AÜİİBFD
Anadolu Üniversitesi İktisadi ve İdari Bilimler Fakültesi
Anadolu University Journal of Economics and Administrative Sciences

Cilt: 25, Sayı: 4, Yıl: 2024
e-ISSN: 2687-184X
https://dergipark.org.tr/en/pub/anadoluibfd

Makale Türü / Submission Type: Araştırma Makalesi/Research Article
Başvuru Tarihi / Date Submitted: 26/05/2024
Kabul Tarihi / Date Accepted: 08/10/2024

DOI: 10.53443/anadoluibfd.1490157
2024, 25(4), 339-356

BANKING ON STRENGTH: UNVEILING FINANCIAL DYNAMICS THROUGH PCA IN TURKEY'S BANKING SECTOR

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Abstract

In this study, principal component analysis method is used to analyze the financial indicators of net interest income, fee and commission income, interest income on marketable securities portfolio, return on assets and return on equity of private, public and foreign-owned deposit banks operating in Turkey for the period covering 2010-2022. Since important financial indicators such as net interest income, fee and commission income, interest income on marketable securities portfolio, return on assets and return on equity have high correlations with each other, the aim of the study is to classify and dimensionally reduce these variables through principal component analysis. In addition, a financial strength index consisting of net interest income, fee and commission income and interest income on marketable securities portfolio and a profitability index based on return on assets and equity have been developed. The profitability index and financial strength index are classified according to their dimensions. According to the findings, since the financial strength index of foreign-owned deposit banks is generally low, the profitability index is also low.

Keywords: Principal Component Analysis, Financial Strength Index, Profitability Index, Deposit Banks

JEL Codes: M40, M49

GÜÇLÜ BANKACILIK: TÜRKİYE BANKACILIK SEKTÖRÜNDE PCA YOLUYLA FİNANSAL DİNAMİKLERİ ORTAYA ÇIKARMA

Öz

Bu çalışmada, Türkiye'de faaliyet gösteren özel, kamu ve yabancı sermayeli mevduat bankalarının 2010-2022 yıllarını kapsayan dönemde net faiz gelirleri, alınan ücret ve komisyonları, menkul kıymetlerden alınan faiz gelirleri, aktif karlılığı ve özkaynak karlılığı finansal göstergelerinin analizinde temel bileşenler analizi yöntemi kullanılmıştır. Çalışmanın amacı, net faiz geliri, ücret ve komisyonlar, menkul kıymetlerden elde edilen faiz gelirleri, aktif karlılığı, özsermaye karlılığı gibi önemli finansal göstergelerin birbirleriyle yüksek korelasyona sahip olmasından dolayı temel bileşen analizi ile bu değişkenlerin sınıflandırılması ve boyutlarının indirgenmesidir. Ayrıca net faiz geliri, ücret ve komisyon gelirleri ile menkul kıymetlerden elde edilen faiz gelirlerinden oluşan bir finansal güç endeksi ile aktif getirisine ve özsermayeye dayalı bir karlılık endeksi geliştirilmiştir. Karlılık endeksi ve finansal güç endeksi boyutlarına göre sınıflandırma yapılmıştır. Elde edilen bulgulara göre, yabancı sermayeli mevduat bankalarının finansal güç endeksi genel olarak daha düşük olduğundan karlılık endeksi de daha düşük tespit edilmiştir.

Anahtar Kelimeler: Temel Bileşenler Analizi, Finansal Güç Endeksi, Karlılık Endeksi, Mevduat Bankaları

JEL Kodları: M40, M49

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INTRODUCTION

The banking sector, which is an integral part of the financial sector, brings together those who provide funds with those who request it. As of December 2022, the banking sector in Turkey consists of 57 banks, 35 of which are deposit banks, 6 participation banks, and 16 development and investment banks. According to the Banking Regulation and Supervision Agency, the sector's net interest income has been announced as 764 billion TL and its net profit has been announced as 432 billion TL. In the fourth quarter of 2022, total interest income reached 471 billion TL, an increase of 28 billion TL compared to the previous quarter. In December 2022, profitability rates have been increased across all bank groups compared to the same period in 2021 (Banks in Turkey, 2023). Public deposit banks are banks defined, such as Ziraat Bank and Halkbank, as being entirely owned by the treasury or other public legal entities. Private deposit banks are banks that have been established as commercial, investment and deposit banks, such as Akbank and Yapı Kredi Bank, and are entirely owned by private individuals and organizations that do not have a public share. Foreign-owned banks are banks with foreign-owned wholly owned by companies such as HSBC Bank, ING Bank and QNB Finans (Arabacı, 2018, p. 28-29).

Deposit banks play a crucial role in Turkey's economy by providing financing opportunities to those seeking funds and collecting savings from those with surplus funds, making them more active among financial institutions. They are extensively studied for their financial performance, the factors affecting this performance, and their impact on the national economy (Atukalp, 2019, p. 38-39; Kevser, 2021, p. 66).

General characteristics and operational activities of deposit banks are as follows:

• Providing various financial services to individuals and businesses, supporting economic activities with various loan products, collecting deposits and providing investment opportunities,

• To support economic activities by offering customers various loan products such as personal loans, mortgage loans, vehicle loans, commercial loans,

• To offer various investment products to customers so that they can invest their savings,

• To provide services to customers through digital channels such as internet banking, mobile applications, ATMs and online payment systems (Ekinci and Poyraz, 2019, p. 980).

Banks must implement effective risk management against various risks such as credit risk, liquidity risk and market risk in order to maintain their financial stability and provide consistent service. Deposit banks in Turkey are strictly supervised by regulatory institutions such as the Central Bank of the Republic

of Turkey (CBRT) and the Banking Regulation and Supervision Agency (BRSA) in order to ensure the financial stability of the sector and increase its reliability.

This study aims to measure the financial performance of private, public and foreign-owned deposit banks in Turkey. For this purpose, in order to use financial indicators that have high and positive correlations with each other, such as net interest income, fee and commission income, interest ıncome on marketable securities portfolio, return on assets and return on equity, the dimensions of these indicators have been reduced through principal component analysis. Additionally, financial strength index and profitability index have been created using these indicators and the indicators have been classified according to these dimensions. This study differs from others by applying Principal Components Analysis (PCA) to a unique combination of macroeconomic performance indicators and sectoral financial indicators, focusing specifically on private, public and foreign-owned deposit banks of the Turkish banking sector. Unlike studies that evaluate financial performance or risk management separately, this research synthesizes these dimensions into comprehensive indices, namely the financial strength index and the profitability index. Therefore, this study offers a new approach to evaluating bank performance by integrating macroeconomic influences and industry-specific financial measures. This methodology will not only improve understanding of the financial health of banks in a dynamic economic environment, but will also contribute to the literature by providing a more detailed analysis of how different types of banks adapt and perform. Thus, emphasizing the originality and relevance of this study. In the context of financial studies in Turkey.

This study covers in more depth the comparative analysis of financial strength and profitability indices of different types of banks in Turkey, using PCA to transform financial data with positive and high correlations with each other into understandable measurements. Additionally, it is conducted a detailed discussion of methodological approaches, including clustering and PCA, highlighting their usefulness in revealing key patterns in bank operations. Through a synthesis of theoretical insights and empirical findings, this study contributes to a richer understanding of the dynamics shaping the banking industry landscape.

LITERATURE REVIEW

The literature on banking sector analysis reveals a rich array of methodologies focused on improving the understanding of financial performance and stability. In the studies conducted by Çelik (2019) and Gülencer (2020), Principal Components Analysis (PCA) has been applied to reduce dimensionality, address neglected variable and multicollinearity problems, and improve the evaluation of macroeconomic and sectoral financial indicators. Ünsal and Duman (2005), Cengiz (2010) and Yücel (2009) contributed by examining bank performance indicators, using PCA for risk and profitability analysis, and exploring clustering methods for a nuanced understanding of bank categorizations. Bölükbaşı, Ürkmez, and

Karamustafa (2018) have been provided insight into the dynamic interaction between banking financial stability and economic activity by integrating PCA with Granger causality and VAR models. These studies are underscored the multifaceted approach to bank analysis and highlight the role of PCA in simplifying complex data sets to provide clearer insights into banking trends and performances.

Ünsal and Duman (2005) have been divided liquidity risk, credit risk, capital risk and profitability ratios, which are indicators of bank performance, into certain variable groups using principal component analysis and scaled these groups with Xi score values. Through these scales, the performances of public banks, private and foreign-owned commercial banks have been evaluated comparatively according to the relevant indicators. As a result of the analysis, it has been stated that public banks performed better in terms of asset quality, while private banks have superior in terms of profitability. It is also stated that private banks come to the fore in terms of profitability, followed by public banks. Yücel (2009) has been evaluated the performance of twenty-four banks operating in Turkey (3 public, 10 private deposit banks and 11 foreign-owned banks established in Turkey) using nineteen different banking-related variables in the period covering the years 2002-2007. It has been stated that the main purpose of this study is to create the performance ranking of these twenty-four banks in Turkey, taking into account various risk factors in the banking sector. By using principal component analysis, these risk factors have been reduced to a smaller number of irrelevant factors and it has been aimed to rank banks according to the score values of these factors. It has been stated that the important finding of the study has that public banks surpassed foreign-owned and private deposit banks in terms of capital, liquidity, credit and profitability ratios in 2002 and provided important details about their financial performance in the relevant period. Cengiz (2010) has been stated that a similar approach has been followed in various studies that tried to cluster Turkish deposit banks using various ratio values. This study has been aimed to ensure that banks cluster by using clustering rates and to compare and evaluate the suitability of clustering methods that can be used for this purpose. It has been emphasized that it is important to include categorical features in addition to ratios. These features have been combined using optimal scaling techniques for clustering banks and the results have been interpreted comparatively. As a result of the study, a solution is presented to effectively combine variables of different scales in cluster analysis by proposing an alternative method in cases where nominal and ordinal scale variables are available. The study by Çelik (2019) used weighted macroeconomic performance indicators and sectoral financial indicators using Principal Components Analysis (PCA) to deal with neglected variable and multicollinearity problems. Accordingly, two indices have been created: macroeconomic performance index (MPI) and sectoral financial performance index (SFPI). In addition, five different financial indicators, which are widely used in the literature and thought to affect the net interest margin, have been transformed into a single variable using PCA. Similarly, five different macroeconomic performance indicators (inflation,

growth, unemployment, current account deficit and budget deficit) have been transformed into a single variable using the PCA method. Gülencer (2020) has been aimed to analyze the financial performance of the 10 largest deposit banks in Turkey according to their size by using the TOPSIS and VIKOR methods by applying Principal Components Analysis (PCA) to the data used in the analysis. It has been stated that the research adequately represented the sector as it covered 84% of the sample group, which has a significant share in the sector. It has been stated that the financial data of the banks used in the research for the years 2013-2017 have been obtained from the Public Disclosure Platform (PDP), and according to both analyses, private banks exhibited better financial performance than public banks. Bölükbaşı, Ürkmez, and Karamustafa (2018) have been conducted a study using monthly data for the periods 2005-2016, focusing on a banking fragility index consisting of non-performing loans, capital adequacy ratio, and period net profit or loss series. The industrial production index growth rate has been used to represent economic activity. Initially, financial ratios have been standardized to be defined in the same unit and a Banking Financial Stability (BFS) has been created using principal component analysis. Then, Granger causality analysis has been applied to test for causality between BFS and IPI variables. Lastly, to examine the dynamic relationship between variables, a vector autoregressive (VAR) model has been estimated. According to the estimation results, it has been found that BFS had no significant effect on economic activity, but economic activity had an effect on BFS. The results of the Granger causality and VAR analysis have been consistent and supported these findings. The study conducted by Salina, Zhang and Hassan (2021) have been investigated the financial soundness of the Kazakh banking sector. The importance of this study is emphasized by the fact that the World Bank ranked Kazakhstan first in the world in terms of problem loans compared to total gross loans in 2012. In the study, various accounting indicators affecting bank financial soundness have been determined using data on all Kazakh banks between January 2008 and January 2014, and these indicators have been isolated using Principal Component Analysis (PCA), and then Kazakh banks have been grouped as sound, risky and financially weak banks in two different time periods (2008 and 2014) using the K-Means method. It is stated that the methodology used in the study is recommended because it enables monitoring changes in the structure of the banking sector and providing early warning signals for financially risky banks. In the study conducted by Vo and Nguyen (2021), it has been stated that the World Bank considers financial inclusion as a fundamental mechanism for reducing poverty and increasing welfare in emerging markets. In this study, it is stated that the financial inclusion index is calculated with four sub-indices covering the prevalence and use of financial products and services. It is stated that PCA and dynamic generalized moments methods have been used on the data of 1507 banks in emerging markets in Asia in the period covering 2008-2017. It is emphasized that PCA plays an important role in understanding the effect of financial inclusion on bank performance due to its ability to reduce the size of the data, highlight important variables and provide simplicity in the analysis. As a result of the study, it is stated that financial

inclusion makes a positive and significant contribution to the performance of banks in the Asian region, and that the low bankruptcy risk of banks and the high national economic growth increase bank performance.

DATA AND METHODOLOGY

Financial reports for the period covering 2010-2022 of private, public, and foreign-owned deposit banks operating in Turkey have been utilized as the dataset. These financial reports have been obtained from the Public Disclosure Platform (PDP) and the Banking Regulation and Supervision Agency (BRSA) websites. The variables used in the study are described as follows:

Net Interest Income (NII) represents the amount remaining after deducting interest payments and other financing costs from the interest income generated by interest-earning assets (such as loans and bonds) of deposit banks. This income is one of the primary sources of revenue for banks. In other words, banks earn net interest income by deducting the interest expenses and other costs from the interest income generated from loans and other interest-earning assets provided to customers.

Fee and Commission Income (FCI) are the fees and commissions that deposit banks receive from their customers in return for various financial services they offer. These services include account management fees, card usage fees, fees for bank transfer and EFT transactions.

Interest Income on Marketable Securities Portfolio (IIMSP) is an indicator that reflects the interest income earned by banks from their investment activities and shows the relationship of this income with capital market instruments. This income item emphasizes the importance of interest income earned by banks from their capital market investments. Banks generally earn interest income by investing in financial instruments such as government bonds, corporate bonds and other securities. IIMSP measures the impact of interest income earned from such investments on the overall financial performance of the bank.

Return on Assets (ROA) is one of the key indicators used to measure financial performance based on total assets. ROA provides information about whether banks use their assets effectively and the profits generated from these assets. Return on Equity (ROE) is one of the ratios that attracts the most attention from current or potential investors. This ratio shows how profitably the capital invested in the bank is used (Dizgil, 2017, p. 34).

ROA refers to the balance between revenues from investing and lending activities and the costs associated with these activities. A high ROA indicates that the assets and loan portfolio are being managed effectively. ROE shows the return on the bank's equity capital. It measures the bank's ability to use its resources effectively. A high ROE is a positive sign in terms of capital efficiency and financial soundness.

These financial indicators are used to evaluate a bank's performance and manage its risks. These indicators, followed by regulatory and supervisory institutions, are extremely important in evaluating whether banks have a healthy financial structure.

The variables used in this study are the basic indicators widely used in measuring the financial performance of banks. NII is one of the most important income items of banks and has been preferred because it reflects the difference between the interest income obtained from lending and deposit collection activities of banks and the expenses related to these activities. FCI shows the income obtained from various services provided by banks and has been used in the study because these incomes provide information about the operational profitability of banks. IIMSP reflects the interest income obtained from investment activities of banks and shows their relations with capital market instruments. ROA and ROE have been selected as important performance measures that show the efficiency of banks and the return they offer to their investors. These variables have been included in the scope of the study because they provide important data to analyze the financial soundness and profitability of banks.

TOPSIS, VIKOR, and VAR methods offer distinct analytical advantages when compared to PCA in our study. TOPSIS and VIKOR are multi-criteria decision-making (MCDM) techniques that evaluate and rank alternatives based on their closeness to an ideal solution, which can be particularly useful for assessing the performance of banks across multiple criteria simultaneously. These methods provide a structured approach to decision-making, highlighting the best and worst performers in a direct and understandable way. The VAR method, on the other hand, is a statistical approach used to capture the linear interdependencies among multiple time series. It's valuable for understanding the dynamic relationships between economic indicators and bank performance over time. In contrast, PCA is used for dimensionality reduction, transforming a large set of variables into a smaller one that still contains most of the information in the large set. PCA is particularly useful in our study for simplifying complex datasets into principal components that capture the most variance, making it easier to identify patterns and relationships. While TOPSIS and VIKOR excel in evaluating alternatives based on their relative performance, PCA provides a foundational understanding by reducing complexity and highlighting underlying patterns in the data. VAR's strength lies in its ability to model temporal dynamics, offering insights into how economic conditions and bank performance evolve together over time. Together, these methods complement the PCA by providing a multi-faceted analysis of bank performance, incorporating both cross-sectional evaluation and temporal dynamics (Tezergil, 2016, p. 371; Yüksel, Canöz, and Özsarı, 2017, p. 141; Ova, 2021, p. 11; Atalay and Horasan, 2023, p. 597-598; Yılmaz, 2020, p. 2746). In the banking sector, beyond TOPSIS, VIKOR, and VAR, methods like data mining techniques including decision trees, neural networks, support vector

machines, k-nearest neighbor, naive bayes, and logistic regression are extensively used. These methods, especially in conjunction with ensemble learning techniques like bagging and boosting, are applied for purposes such as predicting bank failures, customer churn, and telemarketing outcomes.

TOPSIS and VIKOR are multi-criteria decision-making techniques that evaluate and rank alternatives according to their closeness to the ideal solution. These methods evaluate performance according to multiple criteria, highlighting the best and worst performers in a direct and understandable way. VAR, on the other hand, provides valuable information in understanding the dynamic relationships between economic indicators and banking performance by modeling linear relationships between time series. The advantage of PCA is its dimensionality reduction ability. PCA transforms a large set of variables into a smaller set that preserves most of the variance in the data set. In this way, it enables complex data sets to be reduced to understandable and manageable components. PCA is a powerful tool in identifying basic patterns and relationships in data because it reduces a large number of variables to main components, and these components reflect the most variance in the data. This feature makes PCA effective in revealing hidden structures and relationships in data sets. In this context, the reason for using PCA in this study is to reduce the dimensions of complex financial data and make them more understandable and to reveal basic patterns and relationships in the data. While TOPSIS and VIKOR evaluate the performance of banks according to multiple criteria, VAR can be useful in understanding dynamic relationships; however, the dimensionality reduction and pattern detection advantages provided by PCA make the data simpler and more manageable, allowing for more effective analysis. Therefore, the use of PCA in this study has been made to present complex financial data in a more understandable way and to reveal the basic relationships.

The methodology used in the study is described as follows:

Principal Component Analysis (PCA) is a mathematical algorithm that reduces the dimensionality of data while preserving most of the variation in the dataset. This reduction is achieved by identifying aspects, called principal components, where variation in the data is maximized. Each sample can be represented by a relatively small number of components instead of thousands of variable values. This analysis allows the visual evaluation of similarities and differences between samples by drawing samples and determining whether the samples can be grouped (Ringner, 2008, p. 303). PCA is a multivariate statistical method that combines information from various variables observed on the same subjects into fewer variables called principal components (PCs). "Information" is measured by the total variance of the original variables, and PCs best explain a large part of this variance. PCs have geometric properties that allow for an intuitive and structured interpretation of the main features found in a complex, multivariate dataset. PCA forms the basis of multivariate data analysis in many respects. PCA estimates the correlation structure of variables. In a

PCA model, the importance of a variable is indicated by the size of its residual variance, which is often used for variable selection (Wold, Esbensen, and Geladi, 1987, p. 39). The coefficients obtained as a result of PCA show the effect of the original financial indicators on the basic components. This type of analysis is widely used for understanding financial performance and dimension reduction. PCA, in particular, is used in many financial applications, including financial analysis, risk management, and portfolio management.

FINDINGS AND DISCUSSION

The cluster image of private, public and foreign deposit banks operating in Turkey on the basis of NII, FCI, IIMSP, ROA and ROE for the period covering the years 2010-2022 is presented in Figure 1. Figure 1, Cluster 0 private, Cluster 1 public, and Cluster 2 represents foreign-owned deposit banks. The horizontal axis of the figure shows the eigenvalues of PC1, and the vertical axis shows the eigenvalues of PC2. The triangular representation represents foreign-owned deposit banks, the square representation represents public deposit banks, and the circular representation represents private deposit banks. From a classification perspective, the eigenvalues of PC1 for the 3 classes range approximately from -2.5 to +5.0, while PC2's ranges from -5.0 to +5.0. It appears that classes with high eigenvalues for both components are quite rare. When the entire figure is examined, it is seen that private and public deposit banks have high values for PC1, while foreign-owned deposit banks have high values for PC2. Foreign-owned deposit banks have positive eigenvalues for PC2 and negative eigenvalues for PC1; private and public deposit banks have positive eigenvalues for both components.

The observation of distant distributions between Cluster 0 and Cluster 1 in Figure 1 shows that these two clusters have different characteristics and reflect the diversity in the financial indicators of the banks. In particular, the emergence of such differences may reflect the differences in the financial strategies and operational approaches of the banks. The distances between the clusters can be considered as a direct indicator of the differences in the financial performances and types of the banks. In addition, the observation of such differences can be interpreted as an important finding in terms of better understanding the heterogeneity and diversity in the banking sector. Banks in Cluster 0 are generally characterized by high PCA1 values and average PCA2 values. For example, a sample with a PCA1 value of 2.4186 and a PCA2 value of 0.5916 can be interpreted as having high PCA1 and average PCA2 values. This indicates that banks in the cluster have a general success in terms of financial performance due to their high PCA1 values. In addition, their PCA2 values are mostly positive or close to zero, which reveals that the performance of the banks is generally positive. The PCA1 values of banks in Cluster 1 are generally low, and the PCA2 values are negative and low. For example, a sample with a PCA1 value of -0.6965 and a PCA2 value of -0.1350 has low PCA1 and negative PCA2 values. The banks in this cluster stand out with lower PCA1 and negative

PCA2 values in terms of financial performance. This situation also indicates that banks may generally show low performance. The PCA1 and PCA2 values of banks in Cluster 2 are quite high. For example, a sample with a PCA1 value of 13.1847 and a PCA2 value of 4.6641 has high PCA1 and high PCA2 values. It can be stated that the banks in this cluster exhibit very strong financial performance with high PCA1 and PCA2 values.

Figure 1: Banks PCA clustering analysis

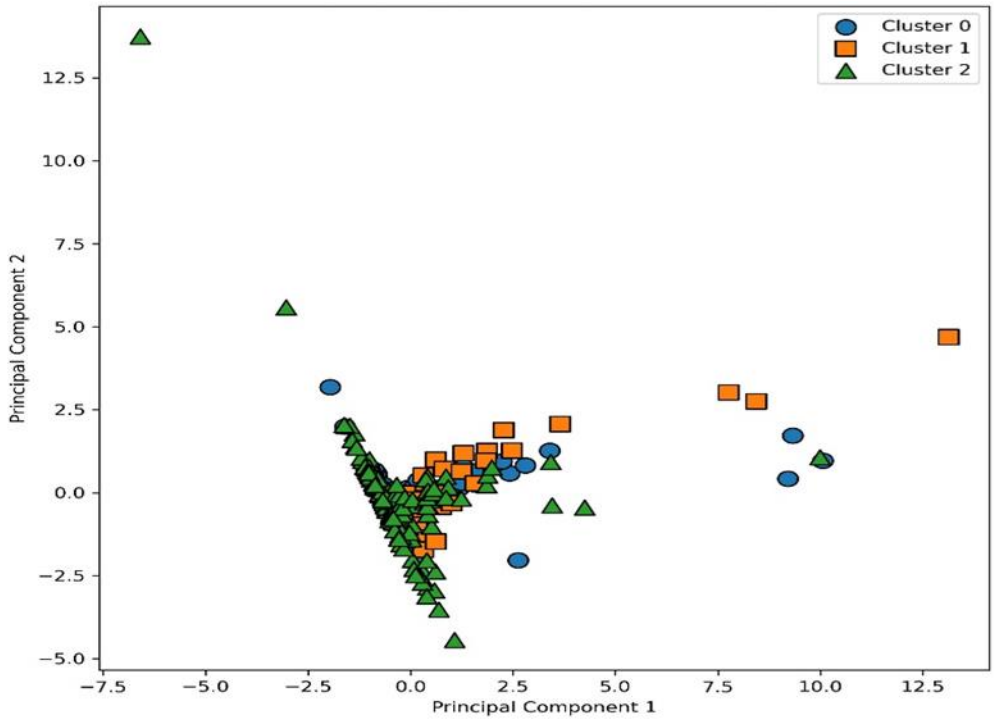

Figure 1 shows the cluster analysis of variables such as NII, FCI, IIMSP, ROA and ROE, reduced to 2 components, using PCA for the period between 2010-2022 of deposit banks in Turkey. Figure 2 reveals that IIMSP, NII and FCI variables move together like ROA and ROE variables and shows that there is a correlative relationship between these grouped variables. Since IIMSP is a part of NII, it can be said that it is natural to have a correlation between these variables when the income statement compositions of banks are taken into consideration. Similarly, FCI contributes to the total revenues comprising IIMSP and NII. ROA and ROE are expected to move together since the net profit for the period is used in calculating and equity capital is included in total resources.

The fact that certain variables, such as NII and FCI, move together is often due to being influenced by similar economic factors or bank strategies. Banks with higher NII often have strategies to earn interest

on loans and securities. At the same time, higher FCI indicates the effectiveness of the strategies implemented by banks towards customers or in generating revenue through service charges and fees, which may be related to the scope of services offered. Similarly, the associated movement of ROA and ROE also suggests that banks with higher profitability in terms of assets and equity probably share certain operational efficiencies or market advantages. Banks that manage their assets effectively tend to have a higher ROA, which is linked to better credit management or investment strategies. High ROE generally indicates that banks can generate significant profits by using their equity capital and effective equity management.

The separation of the cluster according to the main components may be due to the fact that these banks have different income streams and manage their profitability differently. For example, banks that are more reliant on traditional banking activities may cluster differently than those with diverse revenue sources. Banks in different clusters may also exhibit different risk profiles, capital structures and market positioning, which in turn may affect their financial indicators.

Figure 2: Principal components analysis

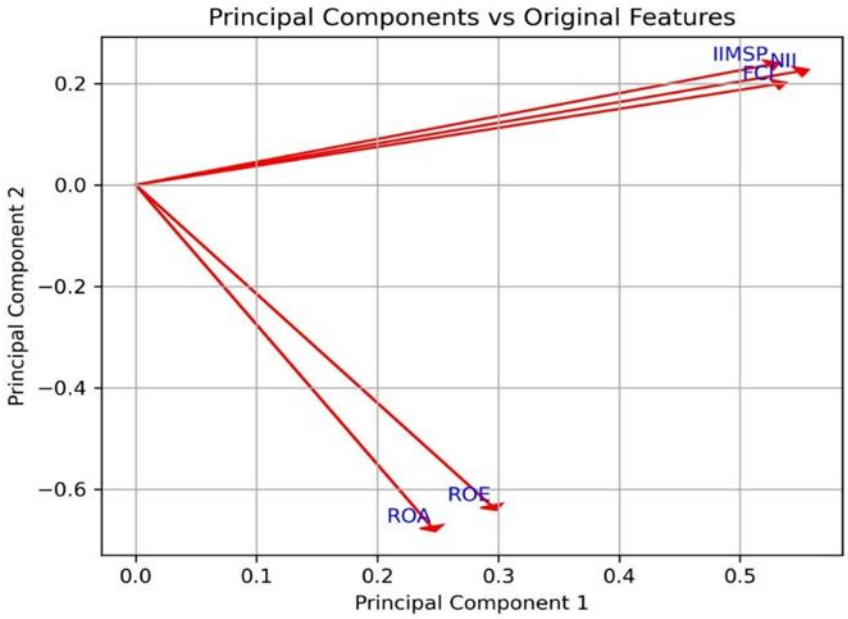

Figure 2 shows that the contributions of NII, FCI and IIMSP are more dominant than ROA and ROE. PC1 shows a positive relationship with NII, FCI and IIMSP, while it has a weaker and negative relationship with ROA and ROE. PC2, on the other hand, shows a negative relationship with ROA and ROE, which indicates a certain structure represented by PC2. Therefore, it can be stated that as ROA increases, the PC2 value may decrease. Similarly, negative PC2 indicates how much the bank's profit has decreased relative to

its equity capital. This negative impact on ROE could mean that the bank is not using its equity capital effectively.

The clustering of NII, FCI, and IIMSP along PC1 indicates that these variables have a common trend in the data set. Banks with high NII, FCI and IIMSP are also likely to score high in PC1. This may be due to market conditions that support interest and non-interest income. That is, there may be strategies that provide a strong revenue mix, such as effectively combining banks' traditional credit offerings with a variety of service offerings. The negative relationship of ROA and ROE with PC2 means that banks with higher profitability measures tend to have lower scores on PC2. This may indicate that more profitable banks are positioned differently in the PCA space, perhaps due to more conservative management or lower risk profiles. A negative PC2 could mean that banks with higher profitability may sacrifice growth in ROA and ROE for stability.

PCA essentially reflects the operational focus of the bank. Whether prioritizing traditional banking operations (high NII and FCI) or focusing on maximizing asset and equity efficiency (high ROA and ROE), the movement of these components is influenced by many factors such as economic conditions, interest rates, regulatory frameworks and individual bank strategies.

Table 1: PC1 and PC2 coefficents

Coefficents	NII	FCI	IIMSP	ROA	ROE
PC1	0,55	0,53	0,52	0,24	0,29
PC2	0,22	0,20	0,24	-0,67	-0,63

The PC1 and PC2 coefficients in Table 1 give an idea about the financial structure and strategic focus of banks. When Table 1 is examined, it can be stated that PC1 is dominated by NII, FCI and IIMSP, therefore a significant part of the banks' income is obtained from core banking activities such as NII and FCI. It can also be stated that IIMSP has a strong impact on PC1, which may be due to greater allocation of resources to marketable securities or favorable rate environment. Conversely, the negative coefficients of ROA and ROE on PC2 highlight an inverse relationship with these profitability ratios. This may indicate a potential trade-off strategy in which banks focused on increasing ROA and ROE may not strongly prioritize traditional revenue streams, or may reflect banks' strategic risk management, where higher profitability is achieved through a cautious approach to asset and equity management.

These coefficients reflect banks' balance between traditional revenue generation and profitability optimization. The strategic implications are important as they may indicate different risk profiles,

operational efficiencies and market approaches between banks that are successful in traditional banking activities and banks that achieve higher profitability through asset and equity management.

Figure 3: Relationship between financial strength index and profitability index

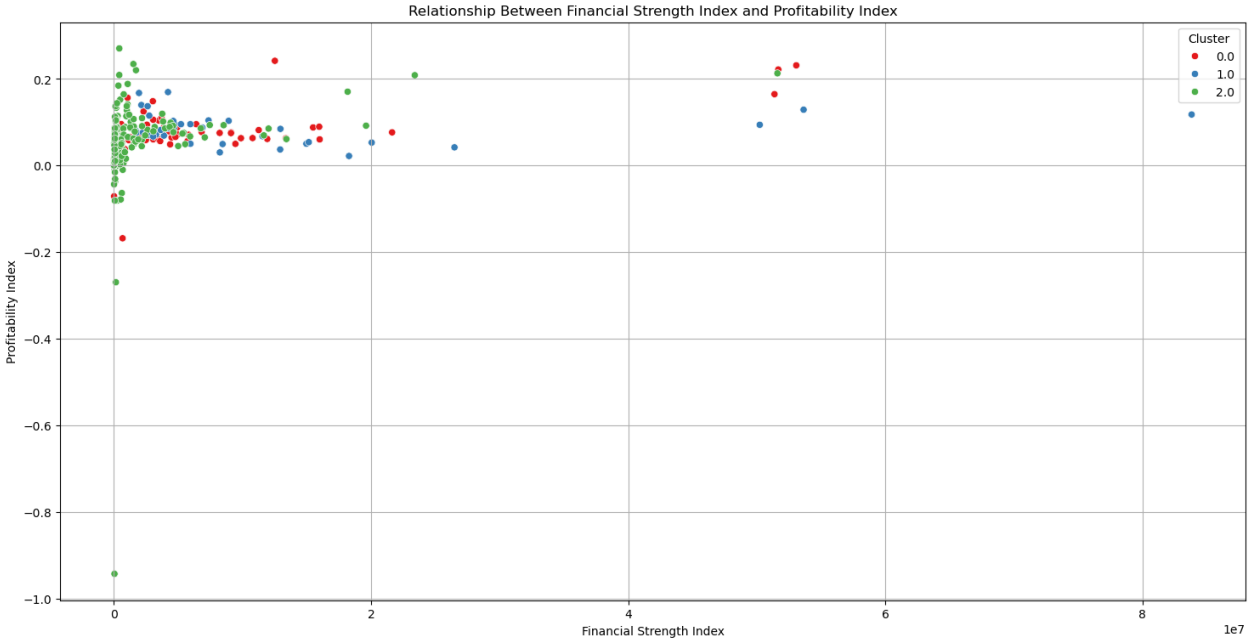

Figure 3 contains a scatter plot showing the relationship between the financial strength index and profitability index of different types of banks operating in Turkey.

In this study, two basic indices have been created to evaluate the financial performance of banks: Financial Strength Index and Profitability Index. Financial Strength Index has been calculated to reflect the financial health and risk management of the bank and has been obtained with the following formulas. Financial Strength Index has been calculated by taking the average of NII, FCI and IIMSP income items.

$$\text{Financial Strength Index} = \frac{\text{NII} + \text{FCI} + \text{IIMSP}}{3}$$

This index provides a combination of various financial indicators of the bank and allows the evaluation of its general financial strength. Profitability Index has been used to measure the profitability performance of the bank. Profitability Index has been calculated by taking the average of ROA and ROE.

$$\text{Profitability Index} = \frac{\text{ROA} + \text{ROE}}{2}$$

The financial strength index and profitability index allow a detailed examination of the financial health and profitability of banks. The formulas used evaluate the overall performance of banks by taking the weighted averages of financial indicators. This method provides a comprehensive and balanced approach to assessing the overall performance by providing a combined analysis of various financial indicators of banks. The weighted average calculation allows obtaining more objective and valid results by taking into account the impact of each indicator on the overall performance. This allows a more holistic and accurate assessment when comparing the performance of banks.

Examining the figure shows that there is a direct proportion between the two indices for foreign-owned banks. thus showing that the lower financial strength of these banks corresponds to lower profitability. In contrast, private deposit banks exhibit a moderate financial strength index with a compatible profitability index, while public deposit banks stand out with high values in both indices, indicating that these banks have a strong profit-generating potential. This could be interpreted as a reflection of the diverse strategies and operational models adopted by these banks. Public deposit banks, often backed by state support, may have access to more stable resources and policy-driven mandates that enable them to secure higher financial strength and profitability. Private deposit banks tend to show a balance, possibly due to a mix of conservative and aggressive strategies, while foreign-owned deposit banks might be experiencing competitive and operational challenges that affect their financial positioning within the Turkish banking landscape.

The findings align closely with the research conducted by Çelik (2019), Ünsal and Duman (2005), Cengiz (2010), Gülencer (2020), and Yücel (2009). Similar to Çelik (2019), our analysis uses PCA to simplify complex financial data into interpretable indexes. Ünsal and Duman (2005) highlight the performance distinctions between different types of banks, which our study also observes in the context of financial strength and profitability indexes. Cengiz (2010) emphasizes the importance of clustering for insightful analysis, a technique our research employs to categorize banks. Gülencer (2020) and Yücel (2009) focus on financial performance evaluation, paralleling our use of PCA to derive meaningful conclusions about bank performance. Bölükbaşı, Ürkmez, and Karamustafa (2018) explore the relationship between

banking stability and economic activity, complementing our findings on the interplay between financial indicators and bank performance.

CONCLUSION

NII, FCI, IIMSP, ROA and ROE are important financial indicators used to evaluate the healthy functioning of a bank in the industry. These indicators are directly related to activities such as collecting deposits and extending loans and are of critical importance in managing credit risk and maintaining operational profitability. FCI increases a bank's income diversification. IIMSP represents the income generated through financial instruments in the banks' portfolio and reflects their asset management strategy and portfolio management skills.

For the banking sector, a negative PC2 reflects a negative relationship with key indicators related to ROA and ROE. This negative relationship means that as one of certain financial indicators increases, the other decreases, or as one decreases, the other increases. A negative PC2 can generally be interpreted as a weakness or negativity in the bank's financial indicators. However, this interpretation provides a general perspective and should be evaluated together with other financial indicators for a full evaluation. In financial analysis, each indicator and component is generally considered part of a whole.

The results of the analysis conducted within the scope of the study show that public deposit banks in Turkey have higher financial strength and profitability indices compared to private and foreign-owned deposit banks in the period covering the years 2010-2022. This may be due to:

• Public deposit banks generally have high financial reliability due to the financial strength of the government providing additional security and access to lower cost resources,

• Government support generally leads to a decrease in risk perception among investors and customers, making these banks appear safer,

• Public deposit banks generally carry a broad social mission that contributes to economic development, employment growth and social services, tends to create a positive public perception and increase customer loyalty.

Unlike most studies that use financial ratios to measure the financial performance of banks, this study develops a financial strength index based on NII, FCI and IIMSP income items and a profitability index based on ROA and ROE. These indices are expected to contribute to the literature and provide a new perspective for future studies.

Various methodologies are used in the literature to evaluate the financial performance of banks. In the studies of Çelik (2019) and Gülencer (2020), dimension reduction, addressing of neglected variables and solving multicollinearity problems have been achieved by using Principal Component Analysis (PCA). Ünsal and Duman (2005), Cengiz (2010) and Yücel (2009) have been subjected the performance indicators of banks to risk and profitability analysis using PCA and examined the categorization of banks by applying clustering methods. In the study of Bölükbaşı, Ürkmez and Karamustafa (2018), dynamic financial stability analysis has been performed with PCA and the relationship between the banking sector and economic activity has been examined using the Granger causality test and the VAR model. Salina, Zhang and Hassan (2021) have been evaluated the financial soundness of the Kazakh banking sector with PCA and classified banks as financially strong, risky and weak using the K-Means method. In the study of Vo and Nguyen (2021), the relationship between financial inclusion and bank performance has been examined using PCA and dynamic general instantaneous methods.

In this study, beyond the methods of measuring bank performance using financial ratios in most studies, Financial Strength Index based on NII, FCI and investment income and market strategies performance and Profitability Index using criteria such as return on assets (ROA) and return on equity (ROE) have been developed. These indices have the potential to contribute to the literature and provide a new perspective for future studies.

AUTHOR STATEMENT / YAZAR BEYANI

Researcher declared that all contributions to the article were his own. Researcher have not declared any conflict of interest.

Araştırmacı makaledeki tüm katkının kendine ait olduğunu bildirmiştir. Araştırmacı herhangi bir çıkar çatışması bildirmemiştir.

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