RESEARCH
O&G Forum 2024; 34 – 2s: 192 - 203

FINANCIAL PERFORMANCE COMPARISON OF PRIVATE AND FOREIGN-CAPITALIZED DEPOSIT MONEY BANKS IN THE TURKISH BANKING SECTOR FOR THE PERIOD 2012-2022 WITH GRAY RELATION ANALYSIS AND GRAY RELATION LEVEL AND RANKING

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Abstract
Today, the banking sector has a very important function for our country's economy as well as the economies of the world countries. In order to ensure the functioning and stable structure of the financial system, it is not possible to think separately from the activities of the banking sector. Due to the interaction with the financial system, crises arising in the banking sector will not cause a partial loss, on the contrary, the whole economy will suffer. From this point of views, the level of success in the performance of banks becomes even more important. In this study, Gray Relation Analysis (GRA), which is one of the Multi-Criteria Decision Making (MCDM) methods, is used in performance evaluation by comparing the performance of private capital deposit banks and foreign capital deposit banks established in Turkey in the Turkish banking sector. Capital structure, return on assets, liquidity and profitability performances of private and foreign capitalized deposit banks were ranked for the period 2012-2022 through GRA relationship analysis.
Keyword: Gray Relation Analysis, Banking Sector, Performance Measure, Capital Structure, Asset Quality.
Subject classification codes: G21, G29.

INTRODUCTION

In today's world, it is becoming increasingly difficult to keep up with the pace of development and progress in many sectors as an effect of intense globalization. It is an undeniable fact that the fund mobilization in the competitive environment, which has become even stronger as a result of the deepening trends in international financial markets, has reached serious dimensions. For countries that want to rapidly adapt to this situation, having a healthy banking sector is of primary importance in maintaining the stable structure of the financial system and increasing its resilience to possible economic shocks. The banking sector intermediates the supply and demand for funds in the financial system and ensures that the savings collected are transformed into productive investments. Moreover, since it creates dematerialized money and contributes to the continuity of monetary and fiscal policies, it has an important position in the economic growth of countries. Strong economies require a robust and active banking sector that manages the risks arising from internal and external factors that the banking sector may face, interacts directly with the economic system and operates in a healthy structure. One of the most important objectives of the banking sector in order to ensure the sustainability of its activities and the continuity of its assets in a tough competitive environment is the expectation of high performance. The success achieved through the proper use of power and capabilities explains the concept of performance.

In other words, performance is the positive or negative outputs and results at the end of a certain period of their efforts towards their plans and activities to achieve their goals. As is the case for all businesses, performance measurement, evaluation and reporting for banks can take place within the control mechanism. Performance measurement for banks can be done for financial and non-financial elements. However, commonly used performance measures are financial measures. The extent to which banks are reliable, their economic soundness and stability can be determined by the presence of indicators such as profitability, capital, liquidity, which are financial elements. In this context, the results of financial ratios provide information about the reliability and economic size of banks. Through the combinations of these ratios, the performance of banks can be monitored and whether they are successful or not as a result of their activities in the sector can be revealed with these performance criteria.

However, testing financial and non-financial factors (reputation, quality, etc.) together, which has been the subject of many recent studies, suggests that a more accurate performance measurement can be made. The challenging conditions of the financial sector and the necessity to utilize resources in the most efficient way have brought about the need to compare where banks stand with their competitors in their sectors in an intensely competitive environment. Financial performance analysis is important in terms of estimating the current situation of banks and taking

necessary measures for the future. In addition, performance measurement also enables the comparison of banks. In this study, the entry into force of Basel II regulations as of July 2012 led to an increase in the capital adequacy ratio in the sector. In addition, the favorable developments in the macroeconomic conjuncture following the regulations, Turkey's investment grade rating and rapidly declining interest rates had a positive impact on equity. Despite the decline in the balance of non-interest income and expenses, the sector's net profit for the period increased by 19.2% compared to the same period of the previous year, mainly due to the rising net interest margin. Profits of 37 out of 49 banks operating in the sector increased in the last one year period and the sector's key selected ratios improved positively. In addition, the total assets of the banking sector have increased and they have significantly increased their securities issuances (BRSA, 2013/1). Therefore, a comparison of the performance of 8 privately owned deposit banks and 16 foreign-owned deposit banks established in Turkey operating in the Turkish banking sector between 2012 and 2022, a period of positive developments, has been made. In the study, Gray Relation Analysis (GRA), one of the Multi-Criteria Decision Making (MCDM) methods, was used in performance evaluation. With the analysis carried out, the analysis was carried out separately for domestic and foreign banks in the gray models established due to the differences in the capital structure operating in the Turkish banking sector on performance. In the first part, Gray coefficients were calculated for each parameter and then Gray relationships were determined in determining the ranking. Performance ranking values were determined according to the size of these relationship coefficients (r).

LITERATURE

Gray relational analysis method is frequently applied in measuring and evaluating financial performance in the banking sector.

Wu and Lin (2011) propose a new approach to analyze the credit risks of the banking sector based on gray relational analysis (GRA) modeling. In order to build a financial crisis warning system for the banking sector, the GRA approach is developed and applied to a real data set of 111 samples. The results of the existing model are compared with traditional ones, logistic regression and back-propagation neural network. The results show that the proposed GRA model shows better prediction accuracy than traditional models in predicting financial crisis as well as financially sound banks.

Delcea et al. (2013) This study identifies some of the most important categories of risk faced in turbulent economic systems and investigates whether there is a strong relationship between the identified risk categories and the development of banks. GRA (gray relational analysis) was used, considering that this relationship depends on the same banking sector. Using data from Bankscope, the analysis was carried out on 20 European banks divided into 4 groups according to the banking sector to which they belonged over a three-year period from 2009 to 2011. For this purpose, banks were grouped into 4 main categories, each corresponding to a specific banking sector (A, BB, BBB and CCC). As a result, it was found that due to the relatively stable economic environment, the relationship between the main risk categories and the performance/survival of companies with an A ranking for banks operating in the banking sector is very strong. On the other hand, the situation of banks operating in the banking sector and receiving a CCC ranking of BB is not predictable.

Bradea et al. (2013) This study attempts to provide a new perspective on banking risks and their impact on the profitability of the banking sector as a whole and their significant impact on the survival of banks in today's economy. It has been identified that this impact has become difficult to measure and manage due to the increasingly uncertain economic environment and that there is a dire need for some methods that work best under uncertain conditions and what can work better than gray system theory methods. It is noted that although it is quite new, the rapid application of gray system theory has resulted in success, it has been successfully applied in analysis, modeling, forecasting, control and decision making in practically all areas, and its advantage is that it manages to achieve good performance in tests on a small number of data.

Doğan (2013) In this study, Gray Relational Analysis (GRA) method was applied to measure and compare the financial performance of 10 banks whose shares were traded on the Istanbul Stock Exchange (ISE) between 2005 and 2011. In addition, it is aimed to reduce the number of financial ratios that determine bank performance and thus to determine which financial ratio is more important in performance measurement. As a result of the ICA method, it was determined that "Akbank" ranked first in terms of financial performance and "Yapı Kredi Bank" ranked last. It is also concluded that a bank with a high "Return on Assets" may also have a high financial performance.

Altan and Candoğan (2014) In this study, it was examined whether the results of traditional performance measurement methods and Gray Relation Analysis measurement results differ by using the same number of data. For this purpose, an application was made on participation banks operating in Turkey. According to the results of the application, it is seen that the results of performance measurement using traditional ratios and the results of Gray Relationship Analysis differ. As a result, it was observed that a bank that ranked first according to the results of traditional ratio analysis dropped to third place in gray relationship analysis, and a bank that ranked first in gray relationship analysis dropped to third place in the traditional method. In the study, it was stated that the number of data used for the traditional method is low and does not take into account the relationship between the data, and that the relationship between the data is taken into account in Gray Relationship Analysis, so more accurate results can be obtained and a more accurate performance ranking is possible.

Mohammadreza and Mahdi (2014) This study is based on the idea that categorizing customers can create motivation among customers as companies try to satisfy existing customers and attract new ones. In this context, it is stated that customers with high priority will be able to benefit from the advantages offered to them by companies and customers with low priority will try to get higher priority to benefit from these advantages. It has been suggested that this motivation may lead to a win-win relationship between customers and companies. For this reason, the information required for classification was taken from the customer relationship management (CRM) database and the gray relational analysis (GRA) method was applied to rank the customers. Three different types were considered: non-prioritized, two-prioritized and high-prioritized. Priority models were identified in which high-priority customers had a non-priority priority over low-priority customers. Performance measures were calculated for each model and the results were compared. A case study in a bank is also presented to illustrate this procedure.

Sakınç (2015) In this study, the performance of brokerage houses in Istanbul Stock Exchange (BIST) was measured. In the

study, Gray Relational Analysis, which is one of the multi-criteria decision-making methods and provides better solutions than mathematical methods in an uncertain environment, was used as a performance measurement method. The financial statements of brokerage houses traded on the Istanbul Stock Exchange between 2011 and 2013 were analyzed. In order to examine the liquidity, profitability, financial position and capital adequacy of brokerage houses, 15 financial ratios were used. According to the results obtained from the Gray Relational Analysis method, Info Securities ranked first, Gedik Securities second, Global Securities third, İş Securities fourth and Osmanlı Securities fifth.

Thakur and Anbanandam (2015) In this study, since the suppliers of any organization are considered as strategic partners and an integral part of the supply chain network, the selection of suppliers is considered to be a crucial decision for achieving competitive advantage; therefore, supplier selection is based on the evaluation of various attributes of each alternative; hence, this problem is a multi-attribute decision making (MADM) problem. The aim of this paper is to propose a model for selecting the best supplier. In order to select the appropriate supplier with uncertain information, the application of gray theory is preferred. Gray values are used to give the ratings and weighting according to various criteria used to evaluate different supplier alternatives. Finally, the degree of gray probability was calculated to rate the various alternatives. For this, a case study from the Indian banking sector was conducted. The proposed supplier selection model using gray theory approach has been applied in the banking sector. This case study is focused on selecting the best vendor for "optimizing digital banking" among four available vendors.

Ayrıçay et al. (2017) In this study, 10 ratios calculated from the balance sheet and income statement items of the participation banks operating in Turkey in the fourth period of 2016 were used. The weight of the ratios relative to each other was determined by Analytic Hierarchy Process (AHP). Gray Relational Analysis (GRA), which makes it possible to reach a decision with a small number of data, was used to rank participation banks according to their performance. As a result, a ranking was made for the analyzed period. It is stated that the ranking is Vakıf Participation, Kuveyt Türk, Ziraat Participation, Türkiye Finans and Albaraka Türk. As a result, the general situation and performance evaluation of participation banks as of 2016 has been realized.

Yüksel et al. (2017) It is aimed to measure financial performance in the Turkish banking sector and combine data mining with multi-criteria decision-making methods. For this purpose, a text mining process was applied to measure the pairwise comparison of criteria. Two integrated models, DEMATEL-GRA and DEMATEL-MOORA, were defined in the model. As a result, it was found that both integrated models can provide the best ranking to measure the financial performance of the banking sector and that data mining results can be appropriately adapted to multidimensional decision-making processes. It is suggested that the methodology of the study can be extended by using different types of multi-criteria decision-making models and various data mining processes such as web mining can be added for comprehensive analysis. Another important result of this study is that foreign banks are found to have better performance than public and private banks.

Sezer et al. (2018) This study compares the financial performance of five banks traded in BIST between 2011 and 2015 using Gray Relational Analysis (GRA). In addition, it is aimed to determine which ratio is more important for the performance of banks. As a result, the financial performances of five banks in BIST are ranked according to the approach.

Ömürbek et al. (2018) In this study, the profitability of the "deposit" and "development and investment" bank groups, which are considered according to their functions, was estimated with the basic GM (1,1) until 2020 based on the data between 2013 and 2016. Banks are analyzed on a group basis according to their functions and are analyzed as deposit banks and development and investment banks. In the study, the data sets were created from profitability ratios and profitability forecasts were made for each bank group by considering each ratio separately. The purpose of this study is to test the effectiveness of the gray forecasting method when there is limited data. For this purpose, the profitability forecasts of the bank groups considered functionally were tried to be obtained. The results show that for each bank group, the gray forecasting method produces forecasting results that can be considered quite good in an environment with limited data. As a result, it is stated that the profitability performance of banks can be evaluated as an indicator of corporate success and therefore, the application will contribute to the banks to have an idea about their profitability performance in the future periods.

Tooraj and Arvin (2020) The purpose of this study is to design an inference engine to measure the level of readiness of each bank before starting the corporate sustainability audit process. According to the output of the designed inference engine, the audit team can make decisions about audit resources and audit process. In this research, hybrid rough and gray set theory is used to design and build a rule model system to measure the sustainability level of banks. First, 16 rule models were extracted using rough set theory (RST) and each model was cross-validated. To measure the readiness of new banks, the object-relative reduction model was selected as the inference engine with 95.6% accuracy. Sustainability measurement of banks based on RST is a new approach in the field of corporate sustainability.

Tihana (2020) This study focuses on the possibilities of Gray Relational Analysis (GRA) as a tool for portfolio selection. The main objective of the paper is to empirically assess the possibilities of dynamic portfolio construction based on the results obtained from the ranking of stocks when using the GRA approach. As a result of the analysis, it was found that there are possibilities to exploit the advantages of the GRA methodology for constructing stock portfolios. The importance of this research lies in its incorporation of the GRA approach as a tool to achieve commonly known investment objectives more efficiently, in less time and even including transaction costs.

Tekin and Keskin (2021) In this study, a different approach to portfolio construction from stocks using multi-criteria decision making techniques was tried. For this purpose, TOPSIS and Gray relational analysis methods were used. In this study, it was attempted to make portfolio diversification on the basis of stock market performance ratios with TOPSIS and Gray Relational Analysis methods by using quarterly data for the period 2015-2019 of companies operating in three different sectors: banking, retail and wholesale trade and textile. As a result, it was observed that the portfolio formed by the companies with the lowest performance in terms of stock market performance ratios reflected the highest average percentage change in positive terms. It was determined that the return of the formed portfolios was higher than the return of BIST100, BIST Banking, Gram Gold and Dollar alternatives. This situation is interpreted as TOPSIS and Gray relational analysis methods can be used as an alternative method in the formation of profitable portfolios.

Medetoğlu and Saldanlı (2022) The main purpose of this study is to analyze the financial performance of banks. Gray Relational Analysis was used within the scope of the study. In the study, financial ratios obtained from the financial statement data of 11 banks between 2018 and 2020 were analyzed. As a result of the study, it was determined that Akbank T.A.Ş. had the highest financial performance in 2018 and 2020, while Türkiye Halk Bankası A.Ş. had the lowest financial performance. In 2019, the highest financial performance of ING Bank A.Ş. and the lowest financial performance of Denizbank A.Ş. were determined. The financial performance ranking of the banks in the study is shown in a table at the end of the study.

METHODOLOGY AND DATA

In this section of the study, the Gray relational analysis method used in the analysis will be explained. Then the data set used in the study will be explained.

Methodology

Grey Relational Analysis; Deng (1982) proposed the concept of grey relational space, which builds on the concepts of system theory, space theory, and control theory. GRS is useful for capturing the correlations between the reference factor and other factors which can be compared within a system. One of the features of GRA is that both qualitative and quantitative relationships can be identified among complex factors with insufficient information (relative to conventional statistical methods). Under such conditions, the results generated by conventional statistical techniques may not be acceptable without sufficient data to achieve desired confidence levels. In contrast, grey system theory can be used to identify major correlations among factors of a system with a relatively small amount of data. (Cheng et al., 2010).

The basic idea of GRA is that the closeness of a relationship is judged by the similarity of the geometric patterns of the sequence curves. The more similar the curves are, the higher the degree of GRA between the sequences and vice versa. GRA is often used for factor analysis, project decision making and order analysis (Naiming and Sifeng 2009).

Gray Relation Analysis can be used to quantitatively and logically measure the relationship between two sets. What needs to be done for this process is to numerically calculate the relationship between the sequences to be compared. The degree of relationship calculated as a result of the operations is called the degree of gray relationship and takes values between "0" and "1" (Feng and Wang, 2000). This measure shows the similarities or differences between the analyzed elements. When the change between two elements is continuous, there will be a higher relationship between the elements if the changes occur together, and a lower relationship if they do not occur together (Uçkun and Girginer, 2011).

Steps of the Analysis

Step 1. Decision matrix construction

The evaluated values of variables in an MCDM (multicriteria decision-making) problem form a decision matrix. A decision matrix has n choices and m selection criteria. The decision matrix is expressed as equation (1).

i: selection criteria; i: 1,2,3, … , m

j: alternative; j: 1,2,3, … , n

$$\begin{bmatrix} X_1(1) & X_1(2) & \dots & X_1(m) \\ X_2(1) & X_2(2) & \dots & X_2(m) \\ \vdots & \vdots & \vdots & \vdots \\ X_n(1) & X_n(2) & \dots & X_n(m) \end{bmatrix} \quad (1)$$

Step 2. Standard series construction

Standard series are target values for selection criteria in decision-making models. The standard series determines the reference point for MCDM problems. The standard series can be constructed using equation (2):

x_0={ x_0 (1), x_0 (2),……x_0 (m) or [x_0 (1), x_0 (2… x_0 (m)] (2)

where

m: total number of selection criteria,

x_0: target value of the selection criteria

Step 3. Normalization of the decision matrix

Normalization of decision matrix: Normalization must be performed to create comparable series. The values of the normalized series lie within the interval. Normalization can be applied in three different ways depending on the selection policy. Equation (3) is used to carry out the normalization process when a multi criteria decision-making problem involves selection criteria where higher is preferred:

$$X_i^*(k) = \frac{X_i(k) - \min_k X_i(k)}{\max_k X_i(k) - \min_k X_i(k)} \quad (3)$$

Where

$\min_k X_i(k)$: minimum value in the decision matrix from the viewpoint of selection criteria i

$\max_k X_i(k)$: maximum value in the decision matrix from the viewpoint of selection criteria i

The normalization step is performed using Equation (4). If low, it is suitable as a selection criterion in multi-criteria decision problems:

$$X_i^*(k) = \frac{\max_k X_i(k) - X_i(k)}{\max_k X_i(k) - \min_k X_i(k)} \quad (4)$$

If the selection criteria of the MCDM problem has the desired values, the normalization step is performed by equation (5):

$$X_i^*(k) = 1 - \frac{|X_i(k) - X_0(k)|}{\max\{\max_k X_i(k) - X_0(k); X_0(k) - \min_k X_i(k)\}} \quad (5)$$

Where

k: alternative; j: 1,2,3, … , n

$X_0(k)$: desired value of alternative k

Step 4. Construction of the difference series

Construction of difference series: Absolute difference between normalized decision matrix values and standard series values. The calculation method for determining the absolute difference between the entries of the normalized decision matrix and the standard series values can be determined by Equation (6).

After finding the differences is represented as given in the equation (7):

$$\Delta_{0i}(k) = |X_i^*(k) - X_0^*(k)| \quad (6)$$

$$\begin{bmatrix} \Delta_{01}(1) & \Delta_{01}(2) & \dots & \Delta_{01}(m) \\ \Delta_{02}(1) & \Delta_{02}(2) & \dots & \Delta_{02}(m) \\ \vdots & \vdots & \vdots & \vdots \\ \Delta_{0n}(1) & \Delta_{0n}(2) & \dots & \Delta_{0n}(m) \end{bmatrix} \quad (7)$$

Step5. Calculation of grey relational coefficients and construction of grey factor matrix:

To obtain the gray relationship coefficient, we need to identify the values of the difference series that are at their highest and lowest. The calculation process of the gray relationship coefficient can be applied using Equation (8):

$$\gamma(X_0(k), X_i(k)) = \frac{\Delta_{min} + \varsigma \times \Delta_{max}}{\Delta_{0j} + \varsigma \times \Delta_{max}} \quad (8)$$

where

Δ_{max}: the highest value in the difference series

Δ_{min}: the lowest value in the difference series

γ: grey relational coefficient

ς: adjustment coefficient between Δ_{0j} and Δ_{max} ; $\varsigma \in [0,1]$

The gray coefficient matrix is constructed using the values of the gray relationship coefficients.

The gray coefficient matrix contains all the gray related coefficients as seen in equation (9):

Step 6. Determination of grey relational grades

The gray relationship indicates the similarity between the normalized decision matrix and the standard series. Similarity increases as the level of gray relationships increases. The highest similarity gives the best alternative to the MCDM problem.

When the importance of the selection criteria in the MCDM problem is equal, the gray relationship is calculated as T gray relationship by Equation (10):

$$\tau(X_0, X_i) = \frac{1}{m}\sum_{k=1}^{m}\gamma(X_0(k), X_i(k)1) \quad (10)$$

When the selection criteria have different importance in the MCDM problem, the gray relationship degree is calculated using Equation (11):

$$\tau(X_0, X_i) = \sum_{k=1}^{m}\gamma(X_0(k), X_i(k)) \cdot W_i(k) \quad (11)$$

where

$W_i(k)$: *weight value of the selection criteria i.*

The GRA method ends up with finding the weights Wi(k) for each alternative defined in the problem and show their importance in terms of the selection criteria. In this paper, those importance values are considered as the performance of the firms in the dataset with respect to the selected ratios, i.e. selection criteria. (Özdağoğlu et al., 2017).

METHOD

In the study, the mean and deviation values of the parameters related to the data were analyzed. Mann Whitney U test was used to analyze the parameters according to domestic and foreign capital structure. The significant acceptance value was chosen as 0.05. Afterwards, Gray analysis model was used to examine the performance evaluations of domestic and foreign groups separately. SPSS 25.00 program was used in calculations.

DATA

Performance Gray Relation Coefficients are calculated by using financial ratios related to asset quality, liquidity, capital structure and profitability of private capital deposit banks operating in the Turkish banking sector and foreign capital deposit banks established in Turkey for 2012-2022 and the level and ranking of the Gray relationship are examined. The financial ratios used in the analysis were obtained from the official website of the Banks Association of Turkey istatistik@tbb.org.tr.

Table 1. Criteria for Performance Evaluation

Variables	Explanation	Notation
Net Profitability Performance	ROA [Net Profit (Loss)/Total Assets]	NPTA
	ROE [Net Profit (Loss) for the Period / Equity]	NPE
	Profit Before Tax/Total Assets	PTTA
Asset Quality Performance	Financial Assets/Total Assets	FATA
	Total Loans/Total Assets	TLTA
	Total Loans / Total Deposits	TLTD
	Non-Performing Loans (Gross)/Total Loans	NPLTL
Capital Adequacy Performance	Shareholders' Equity/Total Assets	ETA
	[Capital requirement for Credit+Market+Op.Risk x12,5)]x100	CAR
	Shareholders' Equity/ (Deposits + Non-Deposit Resources)	EDN
Liquidity Performance	Liquid Assets/Total Assets	LATA
	Liquid Assets/Short Term Liabilities	LASL

Table 2. Private and Foreign-Capitalized Deposit Banks Included in the Data Analysis

Foreign Capitalized Deposit Banks	Private Capitalized Deposit Banks
Alternatifbank A.Ş.	Akbank T.A.Ş.
Arap Turk Bank	Anadolubank A.Ş.
Burgan Bank A.Ş.	Fibabanka A.Ş.
Citibank A.Ş.	Şekerbank T.A.Ş.
Deniz bank A.Ş.	Turkish Bank A.Ş.
Deutsche Bank A.Ş.	Türk Ekonomi Bankası A.Ş.
HSBC Bank A.Ş.	Türkiye İş Bankası A.Ş.
ICBC turkey Bank A.Ş.	Yapı ve Kredi Bankası A.Ş.
ING Bank A.Ş.	
Odea Bank A.Ş.	
QNB Finansbank A.Ş.	
Turkland Bank A.Ş.	
Türkiye Garanti Bankası A.Ş.	

ANALYSIS AND FINDINGS

Table 3. Analysis of Parameters by Capital Structure

	Capital Structure		p
	Foreign (n=167) X±s.s.	Local (n=88) X±s.s.	
ETA	16,94±18,58	11,14±2,76	0,03*
CAR	29,86±54,01	17,06±3,15	0,01*
EDN	38,91±111,3	13,89±3,62	0,36
FATA	25,82±17,82	20,28±11,02	0,04*
TLTD	55,25±15,86	63,97±7,94	0,01*
TLTA	120,56±103,55	99,55±14,66	0,32
NPLTL	4,25±6,44	4,22±2,55	0,39
LATA	33,07±16,27	23,17±7,9	0,01*
LASL	131,93±463,2	43,52±21,37	0,01*
NPTA(ROA)	1,91±1,23	2,15±7,09	0,67
NPE (ROE)	10,7±1,29	13,45±2,58	0,03*
PTTA	2,04±1,19	1,64±1,43	0,04*

**Mann Whitney U test, *significant difference at 0.05 level

The parameters of domestic and foreign capitalized banks are analyzed in Table 3. According to the results, it is determined that the levels of ETA, CAR, FATA, TLTD, EDN, LASL, ROE, PTTA differ according to the capital structure ($p<0.05$).

It is observed that ETA, CAR, FATA, LATA, LASL and PTTA levels are higher in banks with foreign capital. TLTD and ROE levels were found to be higher in domestic capital banks. On the other hand, it was determined that the levels of EDN, TLTD, NPLTL and ROA did not differ significantly in domestic and foreign capitalized banks ($p>0.05$).

In this context, due to the differences in capital structure on performance, the gray models were analyzed separately for domestic and foreign banks. In the first part, Gray coefficients were calculated for each parameter and then Gray relationships were determined in determining the ranking. Performance ranking values were determined according to the size of these relationship coefficients (r).

Analysis of Foreign Capitalized Deposit Money Banks (Established in Turkey)

Table 4. Capital Capital Adequacy Performance Gray Relation Coefficients

Bank	Capital Adequacy Performance		
	ETA	CAR	EDN
Alternatif	0,09	0,11	0,14
Arap Tür Bank	0,20	0,13	0,31
Bank of China	1,00	0,47	0,91
Burgan Bank	0,12	0,12	0,19
Citibank	0,20	0,15	0,33
Denizbank	0,13	0,11	0,21
Deutsche	0,25	0,18	0,46
Garanti Bank	0,15	0,11	0,26
HSBC	0,11	0,11	0,18
ICBC Turk	0,11	0,13	0,18
ING Bank	0,15	0,12	0,24
MUFG Ba	0,19	0,22	0,86
Odea ban	0,11	0,13	0,17
QNB Finan	0,12	0,10	0,21
Rabo Ban	0,84	1,00	1,00
Turkland	0,15	0,10	0,23

Capital adequacy performance of foreign capital banks Gray relationship coefficients are calculated and given in Table 4.

Table 5. Asset Quality Performance Gray Relation Coefficients

	Asset Quality			
	FATA	TLTD	TLTA	NPLTL
Alternatif	0,44	0,89	0,68	0,80
Arap Tür B	0,66	0,46	0,31	0,39
Bank of China	1,00	0,36	0,86	0,02
Burgan B	0,37	0,99	0,68	0,82
Citibank	0,86	0,52	0,29	0,70
Denizbank	0,45	0,87	0,58	0,99
Deutsche	0,85	0,60	0,81	0,00
Garanti B	0,54	0,85	0,59	0,86
HSBC	0,65	0,77	0,48	0,90
ICBC Turk	0,57	0,80	0,70	0,65
ING Bank	0,46	0,94	0,68	0,83
MUFG Ba	0,43	0,74	0,94	0,00
Odea ban	0,48	0,83	0,47	0,92
QNB Finan	0,52	0,88	0,63	0,99
Rabo Ban	1,01	0,60	1,00	0,00
Turkland	0,50	0,85	0,47	0,99

Gray relationship coefficients of asset quality performance of foreign capital banks are calculated and given in Table 5.

Table 6. Liquidity Performance Gray Relation Coefficients

	Liquidity performance	
	LATA	LASL
Alternatif	0,63	0,27
Arap Tür B	0,86	0,59
Bank of China	1,00	0,83
Burgan B	0,56	0,24
Citibank	0,88	0,42
Denizbank	0,66	0,23
Deutsche	0,90	0,59
Garanti B	0,69	0,24
HSBC	0,88	0,36
ICBC Turk	0,80	0,33
ING Bank	0,71	0,24
MUFG Ba	1,00	0,72
Odea ban	0,82	0,35
QNB Finan	0,60	0,22
Rabo Ban	0,93	1,00
Turkland	0,77	0,28

Gray relationship coefficients of liquidity performance of foreign capital banks are calculated and given in Table 6.

Table 7. Profitability Performance Gray Relation Coefficients

	Profitability Performance		
	NPTA (ROA)	NPE (ROE)	PTTA
Alternatif	0,06	0,57	0,07
Arap Tür B	0,17	0,68	0,21
Bank of China	1,00	0,72	1,00
Burgan B	0,04	0,31	0,05
Citibank	0,34	1,00	0,38
Denizbank	0,14	0,82	0,14
Deutsche	0,34	0,97	0,40
Garanti B	0,34	0,95	0,22
HSBC	0,07	0,53	0,08
ICBC Turk	0,05	0,50	0,06
ING Bank	0,13	0,62	0,15
MUFG Ba	0,09	0,71	0,10
Odea ban	0,01	0,15	0,03
QNB Finan	0,14	0,93	0,16
Rabo Ban	0,46	0,44	0,54
Turkland	0,10	0,00	0,05

The gray correlation coefficients of profitability performance of foreign capital banks are calculated and given in Table 7.

Table 8. Capital Adequacy Performance Gray Relation Level and Ranking

Banka	Capital Adequacy Performance		
	ETA	CAR	EDN
Alternatif	0,07	0,10	0,14
Arap Tür Bank	0,16	0,11	0,31
Bank of China	0,82 [1]	0,42 [2]	0,91 [2]
Burgan B	0,09	0,10	0,19
Citibank	0,17	0,14	0,33
Denizbank	0,10	0,09	0,21
Deutsche Bank	0,51 [3]	0,16	0,46
Garanti B	0,13	0,10	0,26
HSBC	0,09	0,10	0,18
ICBC Turk	0,09	0,11	0,18
ING Bank	0,12	0,10	0,24
MUFG Bank	0,15	0,20 [3]	0,86 [3]
Odea bank	0,09	0,11	0,17
QNB Finan	0,10	0,09	0,20
Rabo Bank	0,69 [2]	0,89 [1]	0,99 [1]
Turkland	0,12	0,09	0,23

Capital adequacy performance Gray relationship coefficients of foreign capital banks are calculated and given in Table 4.
In Table 8, capital adequacy performance Gray relationship level and ranking are presented.
When the ETA levels of capital adequacy performance of foreign capital banks are analyzed, Bank of China ranks first, Rabo Bank ranks second and Deutsche Bank ranks third. These three banks are ranked earlier than other banks in terms of ETA performance.
When the CAR levels of foreign capital banks regarding capital adequacy performance are analyzed, Rabo Bank ranks first, Bank of China ranks second and MUFG Bank ranks third. In terms of CAR, Rabo Bank and Bank of China are seen to be the two banks that come out earlier than the other banks.
When the EDN levels related to the capital adequacy performance of foreign capital banks are analyzed, Rabo Bank ranks first, Bank of China ranks second and MUFG Bank ranks third. In terms of EDN, Rabo Bank and Bank of China, MUFG Bank are seen as the two banks that came out earlier than the other banks.
According to the Gray relationship levels in Capital Adequacy Performance, Rabo Bank and Bank of China, MUFG, Deutsche Bank are seen as the banks that differ from the other banks ranked higher in the rankings.

Table 9. Asset Quality Performance Gray Relation Level and Ranking

	FATA	TLTD	TLTA	NPLTL
Alternatif	0,08	0,60 [3]	0,67	0,80
Arap Tür Bank	0,32 [3]	0,31	0,31	0,39
Bank of China	0,49 [1]	0,24	0,85 [2]	0,02
Burgan Bank	0,07	0,67 [1]	0,67	0,82
Citibank	0,36 [2]	0,35	0,28	0,70
Denizbank	0,08	0,58	0,57	0,99 [1]
Deutsche	0,36 [2]	0,40	0,80	0,01
Garanti B	0,10	0,57	0,58	0,86
HSBC	0,12 [3]	0,52	0,47	0,90 [3]
ICBC Turk	0,11	0,53	0,69	0,65
ING Bank	0,09	0,63 [2]	0,68	0,83
MUFG Bank	0,08	0,49	0,93 [2]	0,00
Odea bank	0,09	0,56	0,46	0,92 [2]
QNB Finans	0,10	0,59	0,62	0,99 [1]
Rabo Bank	0,49 [1]	0,40	0,99 [3]	0,01
Turkland	0,09	0,57	0,47	0,99 [1]

Gray relationship coefficients of Asset quality performance of foreign capital banks are calculated and given in Table 5.
In Table 9, Asset quality performance Gray relationship level and ranking are presented. Bank of China, Rabo Bank ranks first in FATA levels. Citibank and Deutsche Bank ranked second, while Arab Turk Bank ranked second.
In TLTA levels, Burgan Bank ranks first, ING Bank ranks second and Alternatif Bank ranks third. However, in general, the performances of other banks are close to each other in TLTA levels.
When the TLTD levels regarding the asset quality performance of foreign capital banks are analyzed, Rabo Bank ranks first, MUFG Bank ranks second and Bank of China ranks third. In terms of TLTD, Rabo Bank and Bank of China are seen to be the two banks that came out earlier than the other banks.
Denizbank, QNB Finans, Turkland banks ranked first in terms of the NPLTL parameter related to the asset quality performance of foreign capital banks. Odea bank ranks second and
Gray relationship coefficients of Asset quality performance of foreign capital banks are calculated and given in Table 5.
In Table 9, Asset quality performance Gray relationship level and ranking are presented.
Bank of China, Rabo Bank ranks first in FATA levels. Citibank and Deutsche Bank ranked second, while Arab Tür Bank ranked second.
In TLTA levels, Burgan Bank ranks first, ING Bank ranks second and Alternatif Bank ranks third. However, in general, the performances of other banks are close to each other in TLTA levels.
When the TLTD levels regarding the asset quality performance of foreign capital banks are analyzed, Rabo Bank ranks first, MUFG Bank ranks second and Bank of China ranks third. In terms of TLTD, Rabo Bank and Bank of China are seen to be the two banks that came out earlier than the other banks.
Denizbank, QNB Finans, Turkland banks ranked first in terms of the NPLTL parameter related to the asset quality performance of foreign capital banks. Odea bank ranks second and HSBC bank ranks third. In terms of the gray coefficient, these banks are determined as the banks that stand out more than the others.

In terms of asset quality performance, Rabo Bank and Bank of China are ranked higher than other banks based on all parameters.

Table 10. Liquidity Performance Gray Relation Level and Ranking

	Liquidity Performance	
	LATA	LASL
Alternatif	0,63	0,26
Arap Tür B	0,85	0,58
Bank of China	0,99 [1]	0,82 [2]
Burgan B	0,55	0,24
Citibank	0,87	0,42
Denizbank	0,65	0,23
Deutsche	0,89[3]	0,59
Garanti B	0,69	0,24
HSBC	0,89[3]	0,35
ICBC Turk	0,79	0,33
ING Bank	0,71	0,24
MUFG Bank	0,99 [1]	0,71 [3]
Odea ban	0,81	0,35
QNB Finan	0,60	0,21
Rabo Bank	0,92[2]	0,99 [1]
Turkland	0,76	0,28

Bank of China ranks first in terms of the LATA parameter related to the liquidity performance of foreign capital banks. MUFG bank ranks second and Rabo Bank ranks third.
Rabo Bank is ranked first in terms of the LASL parameter related to the liquidity performance of foreign capital banks. Bank of China ranks second and MUFG ranks third. In terms of LASL, these three banks are well ahead of other banks.
Rabo Bank, MUFG bank and Bank of China are the three prominent banks in terms of Liquidity Performance of foreign capital banks.

Table 11. Profitability Performance Gray Relation Level and Ranking

	NPTA(ROA)	NPE (ROE)	PTTA
Alternatif	0,04	0,51	0,05
Arap Tür B	0,10	0,62	0,14
Bank of China	0,56 [2]	0,65	0,70 [1]
Burgan B	0,02	0,28	0,03
Citibank	0,19	0,99 [1]	0,28 [3]
Denizbank	0,08	0,75	0,10
Deutsche	0,19 [3]	0,91 [2]	0,28 [3]
Garanti B	0,19 [3]	0,87 [3]	0,16
HSBC	0,04	0,48	0,05
ICBC Turk	0,03	0,46	0,04
ING Bank	0,07	0,57	0,11
MUFG Bank	0,05	0,64	0,07
Odea ban	0,01	0,13	0,02
QNB Finans	0,08	0,87 [3]	0,11
Rabo Bank	0,26 [2]	0,40	0,38 [2]
Turkland	0,06	0,01	0,03

Bank of China is ranked first in terms of ROA parameter regarding the Profitability Performance of foreign capital banks. Deutsche Bank and Garanti Bank rank second and Rabo Bank ranks third. While Bank of China ranks first in terms of ROA, it can be stated that it has a different performance from other banks.
In terms of ROA parameter related to the profitability performance of foreign capital banks, Citibank ranks first, Deutsche bank, Garanti Bank and QNB Finans Bank rank second and third, respectively.
In terms of PTTA, Bank of China is ranked first, Rabo Bank is ranked second, and Deutsche and Citibank are ranked third.
Deutsche bank, Rabo Bank, Guarantee Bank of China and Citibank are the banks that rank first in terms of profitability compared to other banks.

Analysis of Private Capital Deposit Banks
This section analyzes the performance levels of domestic banks.

Table 12. Capital Adequacy Performance Gray Relation Coefficients

	Capital Adequacy Performance		
	ETA	CAR	EDN
Akbank	0,95	0,96	0,96
Anadolu B	1,00	0,87	1,00
Fibabanka	0,57	0,88	0,57
İşbankası	0,87	0,91	0,90
Şekerbank	0,66	0,78	0,64
TEB	0,70	0,84	0,70
TurkishB	0,98	1,00	0,95
Yapı ve K	0,80	0,86	0,86

Gray relationship coefficients of capital adequacy performance of domestic private equity banks are calculated and presented in Table 12.

Table 13. Asset Quality Performance Gray Relation Coefficients

	FATA	TLTD	TLTA	NPLTL
Akbank	0,82	0,89	0,54	0,54
Anadolu B	0,93	0,83	0,79	0,80
Fibabanka	1,00	1,00	0,43	0,43
İşbankası	0,89	0,96	0,50	0,50
Şekerbank	0,96	0,88	1,00	1,00
TEB	0,95	0,93	0,49	0,49
TurkishB	0,87	0,79	0,74	0,74
Yapı ve K	0,90	1,00	0,73	0,73

Gray relationship coefficients of asset quality performance of domestic private equity banks are calculated and given in Table 13.

Table 14. Liquidity Performance Gray Relation Coefficients

	Liquidity Performance	
	LATA	LASL
Akbank	0,75	0,73
Anadolu B	0,69	0,74
Fibabanka	0,64	0,64
İşbankası	0,65	0,58
Şekerbank	0,52	0,45
TEB	0,70	0,57
TurkishB	1,00	1,00
Yapı ve K	0,64	0,61

Gray relationship coefficients of liquidity performance of domestic private equity banks are calculated and given in Table 14.

Table 15. Profitability Performance Gray Relation Coefficients

	Profitability Performance		
	NPTA(ROA)	NPE (ROE)	PTTA
Akbank	1,00	1,00	1,00
Anadolu B	0,27	0,85	0,97
Fibabanka	0,17	1,00	0,56
İşbankası	0,25	0,93	0,81
Şekerbank	0,08	0,37	0,26
TEB	0,19	0,92	0,66
TurkishB	0,04	0,14	0,13
Yapı ve K	0,23	0,96	0,76

The Gray correlation coefficients of profitability performance of domestic private equity banks are calculated and presented in Table 15

Table 16. Capital Adequacy Performance Gray Relation Level and Ranking

	Capital Adequacy Performance		
	ETA	CAR	EDN
Akbank	0,90 [3]	0,95 [2]	0,92 [2]
Anadolu Bank	0,95 [1]	0,86	0,96 [1]
Fibabanka	0,54	0,87	0,54
İşbankası	0,83	0,90 [3]	0,86 [3]
Şekerbank	0,63	0,77	0,62
TEB	0,66	0,83	0,67
TurkishBank	0,93 [2]	0,99 [1]	0,92 [2]
Yapı ve K	0,76	0,85	0,83

Capital adequacy performance Performances were determined according to gray relationship levels. According to these results, Anadolu Bank is the bank with the best performance in terms of ETA. Turkish Bank ranks second and Akbank ranks third. These three banks perform better than other banks in terms of ETA.
Capital adequacy performance The performances were determined according to gray relationship levels. According to these results, Turkish Bank ranks first, Akbank ranks second and İşbank ranks third in terms of CAR.
In terms of EDN, Anadolu Bank ranks first, Akbank and Turkish Bank rank second and İşbank ranks third. In terms of capital adequacy performance, Turkish Bank, Akbank, Anadolu Bank and Isbank are the leading banks.

Table 17. Asset Quality Gray Relation Level and Ranking

	Asset Quality			
	FATA	TLTD	TLTA	NPLTL
Akbank	0,99 [1]	0,81	0,89	0,54
Anadolu Bank	0,58	0,91 [3]	0,83	0,80 [2]
Fibabanka	0,59	0,99 [1]	0,99 [1]	0,43
İşbankası	0,77 [2]	0,88	0,96 [2]	0,50
Şekerbank	0,51	0,95 [2]	0,88	0,99 [1]
TEB	0,62	0,95 [2]	0,93 [3]	0,49
Turkish Bank	0,64	0,86	0,79	0,74 [3]
Yapı ve Kredi	0,67 [3]	0,89	0,99 [1]	0,74 [3]

Asset quality performance Performances were determined according to gray relationship levels. According to these results, Akbank is the bank with the best performance in terms of FATA. İşbank ranks second and Yapı ve Kredi ranks third. In terms of FATA, these three banks outperform Akbank in comparison to other banks.
In terms of TLTD, Fibabanka ranks first, Şeker and TEB rank second. Anadolu Bank ranks third.

In terms of asset quality performance, Yapı Kredi and Fibabanka rank first, İşbank ranks second and TEB ranks third.
When NPLTL levels are analyzed, Şekerbank ranks first, Anadolu Bank ranks second and Turkish Bank-Yapı Kredi ranks third. In terms of Asset Quality Performance, Anadolu Bank, Fibabank, İşbank, Şekerbank, TEB, Yapı Kredi are the leading banks.

Table 18. Liquidity Performance Gray Relation Level and Ranking

	LATA	LASL
Akbank	0,74[2]	0,73[2]
Anadolu Bank	0,69[3]	0,73[2]
Fibabanka	0,69[3]	0,64[3]
İşbankası	0,64	0,57
Şekerbank	0,52	0,45
TEB	0,69[3]	0,56
Turkish Bank	0,99[1]	0,99[1]
Yapı ve K	0,64	0,60

Turkish Bank ranks first in terms of liquidity performance LATA levels. Akbank ranks second, while Anadolu bank and Fibabank rank third.
Turkish Bank ranks first in terms of liquidity performance LASL levels. Akbank and Anadolu bank ranked second and Fibabank ranked third.
While Turkish Bank ranks first by far in terms of liquidity performance, Akbank and Anadolu bank, Fibabank are the other banks with high liquidity performance.

Table 19. Profitability Performance Gray Relation Level and Ranking

	Profitability Performance		
	NPTA(ROA)	NPE (ROE)	PTTA
Akbank	0,82 [1]	0,82 [1]	0,82 [1]
Anadolu Bank	0,32[2]	0,70	0,79 [2]
Fibabanka	0,14	0,82 [1]	0,46
İşbankası	0,32[2]	0,76 [3]	0,67 [3]
Şekerbank	0,07	0,31	0,21
TEB	0,16	0,76 [3]	0,54
TurkishB	0,03	0,12	0,11
Yapı ve Kredi	0,29[3]	0,79 [2]	0,62

In terms of Profitability Performance, Akbank ranks first in all parameters in terms of ROA, ROE and PTTA levels.
Fibabank ranks first together with Akbank in terms of ROE. In terms of ROE, Yapı ve Kredi, İşbank and TEB rank second and third, respectively.
Anadolu Bank ranks second in ROA and PTTA. Yapı ve Kredi ranks 3rd in ROA. İşbank and TEB ranked third in terms of ROE. İşbank also ranks third in terms of PTTA.

In terms of profitability, it is observed that Akbank is ahead of other banks. İşbank, Yapi Kredi and Anadolu Bank are the banks that stand out in terms of profitability performance.

CONCLUSION

In the competitive conditions of today's markets with globalization, all banks are making efforts to increase their performance levels in order to get more share for themselves. In order to achieve the desired performance levels, it is necessary to determine which performance measures are important for success and which measures are less important. Only in this way, bank management can focus on performance measures that will have a significant impact on financial performance. For bank managers, performance measurement results are important because they provide information about the current financial situation of the bank and provide incentives to adopt, update and renew strategies and measures to be taken. With the consideration of performance measurement ranking by bank managers and the innovative steps to be taken in this direction, banks in the Turkish Banking Sector will gain a structure that effectively manages risks and is resistant to shocks thanks to its strong capital structure and adequacy, asset quality, liquidity and profitability. This situation gives banks the power to support the sustainable growth strategy of the sector and to contribute positively to the stable growth of the Turkish economy. In this study, in order to measure and evaluate the performance in real terms, almost all financial ratios related to capital structure, liquidity, asset quality and profitability were taken into account and the analysis provided the opportunity to rank the performance of the banks. For this purpose, the parameters of domestic and foreign capital banks are analyzed in Table 1. According to the results, it is determined that the levels of ETA, CAR, FATA, TLTA, LATA, LASL, ROE, PTTA differ according to the capital structure ($p<0.05$). It is observed that ETA, CAR, FATA, LATA, LASL and PTTA levels are higher in banks with foreign capital. On the other hand, it has been determined that TLTD and ROE levels are higher in banks with domestic capital. It was determined that the levels of EDN, TLTD, NPLTL and ROA did not differ significantly in domestic and foreign capitalized banks ($p>0.05$). In this context, due to the differences in capital structure on performance, the gray models were analyzed separately for domestic and foreign banks. In the first part, Gray coefficients were calculated for each parameter and then Gray relationships were determined in determining the ranking. Performance ranking values were determined according to the size of these relationship coefficients (r). Since there are no studies using GRA in the literature on the performance comparison and measurement of private and foreign capital deposit banks in the Turkish banking sector, it is thought that the results obtained in this study will be guiding in the evaluation of the banks subject to analysis in a broad perspective.

Disclosure statement
No potential conflict of interest was reported by the author.

Funding
The work was not supported by any institution. It is the author's research article.

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