accounts (or two combinations of accounts) of the Balance Sheet and / or Income Statement (Herrera, Gomez & Granadillo, 2012). Matarazzo (2010) highlights that this evaluation of the company can be greatly simplified when you work with the main indicators, obtained from the access to accounting information.

Such accounting information can be characterized as the primary source for the performance evaluation of a company. By calculating the indicators, we can further define which of them shall be used as a management tool. For this analysis to be efficient, there is no need for highly complex indicators or a large number thereof, but rather a selection of an efficient number of indicators for the company under analysis. Comparisons with benchmarking can also be carried out when individually evaluating financial indicators over time, creating parameters to improve the management system (Miranda, 2008).

The analysis of the financial statements can be developed for multiple purposes, such as credit, investment and merger & acquisition decisions, in addition to competition analysis (Silva, 2016). Matarazzo (2010) further emphasizes that the individual study of the balance sheets provides useful and critical information to formulate the organizational strategy, which can be done by comparing the balance sheets with the budgets. This causes the analysis of financial statements to become a complementary tool for decision-making. After the individual diagnosis of each indicator, a joint analysis of the indicators can be performed aimed to identify the relationships between them, in order to identify a general framework of the performance of the relevant entity.

2.3 Analysis of Indicators for Banking Institutions

The financial and economic performance evaluation of the banking institutions operating in Brazil can be carried out through analysis of the financial statements. The bank accounting has some specifics, which result in differences between the statements presented by financial institutions and those presented by industrial and commercial companies or other companies in the service sector of the economy (Naves, 2007).

The management of the liquidity of financial institutions is not an easy task, given the specific characteristics of the financial mediation. Assaf (2012) highlights that the mediation business performed via deposit (fundraising for the bank) represents an obligation towards third parties and is recorded as a liability. The application of these resources is classified as Assets. For example, it can be in the form of cash or in the form of loans granted. I.e., financial banking institutions "Trade" an obligation (demand deposit) for a right (loans receivable). This creates the difficulty in equalizing receipt and payment periods, as well as a great difficulty in the structure of assets (Assaf, 2012).

The creation of economic and financial indicators has been used to facilitate the management of the financial institutions. These indicators aim at evaluating the performance of the company in terms of generation o financial results (Miranda, 2008). The cost effectiveness provided by a company is the result of decisions made related to the capital structure policies, methods for the market and administration of resources available to the administrators. Trying to choose some indicators that are important for the analysis of the financial statements is necessary to carry out the economic and financial evaluation of banks.

However, according to Miranda (2008), studies on the analysis of financial statements of banking institutions using indicators are still scarce in Brazil. According to the author, national publications on the subject are rare and mainly based on specific methodologies, such as CAMELS (Capital, Quality of Assets, Quality of Management, Results and Liquidity) - developed by banking surveillance agencies.

Some authors suggest the use of different indicators that adequately represent the reality of entities in the banking sector. In this context, the approach proposed by Assaf (2012), suggesting 3 main blocks of indicators – which shall be used for the economic and financial analysis of banking institutions. The author provides the calculation of 17 indicators, classified in 3 groups. Table 1 shows the calculation formulas and the concepts related to them.

Table 1
Formulas and Concepts of Economic and Financial Performance Indicators

Solvency and Liquidity Indicators
Voluntary Fit (EV) = Availability / Demand Deposits *Identifies the immediate financial capacity to cover withdrawals against deposits.*
Immediate Liquidity (LI) = (Availability + Interfinantial application) / Demand Deposit *Identifies the institution's capacity to cover demand deposits and part of time deposits.*
Loans on Deposits (ESD) = Credit Operations / Deposits *Discloses, for every R$ 1,00 of borrowed capital, the amount raised in the form of deposits.*
Interest in Loans (PDE) = Credit Operations / Total Assets *Identifies the percentage of asset applied in Credit operations.*
Risk and Capital Indicators
Financial Independence (IF) = Credit Operations / Total Assets *Identifies the level of financial independence with respect to the use of third-party resources.*
***Leverage* (LEV)** = Total Asset / Equity *Identifies the level of leverage of the institution in the use of assets.*
Ratio Capital / Depositor (RCD) = Equity / Deposits *Identifies the relation between the use of own resources and the fundraising in the form of deposits.*
Own Capital Fixed Assets (ICP) = Permanent Asset / Equity *Identifies the level of fixed assets related to own resources.*
Interest Rate Sensitivity (ISJ) = Sensitive Assets / Sensitive Liabilities *Identifies how interest on sensitive assets and liabilities correlates with the market.*
Cost Effectiveness and Profitability Indicators
Return on Equity (RPL) = Net profit / Equity *Provides the percentage recorded as a consequence of profit margins related to the equity*.
Return on total Investment (RIT) = Net Profit / Total Assets *Shows the results of business opportunities activated by the institution.*
Net Margin (ML) = Net Profit / Income from Financial Mediation *Allows to evaluate the basic function of financial mediation of the institution.*
Financial Margin (MF) = Gross Income from Financial Mediation / Total Assets Allows to evaluate the gross income from the financial mediation before credit risk.
Asset Profitability (LA) = Income from Financial Mediation / Total Asset Allows to evaluate the income from the financial mediation resulting from investments in the total assets.
Average Fundraising Cost (CMC) = Fundraising Financial Expenses / Time Deposits Allows to evaluate the *relation between financial expenses and time deposits.*
Interest Payable (JP) = Mediation expenses / Total Liabilities *Refers to capital expenses incurred in the several types of investment.*
Efficiency (EF) = Operating Expenses / Income from Financial Intermediation Allows to evaluate the *need for an operational structure to maintain the operation.*

Note. Source: Adapted from Assaf, A., Neto. (2012). *Structure and analysis of balance sheets: an economic and financial approach*.

The first group is the Solvency and Liquidity, which aims to highlight the organization's own resources in relation to its obligations, and tries to reflect the competence to meet the

demands for cash resources in order to cover financial liabilities. The second group is the Capital and Risk, whose structure is composed of indicators that evaluate the institutions' own capital volume, or the minimum capital that shall be preserved by them (although it is important to highlight that such indicators do not evaluate the risk of assets).

Finally, the third group is the Cost Effectiveness and Profitability, whose composition is structured by indicators that evaluate the wealth maximization of the organization through the risk-return ratio (Assaf, 2012). All indicators mentioned hereunder are calculated based on the financial accounts used by the banking institutions, including those set forth in COSIF. Therefore, they reflect the particularities of the economic and financial characteristics of this sector.

2.4 Application of Factor Analysis in Studies Evaluating Financial Indicators

During the analysis, the financial indicators can be grouped into factors allowing the understanding of the behavior of the original data. Pereira (1999) argues that the researcher can assume that several of their measures shall compose a factor, but instead of subjectively proposing the creation of an indicator, they may prefer to subject the data to a factor analysis. And the results of this analysis shall objectively point to such grouping of measures.

The factor analysis aims to reduce the complexity of a large number of variables in a smaller arrangement, in order to explain the phenomenon in more detail. This type of multivariate technique addresses the problem of analyzing the structure of correlations between a large numbers of variables, determining a set of common underlying dimensions called factors (Mendez & Rondon, 2012).

Thus, the application of such technique allows to identify the main indicators that should be considered for the analysis of the economic and financial performance of the organizations. According to Castro (2015), this methodology is used with the purpose of summarizing and validating the relations observed. Such goal is achieved by identifying a minimum number of factors that explain a maximum variance portion of all indicators.

The use of factor analysis in models related to economic and financial performance is observed in some scientific studies, such as Borges et al. (2014). The authors proposed a cautious model of economic and financial analysis composed of the main indicators arising from the analysis of the financial statements for the years 2010 and 2011, through factor analysis in a group of 44 rural credit cooperatives in the state of Minas Gerais.

The study by Bezerra and Corrar (2006) further proposes a methodology that could reduce the level of subjectivity in the choice of indicators to evaluate companies, as well as be done simultaneously with several indicators. The factor analysis is used in the ion of indicators that analyzed 132 insurance companies of the Private Insurance Surveillance Body (SUSEP), in 2001.

While the research by Carvalho and Bialoskorski (2007) aimed to identify, through factor analysis, which are the most relevant accounting indicators for evaluating the performance of agricultural cooperatives belonging to a certain Cooperatives Development program in the state of São Paulo, in 2000. Fifteen financial performance indicators were covered for the 91 cooperatives analyzed.

With regards to the financial banking institutions, no scientific studies that applied the factor analysis in order to favor the measurement of the economic and financial performance were identified. Which evidences, therefore, an opportunity to apply such technique, which sees to be relevant for the identification of the main indicators and which may bring significant contributions to improve the performance analysis of such institutions.

3 METHODOLOGICAL PROCEDURES

This section includes the methodological aspects related to the development of the study, describing the research sample and characterization, and the procedures for data analysis and application of factor analysis.

3.1 Research Sample and Characterization

This work uses a quantitative approach, according to the classification of Martins and Theóphilo (2007). According to the authors, in this type of research the data are quantified, and analysis and interpretations use statistical techniques.

The study has a descriptive nature and, as main objective, the description of the characteristics of a certain population or phenomenon and the establishment of relations between the variables (Gil, 2010). In this case, we sought to observe, analyze, classify and interpret the information regarding the economic and financial performance of financial institutions in the period covered by the research.

With regards to the data collection for the study, secondary data were used referring to the financial statements of the banking institutions operating in Brazil. Such data were obtained through the website of the Central Bank of Brazil. The spreadsheets referring to the years of 2011, 2012, 2013 and 2014 were collected, with data of such institutions' financial statements. The spreadsheets were obtained under section "50 largest banks and the consolidated National Financial System", available in specific link in said website (BCB, 2015).

The research sample consisted of all classified institutions, such as the Commercial Bank (Banco Comercial), Multiple Bank (Banco Múltiplo) and Caixa Econômica Federal, which operated in Brazil from 2011 to 2014 (those remaining active over the four years were selected). Accordingly, the final sample of the study includes 118 banking institutions. Worth mentioning that the sample included both Brazilian and foreign institutions with branches in Brazil. Based on data corresponding to each of these institutions, the economic and financial performance indicators were calculated.

3.2 Procedures for data analysis and application of factor analysis

Financial institutions had their performance numerically measured by the analysis of their financial statements. The model of statement used follows the COSIF standards (BCB Memorandum no. 1,273, 1987). 17 economic and financial performance indicators were calculated (as shown in Table 1, subitem 2.3), proposed by Assaf (2012).

Note that all financial accounts necessary for the calculations are directly presented by the financial statements under COSIF, except for those relating to the interest sensitivity indicator. To calculate this indicator, the classification of assets and liabilities sensitive to changes in the interest rate was made. According to Assaf (2012), the main balance sheet accounts classified as sensitive assets are those related to interbank investments, securities, and credit operations; and the main balance sheets classified as sensitive liabilities are those of interest-bearing deposits, open-market fundraising, obligations on loans and onlendings, and acceptances and issues of securities. The indicator was calculated considering these accounts for the composition of sensitive assets and liabilities.

The 17 indicators were calculated for each of the financial institutions in the years of 2011, 2012, 2013 and 2014. Such data were analyzed using the multivariate factor analysis statistical methodology. The factor analysis statistical technique was used to identify the most relevant economic and financial indicators for evaluating the performance of Brazilian banking institutions. Although the use to assess organizational performance is largely employed, some limitations are found. For Silva (2016), the amount of indicators to be used in the analysis is an important factor to be considered, since the use of many indicators can confuse the user, while a very small amount may not be enough for the financial evaluation of a company.

According to Januzzi, Coelho, Gonçalves and Vieira (2015), to define which variables shall be considered for determining the company's performance is a relevant aspect. It is important to evaluate all the indicators jointly and to define which ones influence on the company's results, in addition to establishing weights for such indicators. Bezerra and Corrar (2006) argue that this definition usually involves a great level of subjectivity. However, they also point out that it is possible to determine the impact of each indicator in the company's result through the statistical technique called factor analysis. According to Hair, Black, Babin, Anderson and Tatham (2009), the factor analysis change the original variables into new, uncorrelated variables, so called factors. Each factor is a linear combination of the original variables. One measurement of the amount of information transferred to each factor represents the variance. For this reason, the factors are arranged in decreasing variance order. Buesa, Heijs and Baumert (2010) point out that the factor analysis aims to define the underlying

structure in a data matrix, and its main purpose is to reduce a set composed of a large number of variables in a small number of factors that may be able to explain the summary of the original data.

Moreover, the model developed, when applying the factor analysis, shall be cautious. Meaning that it needs to explicit the maximum variance from the smallest possible number of variables, so that it leads to sound results and produces relevant information (Puente-Palacios & Laros, 2009). According to Viana (2005), a relationship between the variables is necessary in order to apply the factor analysis method, since it will allow for the identification of groups of correlated variables.

After verifying the correlation between variables, the model was initially developed with the 17 economic and financial performance indicators previously presented (Table 1). Subsequently, seeking for a better explanation of the factors, the variables with low power of relationship with others were excluded and the procedures referring to the factor analysis were repeated.

The adequacy of analysis was also demonstrated through the Kaiser-Meyer-Olkim (KMO) test and Bartlett's sphericity test. The number of factors was selected using the latent root method (based on the variance measure that the factor explains), defining the number of factors with a self-value greater than 1 (Hair et al., 2009).

The extraction method was the analysis of the main components. The purpose of this method is to produce a first factor with the maximum explained variance. Subsequently, with the definition of the first factor and its associated charge, the analysis proceeds with a second factor maximizing the variance explained thereof. The procedure continues until there are as many factors as there were variables, or until the analyst determined that the number of usable factors has been exhausted (Hair et al., 2009).

The adequacy of each variable was also individually analyzed, making use of the Measure of Sampling Adequacy (MSA) test, which was obtained by means of the anti-image matrix, and the communality table analysis.

The factor loads were calculated and presented. The adjustment of the model and its interpretation was later determined. The variance explained by the retained factors was analyzed using the Matrix of Explained Total Variance. The matrix was used after the factor rotation to facilitate the identification of the indicators comprising each of the factors. Varimax, with orthogonal rotation, was the method applied. Hair et al. (2009) state that the orthogonal rotation aims to simplify the rows and columns of the factorial matrix, facilitating the interpretation of the results. There is an attempt to load the weights from the maximization of the sum of the required load variances of the factorial matrix, so that each indicator is related to one of the factors generated.

The Statistical Package for Social Science (SPSS®), version 17.0, was the software used for data analysis.

4 RESULTS AND DISCUSSIONS

Initially the matrix of correlations between the variables covered were analyzed to verify the adequacy of the use of factor analysis. A significant number of statistically significant variables with Pearson correlation coefficient hiher than 30% (at significance level of 1%) were observed. This indicates the feasibility of using the factor analysis. Therefore, it is possible to continue the application of this technique.

4.1 Analysis with all indicators

At first, the factors were established using all indicators at the same time, seeking to aggregate all indicators into factors with high commonality and minimal loss of information. However, the fact that there are indicators that have inexpressive or no relationship with others causes that analysis to reach unsatisfactory results, once the factor analysis seeks to create factors simultaneously explaining all indicators. It was observed that it occurred, in this attempt to unite all the indicators in a single data analysis.

Bartlett's Sphericity Test rejected the void hypothesis that the data correlation matrix is the identity matrix, at the value of $p < 0.001$ (highly significant). While Kaiser-Meyer-Olkim test,

which measures the sample adequacy, presented a value of approximately 0.562. Hair et al. (2009) recommend a minimum of 0.500 for an appropriate analysis. Therefore, these tests indicated the adequacy of the exploratory factor analysis for the analysis and treatment of the data.

Subsequently, the factor analysis was applied for the seventeen indicators. Initially, seven factors were retained. The Matrix of Total Explained Variance allows to verify level degree of explanation reached by such factors. As shown in Table 2, with the extraction of the seven factors, the explanatory power is 76.33% of the total variations of the seventeen indicators initially used.

Table 2
Matrix of Total Explained Variance for analysis with 17 indicators

Compo-nents	Initial Own Amounts			Sum of square extracted loads			Sum of square rotated loads		
	Total	% Variance	% Cumu-lative	Total	% Variance	% Cumu-lative	Total	% Variance	% Cumu-lative
1	3,104	18,257	18,257	3,104	18,257	18,257	2,971	17,476	17,476
2	2,564	15,082	33,339	2,564	15,082	33,339	2,259	13,288	30,764
3	2,316	13,625	46,964	2,316	13,625	46,964	2,071	12,185	42,949
4	1,486	8,743	55,707	1,486	8,743	55,707	1,673	9,842	52,790
5	1,325	7,792	63,499	1,325	7,792	63,499	1,467	8,630	61,421
6	1,155	6,793	70,292	1,155	6,793	70,292	1,310	7,709	69,129
7	1,026	6,038	76,330	1,026	6,038	76,330	1,224	7,201	76,330
8	0,871	5,121	81,451						
9	0,805	4,735	86,186						
10	0,622	3,660	89,846						
11	0,490	2,883	92,729						
12	0,440	2,586	95,314						
13	0,324	1,907	97,222						
14	0,288	1,694	98,916						
15	0,152	0,896	99,812						
16	0,032	0,187	99,999						
17	0,000	0,001	100,000						

Note. Source: research data.

Although the tests indicated the possibility of applying the factor analysis to all variables (the seventeen indicators), it was decided to increase the explanatory power of the factors by analyzing each variable and, if necessary, removing some variables from the analysis. The choice for the indicators that would be excluded from the analysis was made based on two criteria: the analysis of the anti-image matrix and the analysis of the communalities table.

With regards to the first criterion, the anti-image matrix indicates the explanatory power of the factors in each of the variables analyzed. Hair et al. (2009) state that the KMO test evaluates the appropriateness of the application of the factor analysis in general, and also that it is possible to evaluate the individual variables, which should be analyzed through MSA - Measure of Sampling Adequacy indicator.

The diagonal of the bottom of the anti-image matrix indicates the MSA for each of the model variables. Values lower than 0.500 are considered insignificant for the analysis, indicating, in such cases, variables that can be excluded. According to this criterion, the following indicators were taken from the analysis: Interest Payable (JP), Average Fundraising Cost (CMC), Financial Margin (MF) and Asset Profitability (LA), which presented an MSA level of less than 0.500 in analysis carried out.

While in the second the commonality of each one of the indicators was analyzed, in order to evaluate the proportion of the common variance within each variable. According to Hair et al. (2009), the estimated values of commonalities, after extraction of factors, range between 0.0 and 1.0, meaning that if the value is 0.0 there is no partial variance, and if the value is 1.0

there is 100% common variance. Field (2009) argues that indicators with commonality values below 0.700 are disregarded. Following this criterion, the following indicators were taken from the analysis: Loan Interests (PDE), Efficiency (EF), Fixed Equity (ICP), Leverage (LEV) and Financial Independence (FI), which obtained values lower than 0.700 in the analysis carried out.

4.2 Final analysis with eight indicators

After extraction of the indicators indicated by the criteria of the anti-image matrix (MSA) and the communality table, a great improvement was observed in the explanatory power. The final model includes the following indicators: Voluntary Fit (EV), Immediate Liquidity (LI), Loans / Deposits Indexes (ESD), Ratio Capital/Depositors (RCD), Interest Sensitivity Index (ISJ), Return on Equity RPL), Return on Total Investment (RIT) and Net Margin (ML).

The KMO test was 0.588 (greater than 0.500) and the sphericity test continued to be less than 0.001, which validates the use of factor analysis. The Anti-Image Correlation Matrix presented all values of the individual MSA variables above 0.500, evidencing the sample adequacy. In addition, all the indicators of the commonality matrix presented values higher than 0.700 (as can be seen in Table 3), which indicates a high proportion of common variance within the variables.

The KMO test was 0.588 (greater than 0.500) and the sphericity test remained lower than 0.001, which validates the use of factor analysis. The Anti-Image Correlation Matrix presented all values of the individual MSA variables over 0.500, demonstrating the sample adequacy. Moreover, all commonality matrix indicators presented values higher than 0.700 (as shown in Table 3), which indicates a high proportion of common variance within the variables

Table 3
Communality Table for Final Analysis with 8 Indicators

Variable	Initial	Extraction
EV	1,000	0,986
LI	1,000	0,706
ESD	1,000	0,899
RCD	1,000	0,946
ISJ	1,000	0,982
RPL	1,000	0,768
RSIT	1,000	0,959
ML	1,000	0,893

Note. Source: research data.

Three factors were retained with the application of factor analysis for these eight indicators. The extraction method used was the analysis of the main components. The Total Explained Variance had a explanation level significantly higher than that obtained in previous attempts. The variation percentage explained by the three factors was approximately 89.23%, as shown in Table 4.

Table 4
Matrix of Total Explained Variance for Final Analysis with 8 Indicators

Compo-nents	Initial Own Amounts			Sum of square extracted loads			Sum of square rotated loads		
	Total	% Variance	% Cumu-lative	Total	% Variance	% Cumu-lative	Total	% Variance	% Cumu-lative
1	2,806	35,070	35,070	2,806	35,070	35,070	2,581	32,259	32,259
2	2,541	31,766	66,837	2,541	31,766	66,837	2,552	31,897	64,156
3	1,791	22,391	89,227	1,791	22,391	89,227	2,006	25,072	89,227

Continue

Table 4 (continuation)

Compo-nents	Initial Own Amounts			Sum of square extracted loads	Sum of square rotated loads
4	0,414	5,177	94,404		
5	0,352	4,406	98,810		
6	0,037	0,465	99,276		
7	0,033	0,408	99,684		
8	0,025	0,316	100,000		

Note. Source: research data.

Note that the number of the "Initial Own Amounts", described in Table 4, is equivalent to the number of variables analyzed hereunder, which, in this case, is eight. However, only three among these components have total value higher than 1.0 and, therefore, the number of retained factors is only three. Component 1 presented a value of 2.806, component 2 a value of 2.541, and component 3 a value of 1.791.

These factors represent three dimensions underlying the data, which are useful for the banking institutions performance analysis, object of this study. Accordingly, instead of working with the eight financial performance indicators, only three factors are used, since those are responsible for explaining 89.227% of the total association between the data. The use of these factors is in line with Castro's (2015) approach, which emphasizes that the factor analysis is used to summarize and to validate the relationships observed between the financial indicators. So, we identify a minimum number of factors that explain a maximum portion of the variance of the indicators.

4.3 Consideration on indicators excluded from the analysis

A series of tests was performed to see if it was possible to create groups between the indicators excluded from the analysis. In this sense, we verified if these indicators could give rise to other factors that, isolated from those three initially identified, would make up the evaluation model of banking institutions. However, the tests demonstrated the impossibility of creating a factor for grouping the indicators excluded in the study. No tests presented a satisfactory adjustment to the model, the KMO was lower than 0.500 and / or the variables presented low MSA (lower than 0.500) or low commonality (lower than 0.700).

Hence, we determined the inadequacy of employing another factor for these variables, and we objectively chose the indicators that should be part of the evaluation, using the factor analysis criteria. The result obtained was then backed, leading to the use of eight economic and financial indicators for the performance analysis of the 118 financial banking institutions covered by the study.

4.4 Discussions on factors obtained

In order to identify the most significant financial indicators for evaluating banking institutions and establishing the composition of the three factors generated by the factor analysis, we shall observe the matrix of rotated components. Such matrix was generated by Varimax method and is presented in Table 5.

Table 5
Matrix of Rotated Components

	Components		
Variable	**1**	**2**	**3**
RIT	0,971		
ML	0,926		
RPL	0,874		
RCD		0,972	
ESD		0,948	
LI		0,840	
EV			0,989
ISJ			0,987

Note. Source: research data.

Hence, the indicators comprising each of the extracted factors were identified. According to Matarazzo (2010), a joint analysis of the indicators and identification of the relationships between them shall be carried out in order to analyze the general framework an the entity's performance. According to the results obtained (Table 5), the performance of banking institutions can be evaluated through three factors.

The first factor is called Cost Effectiveness and Profitability and is responsible for 35.07% of the variances (see Table 4). This factor is composed of the indicators: Return on Total Investment (RIT), Net Margin (ML) and Return on Equity (RPL), and allows to evaluate the profitability obtained by the banking institution mainly from the primary function of financial mediation.

The second factor is called Capital and Liquidity, and is responsible for 31.77% of the variances. It is composed of the Ratio Capital/Depositors (RCD), Index Loans/Deposits (ESD) and Immediate Liquidity (LI). This factor allows to evaluate the composition of capital against the deposits and the capacity to cover the deposits with current resources.

Finally, the third factor is called Fitting and Interest Sensitivity, and is responsible for 22.39% of variances. It is composed of the indicators Voluntary Fit (EV) and Interest Sensitivity Index (ISJ), This factor allows to assess the immediate financial capacity and the sensitivity to variations in market interest rates.

The indicators may be grouped in three different factors, representing each of the dimensions to be considered when analyzing the financial and economical situation of these entities. Such factors may be converted into new indicators (Cost Effectiveness and Profitability; Capital & Liquidity; and Fitting and Interest Sensitivity), thus allowing the ranking and comparison of institutions based on factor loads. Simply multiply the scores presented in the matrix "Component Score Coefficient" (shown in Table 6) by the initial indicators, and add them up, in each case, in order to calculate the values of these new indicators referring to one of the institutions.

Table 6
Matrix "*Component Score Coefficient*"

Variable	**Components**		
	1	**2**	**3**
RIT	0,379	0,002	0,018
ML	0,355	-0,004	-0,022
RPL	0,356	-0,015	0,104
RCD	-0,009	0,381	0,000
ESD	-0,004	0,372	-0,002
LI	-0,006	0,329	-0,005
EV	0,044	0,000	0,502
ISJ	0,045	-0,006	0,501

Note. Source: research data.

Accordingly, RIT, ML, RPL, RCD, ESD, LI, EV, and ISJ indicators shall make up the model to be considered for the performance analysis of the institutions included in the study. These results are similar to those obtained by Borges et al. (2014) for credit union. The authors identified ten economical and financial indicators that are most relevant to these cooperatives' performance evaluation, from which can be observed that six of them are common to those identified to the financial banking institutions in the research hereunder (RIT, ML, RPL, RCD, ESD and LI).

Worth mentioning that, through the modeling results, the performance of the banking institutions can be evaluated with regards to each of the three factors, setting rankings and comparing the different institutions, as well as their evolution over the years. Therefore, contribution is made to identify the strengths and weaknesses of the institution, as well as to diagnose its current position and to produce results that serve as a basis for forecasting future trends, as recommended by Matarazzo (2010) and Castro (2015).

These factors reflect the characteristics of the banking business, as explained by Assaf (2012). According to such author, the financial institutions develop their market strategies in aiming at maximizing their operating results, so as to operate in competitive environments. In this sense, the financial services offered by banks are managed in a way that minimizes their costs and increases the volume of their applications and, therefore, their revenues. These strategies mainly impact on the "Cost Effectiveness and Profitability" and the "Capital and Liquidity" factors, the most important ones when analyzing the performance of financial institutions (the two factors jointly represent 66.84% of the data variance, as shown in Table 4) .

5 CONCLUSION

Upon the use of the factor analysis, the indicators that explain the maximum variance from the smallest possible number of variables were identified. We conclude that the most relevant economic and financial indicators for the Brazilian banking institutions performance evaluation are: Return on Total Investment (RIT), Net Margin (ML), Return on Equity (RPL), Ratio Capital/Depositors (RCD), Index Loans/Deposits (ESD), Immediate Liquidity (LI), Voluntary Fitting (EV) and Interest Sensitivity Index (ISJ). Thus, we observe the need for monitoring a number of indicators much smaller than that originally presented.

Further, these eight indicators can be replaced by three factors, which explain approximately 89.23% of the total data variance. The factors "Cost effectiveness and Profitability", "Capital and Liquidity" and "Fitting and Interest Sensitivity " allow to classify and compare the performance of institutions, determining the main aspects that shall be considered by the analysis.

Accordingly, upon the use of these indicators and the application of the Factor analysis, the data was summarized to assist in the economic and financial evaluation of the banking institutions. Through the results obtained, financial decision-makers may focus primarily on the indicators and factors that are most relevant for the performance of such institutions, which foster the efficiency optimization of the economic and financial management.

With regards to the academic sphere, the study provides a methodological contribution to evaluate the performance of banking institutions and to increase the level of knowledge about the economic and financial indicators of these institutions. The originality of the research relies in the application of the factor analysis. The new indicators resulting from this application can be used in other studies, in order to complement the analyzes with traditional indicators.

Moreover, the research contributes to make managers, analysts and investors note that it is possible to consolidate financial indicators evaluating the performance of companies within a specific sector. Additionally, it support these agents in establishing a smaller number of indicators and simplifying the companies' analysis process, which allows a better understanding on the data.

Among the limitations of this study, we highlight that the analysis was carried out from the seventeen predetermined indicators. Therefore, other economic and financial indicators were not addressed hereunder. For future researches, we suggested that different indicators are used with the application of the factor analysis, and that comparisons are made with the results herein presented. Finally, we further recommended that the indicators identified

hereunder are used to verify and compare the performance of different banking institutions over the years.

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