Empirical Analysis of the Impact of Remote Customer Acquisition on the Performance of the Turkish Banking Sector

Uzaktan Müşteri Ediniminin Türk Bankacılık Sektörü Performansına Etkisinin Ampirik Analizi

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ABSTRACT

This study examines the impact of remote customer acquisition on bank profitability and credit risk in Turkey, using monthly data from May 2021 to February 2025. Applying Robust Least Squares estimation, the analysis investigates how fully digital and hybrid onboarding channels affect Return on Assets (ROA), Return on Equity (ROE), and Non-Performing Loan (NPL) ratios. Findings indicate that the number of fully remote applications is positively associated with higher NPL ratios, suggesting increased credit risk due to limited human oversight. Conversely, applications finalized through representatives or couriers show a significant negative relationship with NPLs, implying improved credit quality via human verification. Remote applications have positive but statistically insignificant effects on ROA and ROE. In contrast, customers finalized in physical branches positively and significantly impact profitability measures at the 1% significance level. Additionally, interest income relative to average assets strongly supports profitability, while higher NPL and loan-to-deposit ratios negatively affect it. A strong equity ratio also contributes positively to bank performance. These results emphasize the importance of integrating digital tools with traditional banking and human oversight to achieve sustainable profitability and effective risk management during digital transformation.

ÖZET

Bu çalışma, Mayıs 2021'den Şubat 2025'e kadar aylık veriler kullanarak Türkiye'de uzaktan müşteri ediniminin banka kârlılığı ve kredi riski üzerindeki etkisini incelemektedir. Robust En Küçük Kareler yöntemi kullanılarak, tamamen dijital ve hibrit müşteri edinim kanallarının Aktif Karlılığı (ROA), Özsermaye Karlılığı (ROE) ve Takipteki Krediler (NPL) oranları üzerindeki etkileri analiz edilmiştir. Bulgular, tamamen uzaktan yapılan başvuruların NPL oranları ile pozitif ilişkilendirildiğini, bunun da insan denetiminin sınırlı olması nedeniyle kredi riskinin arttığını göstermektedir. Buna karşılık, müşteri temsilcileri veya kuryeler aracılığıyla tamamlanan başvuruların NPL ile anlamlı negatif ilişkisi bulunmuş, bu durum insan kontrolünün kredi kalitesini iyileştirdiğini göstermektedir. Uzaktan başvuruların ROA ve ROE üzerinde pozitif ancak istatistiksel olarak anlamlı olmayan etkileri tespit edilmiştir. Buna karşılık, fiziksel şubelerde tamamlanan işlemler, kârlılık üzerinde %1 anlamlılık düzeyinde pozitif ve anlamlı etkiler göstermektedir. Ayrıca, ortalama aktiflere göre faiz gelirinin kârlılığı güçlü şekilde desteklediği, yüksek NPL ve kredi/mevduat oranlarının ise olumsuz etkilediği belirlenmiştir. Güçlü bir özsermaye oranı da banka performansına pozitif katkı sağlamaktadır. Bu sonuçlar, dijital dönüşüm sürecinde sürdürülebilir kârlılık ve etkin risk yönetimi için dijital araçların geleneksel bankacılık ve insan denetimi ile entegre edilmesinin önemini vurgulamaktadır.

1. INTRODUCTION

In recent years, the concepts of "banking and digitalization" have gained increasing importance in parallel with rapidly advancing technology and changing societal needs. Scientific and technological advancements have not only introduced new possibilities but also made fundamental changes in many sectors. Following the widespread use of the internet, concepts such as cloud technologies, artificial intelligence, the Internet of Things (IoT), augmented reality and virtual reality have entered our lives and the banking sector has also been affected by this digital transformation process.

Digital transformation is a comprehensive process that encompasses a variety of technologies, organizational changes, and strategic shifts. It goes beyond simply adopting new tools; it signifies a fundamental shift in how organizations operate, think, and create value. The process involves the transition from outdated methods of operation to modern, digitally-driven ways of working and thinking, utilizing technologies such as digital, social, and mobile platforms. In summary, digital transformation is a multifaceted process that involves not only the adoption of new technologies but also significant organizational and cultural changes. The goal is to improve business operations, create new value propositions, and meet the evolving demands of the market (Diener & Špaček, 2021).

The digital transformation in the banking sector has fundamentally altered the way institutions manage customer relationships. Customers can now conduct banking transactions through various digital channels, such as computers, mobile applications, ATMs, and phone calls, in addition to traditional banking services. This transformation has created a banking experience that is more cost-effective, efficient, and available 24/7, compared to traditional banking. As a result, customers gain significant advantages in terms of both time and cost. The advantages offered by digital banking have not only provided a better customer experience but have also paved the way for some of the major trends in the sector. Today, technologies such as mobile banking, open-source APIs, artificial intelligence, and data analytics are among the prominent features of banking systems (Bakırtaş & Ustaömer, 2019; Çelik & Mangır, 2020; Gümüş et al., 2020; Demirel, 2021).

In this study, it is examined the impact of remote customer acquisition practices on sectoral performance in Turkey's banking sector, focusing on profitability ratios (ROA and ROE) and non-performing loans (NPL). International literature frequently highlights the positive effects of digital banking applications on bank performance (Berger, 2003; Ciciretti et al., 2009; Yang et al., 2018; Hakizimana et al., 2023). Many studies in Turkey also conclude that digital banking has positive effects on the banking sector and the economy (Danacı & Çetintaş, 2020; Bulut & Akyüz, 2020; Ulusoy & Demirel, 2022; Çetiner & Karaman, 2021; Akyüz, 2023; Deniz, 2023; Ergün, 2023; Çalış et al., 2025). However, studies on digital customer acquisition following remote customer acquisition are limited, and most of them are qualitative (Ezrokh, 2020; Beybur, 2022; Dağıdır Çakan et al., 2022; Yıldırım, 2024).

This study aims to make a significant contribution to the existing literature by addressing the topic at an empirical level. It is important because it looks at how remote customer acquisition affects the performance of banks in Turkey using real data. Even though many studies talk about digital banking, most of them do not focus on this specific topic, and many are based on opinions rather than numbers. By looking at profitability indicators like ROA and ROE, this study helps us better understand how digital tools are really changing banking. The results can help banks, decision-makers, and developers make smarter choices about using digital technology.

Digital transformation has initiated a rapid digitalization process in the banking sector, driven by consumer preferences and increasing competition. With this transformation, consumers can access fast, easy, and low-cost services without having to visit bank branches. For banks, it offers advantages such as increased efficiency, cost reduction and improved customer experience. Digital banking has become a significant investment area for banks in Turkey due to its cost advantages (Akın, 2020; Çon & Arıca, 2024).

In the "CEO Perspective on Digital Transformation in Turkey" report, published by TÜSİAD in 2016 with the support of Samsung Electronics, in collaboration with Deloitte Turkey and GfK, the primary reasons for the banking sector's shift towards digitalization were found to be competitive advantage (36%), followed by increased efficiency (20%) and quicker response to customer needs (18%) (TÜSİAD, 2016). Profitability (16%) and customer loyalty along with new customer acquisition (16%) were also among the other factors. The most significant external factors identified for banks were macroeconomic factors (26%), regulatory issues (19%), and digital technologies (19%). These findings emphasize the importance of digital change in banks and suggest that banks need to have clear and understandable digital strategies.

The digital transformation process in Turkey coincides with a period of rapid increase in the use of the internet and mobile banking. The first internet banking application in Turkey's banking sector was launched in 1997, followed by the mobile banking application in 2007 by İşbank (Türkiye İş Bankası, 2025). Since then, digital banking has become widespread in the sector because of technological development and the advantages of smart mobil phone such as easy usage, improved applications and so customer loyalty (Pilatin, 2023). Particularly after the pandemic started in March 2020, there was a significant rise in digital banking usage. This period helped minimize the negative impacts of the pandemic on the banking sector, while simultaneously accelerating the digitalization process by providing easy access to banking services. Mobile banking has been one of the fastest-growing areas in this transformation (Demirel, 2021; Uzun, 2021).

As shown in the figure below, after 2016, the number of mobile banking users surpassed the number of internet banking users. The global pandemic accelerated this transformation. At the beginning of the global pandemic in March 2020, the number of active mobile banking customers in Turkey was 52,481,204, which increased to 65,344,894 a year later, and reached 78,259,643 by March 2022. As of December 2024, this number is expected to reach 117,754,684.
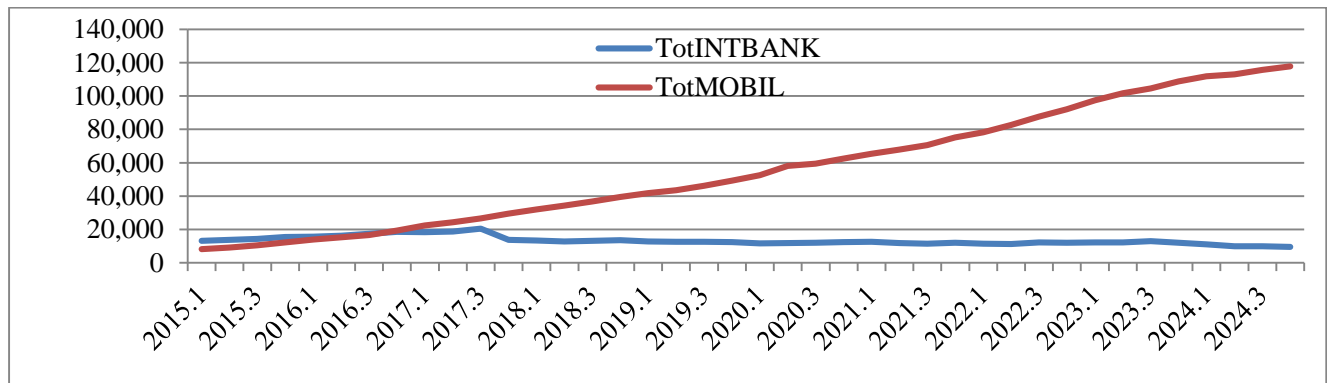

Figure 1. Active Internet and Mobile Banking Customers in the Banking Sector (Thousands)

The digital banking products and services in Turkey's banking sector are as follows (TBB, 2022):

- Remote customer acquisition,

- All types of money transfers, investments, bill payments, and credit card transactions conducted via internet banking and mobile applications,

- Loan application processes,

- Investment transactions,

- Insurance premium payments,

- Traffic fine payments,

- Tax payments,

- Banking products and services developed for people with disabilities (e.g., accessibility in branches, internet, mobile, and ATMs for physical and service access),

- The electronic arrangement of account statements and their transmission to requesting customers via digital platforms,

- Use of virtual POS (with the rise of e-commerce),

- Contactless card usage on POS devices,

- Presentation of a list of deposit accounts at banks on the e-government platform,

- Mortgage and deed-related processes carried out electronically,

- The use of 3D security in e-commerce transactions,

- QR code-based transactions (e.g., ATM withdrawals, etc.),

- The use of the Turkish QR code (TR QR) in payment systems,

- The electronic preparation and transmission of documents created by banks in foreign trade,

- Implementation of document and information verification systems (identity sharing system, address sharing system, verification of documents received from institutions and organizations electronically—e.g., student documents).

According to TBB (2025) data, the most commonly used transactions in internet and mobile banking include money transfers, investment transactions, payments, and credit card transactions. Remote customer acquisition which was introduced in 2021 in Turkey's banking sector, is a significant step in the digital transformation process. In this context, the "Regulation on the Remote Identification Methods to be Used by Banks and the Establishment of the Contractual Relationship in Electronic Environment" prepared by the Banking Regulation and Supervision Agency (BRSA) and effective as of May 1, 2021 (Resmi Gazete, 2021a), established the legal framework for remote customer acquisition. This regulation allows banks to acquire new customers without the need for a physical branch. Furthermore, the "Regulation on the Operational Principles of Digital Banks and Service Model Banking" published on January 29, 2021, and effective as of January 1, 2022 (Resmi Gazete, 2021b), enabled the establishment of digital banks and laid the foundational steps for digital and service model banking.

The "Regulation on the Operational Principles of Digital Banks and Service Model Banking" defines "digital bank" as a credit institution that provides banking services via electronic banking distribution channels instead of physical branches. "Service model banking" is defined as a service model where customers connect directly with service bank systems through open banking services offered via the interfaces of interface providers to perform banking transactions.

In this model, banks share their infrastructure with third parties via API (Application Programming Interface). This allows platforms, such as electronic stores, to offer bank products through their own systems. As a result, banks can expand their customer networks while businesses provide seamless and fast services to their customers. In March 2023, Turkey's first digital bank, Hayat Finans Katılım Bankası, received its operational license from BRSA (Akbaş, 2023).

On May 25, 2023, the "Regulation on Amendments to the Regulation on the Remote Identification Methods to be Used by Banks and the Establishment of the Contractual Relationship in Electronic Environment" was published, allowing legal entities to also participate in the remote customer acquisition process. This development further expanded the scope of digital banking and remote customer acquisition practices (Resmi Gazete, 2023).

Remote customer acquisition allows customers to start banking transactions without visiting physical branches by using advanced technologies such as identity verification, facial recognition, and digital signatures. This system has not only increased competition in the banking sector but has also transformed the customer experience, making access to banking services easier. Customers can open accounts via digital channels, while banks expand their customer portfolios, reduce operational costs, and increase digital competitiveness without needing physical branches.

According to data from the Turkish Banks Association (TBB, 2025), over 2 million new customers joined the banking system through digital channels in the first year of remote customer acquisition. As shown in Figure 2 below, this number rapidly increased in 2022 and 2023, and the sector became even more dynamic with the launch of digital banks.
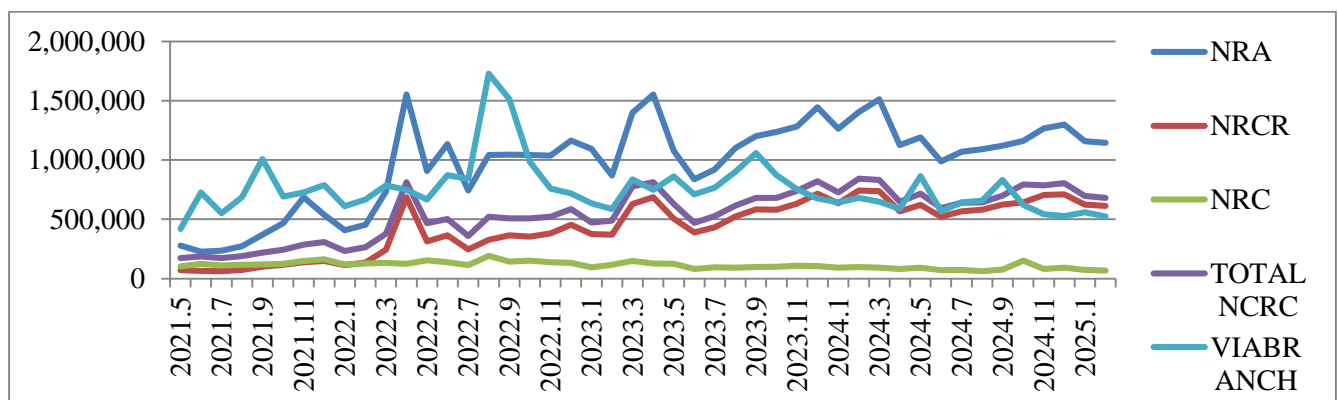

Figure 2. The Impact of Remote Customer Acquisition on Sector Performance

After this brief introduction, the second section of the study presents selected studies from international and national literature on the subject. In the third section, information is provided about the dataset and model used in

the study, while the empirical findings of the model are discussed in the fourth section. The study finishes with a conclusion section.

2. LITERATURE REVIEW

Banks are heavy users of both information technology (IT) and financial technologies, and they possess big data resources that help to understand the general effects of technological change. Many studies have been conducted in the literature on the positive impacts of financial technologies on the banking sector (Berger, 2003; Danacı & Çetintaş, 2020).

Berger's (2003) study shows that improvements in "back office" technologies have led to cost reductions and increased lending capacity, while developments in "front office" technologies have benefited consumers. Research also reveals significant improvements in overall efficiency, particularly in terms of the quality and diversity of banking services. For example, Danacı & Çetintaş (2020), in their study on financial innovations and technology in banks, concluded that innovations in the banking sector make human life easier and lead to increases in profitability and efficiency.

Ciciretti et al. (2009), in their study analyzing whether internet banking adds value to the services of traditional banks, support this result. The study compares internet banking with traditional banking services using various indicators such as bank efficiency, cost structures, profitability ratios, and customer satisfaction. The study shows that internet banking is a significant value creation tool for banks and provides them with a competitive advantage in the digitalization process. Internet activities reduce costs while enhancing service quality, which also strengthens customer satisfaction. However, the effectiveness of internet banking varies depending on the banks' digital strategies and how these strategies are implemented. In particular, internet activities hold more potential for value creation, especially for larger banks.

Sadr (2013) study, using data from Asian countries between 1990 and 2010, examined the relationship between internet banking, profitability, economic growth (GDP), and total deposits, employing panel cointegration and panel error correction models. According to the study's findings, internet banking began to contribute to the banks' return on equity after three years, while an increase in spending on information technology caused a negative effect with a one-year delay.

In a study by Abaenewe et al. (2013) on Nigerian banks, the impact of electronic banking on bank performance was investigated, and a significant improvement was observed in return on equity, although no significant difference was found in return on assets.

Tunay & Akhisar (2017) analyzed the "long-term interaction between internet banking and bank profitability performance" using data from European Union (EU) countries for the 2005-2014 period, applying Pedroni cointegration tests and error correction models. They used ROA and ROE as bank performance measures and found a long-term relationship between internet banking and bank profitability in EU countries outside the Eurozone.

Yang et al. (2018) investigated whether electronic banking and internet banking improve the performance of Chinese banks (ROA, ROE, NIM, Operating Margin, and efficiency ratio) using data from five major banks for the 2003-2013 period. They concluded that internet banking significantly improved ROA, ROE, and operating margin, but had limited effects on NIM and efficiency ratio.

Ulusoy & Demirel (2022) demonstrated that the number of customers using mobile and internet banking, as well as transaction volumes, positively affected active profitability. Çetiner & Karaman (2021) stated that the increase in transactions conducted through internet banking had a positive impact on banks' operating profits, while Korkmazgöz & Ege (2020) examined the effect of mobile banking applications on the financial performance of the banking sector and identified a significant impact. Islamoğlu & Bayrak (2022), in their study on the impact of digital banking services (internet banking transaction volumes) on banks' financial performance, also concluded that the relationship was positive. Moreover, Bulut & Akyüz (2020) stated that digital banking accelerates economic activity, speeding up the flow of money and thereby contributing to economic growth by increasing the volume of financial transactions. On the other hand, some studies found a negative relationship between digital banking and economical growth (Sarı, 2022) while some studies attempt to explain theoretically the relationship between digital banking and economic growth in Turkey (Karadeniz & Karadeniz, 2023).

The role of financial markets in economic development has long been accepted by many economists. Schumpeter emphasized that banks play a crucial role in directing resources to more productive investments (Capasso, 2004).

It is believed that banks, through technological investments, will not only enhance their own capabilities but also contribute to the transformation processes of other sectors (Bakırtaş & Ustaömer, 2019).

Hakizimana et al. (2023) examine the transformation of digital banking in the sector and its effects on performance. The study concludes that digital banking reduces operational costs, increases financial efficiency, and provides greater financial access by expanding the customer base. While digitalization helps banks perform transactions faster and increase revenues, it also promotes financial inclusion. However, there are challenges related to security and regulation in digital banking. The study emphasizes that governments should assist commercial banks in combating technological crimes, as such crimes can negatively affect not only the financial system but also other businesses through the financial system.

Akyüz (2023), using data from the Turkish banking sector for the period 2011:Q1-2023:Q2 and employing the Topsis method, examined the relationship between banking sector performance and internet-mobile banking applications through correlation analysis and found a positive and significant relationship. Deniz (2023), who studied the impact of digital banking services (internet and mobile banking) on bank performance using data from the 2011-2022 period and multiple regression analysis, also found a positive and significant relationship. Çalış et al. (2025) also found that digital banking has a significant and positive effect on both active profitability and return on equity.

This study empirically investigates the impact of remote customer acquisition, a part of the digital transformation process, on the banking sector. As noted above, many studies in the literature have concluded that digital banking positively affects bank performance. However, there are limited empirical studies measuring these effects through a specific subtopic like remote customer acquisition. Most of the existing studies in this field are qualitative analyses. In this context, the study is expected to provide a distinctive and timely contribution to the digitalization literature by revealing the effects of digital customer acquisition on profitability and credit risk in the Turkish banking sector, offering guiding findings for both practitioners and researchers. Moreover, linking digital banking applications to financial performance indicators is believed to enable a more comprehensive evaluation of the digitalization process and increase theoretical and methodological diversity in the literature.

3. DATA SET AND METHODOLOGY

3.1 Dataset

In the study, the dependent variables used are the return on assets (ROA) and return on equity (ROE), which are commonly preferred in the literature (Turkmen & Yigit, 2012; Sadr, 2013; Tunay & Akhisar 2017; Yang et al., 2018; Sarı & Konukman, 2021; Akyüz, 2023; Çalış et al., 2025).

Non-performing loans ratio (NPL), which refers to the ratio of non-performing loans, known as a credit risk, is used in this study as both dependent and independent variable. Because it directly affects banking profitability and bank lending decisions. It is also a good indicator of asset quality (Sarı & Konukman, 2021), so it can be used as a financial performance indicator in the banking sector.

The explanatory independent variables of the study are the number of remote applications and the total number of customers concluded through customer representatives and couriers. The number of remote applications (NRA) shows the number of potential customers who initiated the process for remote acquisition during the relevant period (month) under the framework of the Regulation on Remote Identity Detection Methods to be Used by Banks and the Establishment of an Electronic Contractual Relationship. It should be noted that the applications of current bank customers are not included. The total number of customers concluded via customer representatives and couriers is obtained by summing the number of customers concluded through remote customer representatives and those who applied online and concluded via courier. A list of the banks included in the sector's remote customer acquisition data is provided in Appendix 1.

Branch-based – Concluded Customer Number (VIABRANCH): This variable shows the number of customers acquired during the relevant period (month) where the customer and the branch staff were physically in the same environment, and it is one of the independent variables in the study.

Other banking-specific independent variables include:

- Loan-to-deposit ratio (LOANDEP).
- Equity ratio (EQUITY).

- Interest income to interest-earning assets ratio (INTINCOME).

As both a banking-specific financial indicator and a macroeconomic indicator, the Weighted Commercial TL Loan Interest Rate (INT) is also chosen as an independent variable. These variables serve as control variables in the model.

Other macroeconomic indicators have not been used in the study. This is because it has been stated that after the 2007 Global Crisis, the effects of macroeconomic variables on Turkish banks have been less significant (Ganioğlu & Us, 2014).

All the variables used in the study and their sources are summarized in Table 1 below.

Table 1. Model Variables and Sources

Variables	Variable Type	Explanation	Source
NRA	Explanatory / Independent Variables	Number of Remote Applications	BAT
TOTALNCRC	Explanatory / Independent Variables	Total Number of Customers Concluded with Customer Representatives and Couriers	BAT
VIABRANCH	Explanatory / Independent Variables	Number of Customers Concluded via Branch	BAT
ROA	Dependent Variable	Return on Assets	BRSA
ROE	Dependent Variable	Return on Equity	BRSA
NPL	Dependent and Control Variable	Non-performing Loans (Gross) / Total Cash Loans	BRSA
LOANDEP	Control Variable	Total Cash Loans / Total Deposits	BRSA
EQUITY	Control Variable	Legal Equity / Total Risk-Weighted Assets	BRSA
INTINCOME	Control Variable	Interest Income / Average Interest-Bearing Assets	BRSA
INT	Control Variable	Weighted Commercial TL Loan Interest Rate	CBRT

3.2 Method

In the study, the econometric method initially chosen is the Ordinary Least Squares (OLS) method. This is because the OLS method is a technique that predicts the relationship between dependent and independent variables most accurately under certain assumptions. These assumptions are as follows: "The error term is a stochastic variable with a mean of zero, is normally distributed, and has constant variance. Additionally, there is no autocorrelation between the error terms, no relationship between the independent variable(s) and the error term, and the independent variable(s) have fixed values. There is no multicollinearity among the independent variables, the independent variables are not stochastic, and there are no measurement errors. Lastly, the model setup is correct" (Tarı, 2008). Under these assumptions, OLS is the best linear estimator, and parameters are estimated based on the least squares criterion.

However, in practice, data is often heteroscedastic, autocorrelated, or sensitive to other shocks. Indeed, as a result of diagnostic tests, it was observed that the error terms of the models did not follow a normal distribution. Based on these findings, the influence statistics of the models were examined in the first stage. As shown below, deviations appeared in the influence statistics.
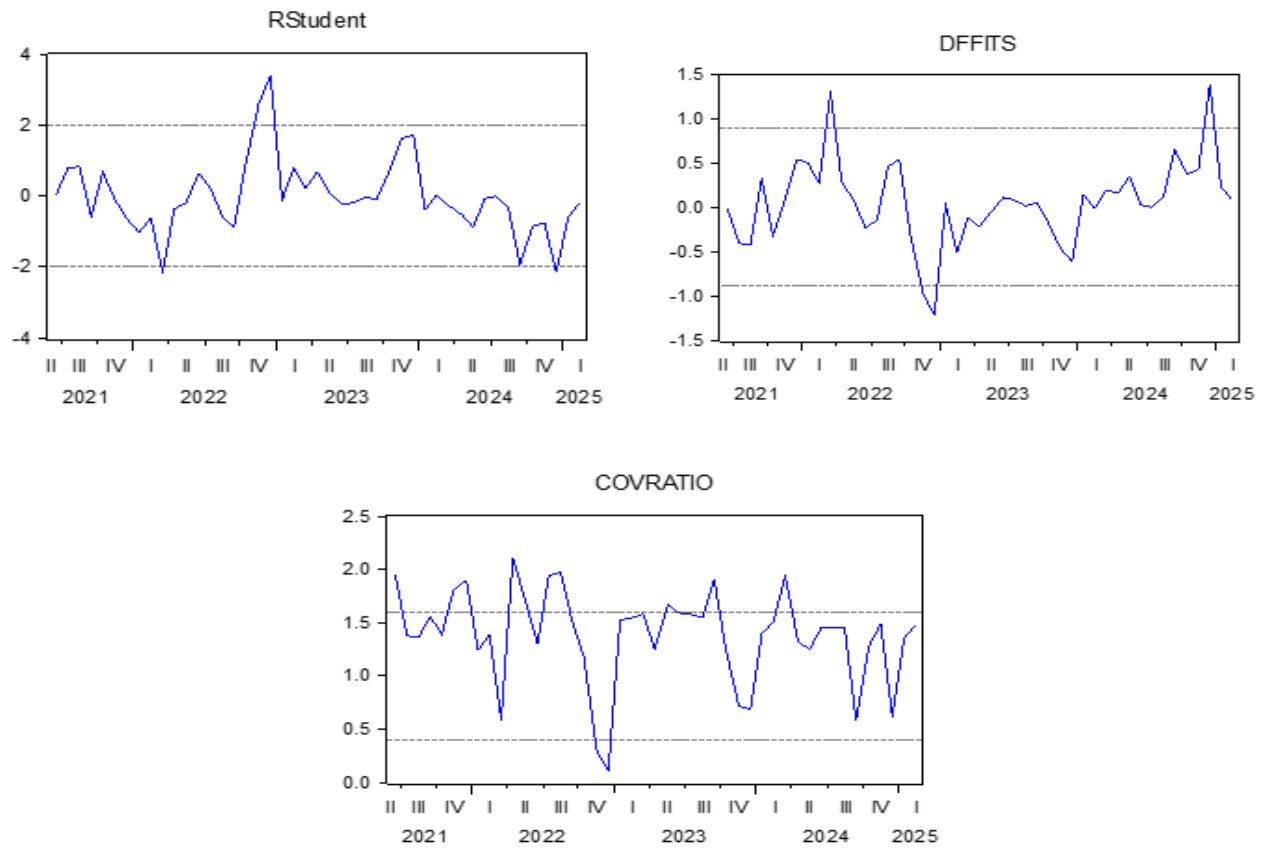
Figure 3. Influence Statistics of the Model 1
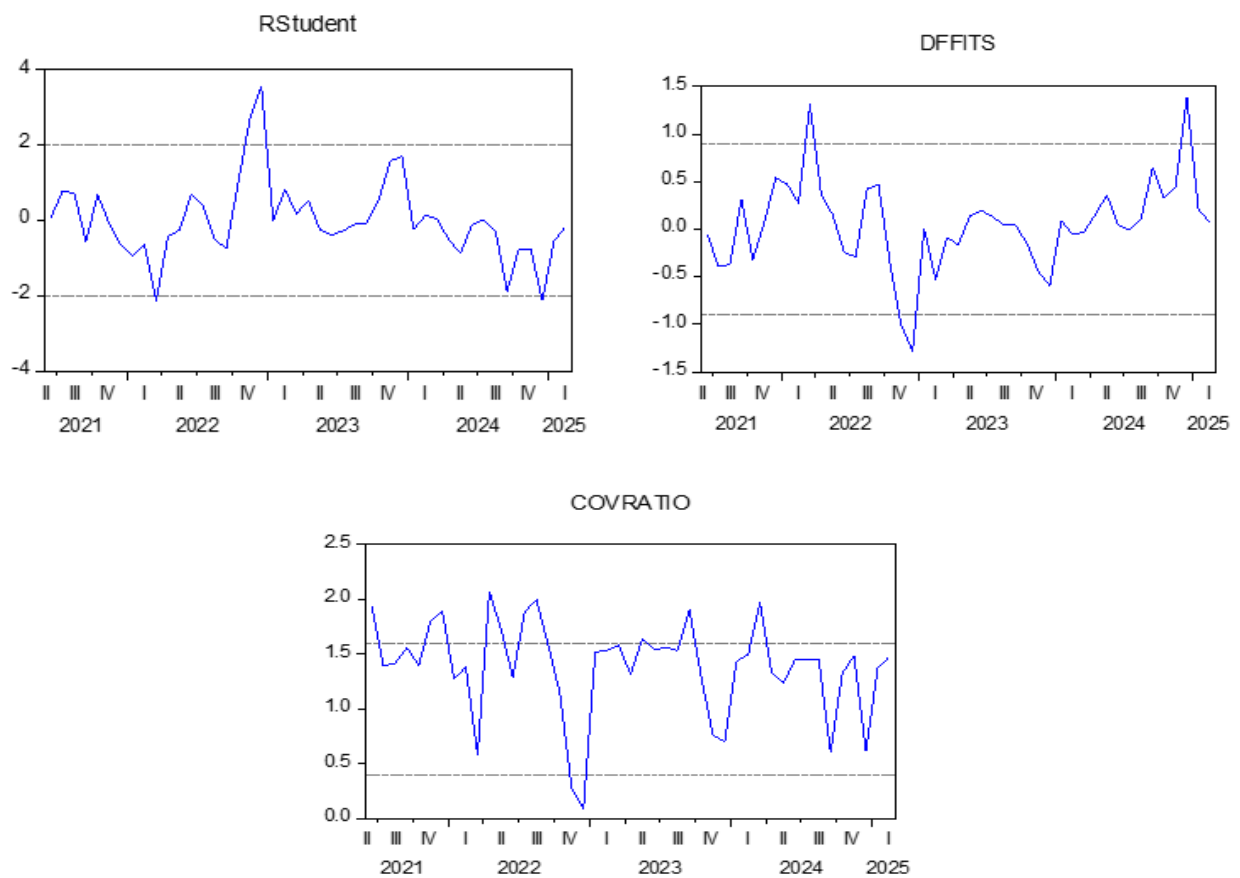
Figure 4. Influence Statistics of the Model 2
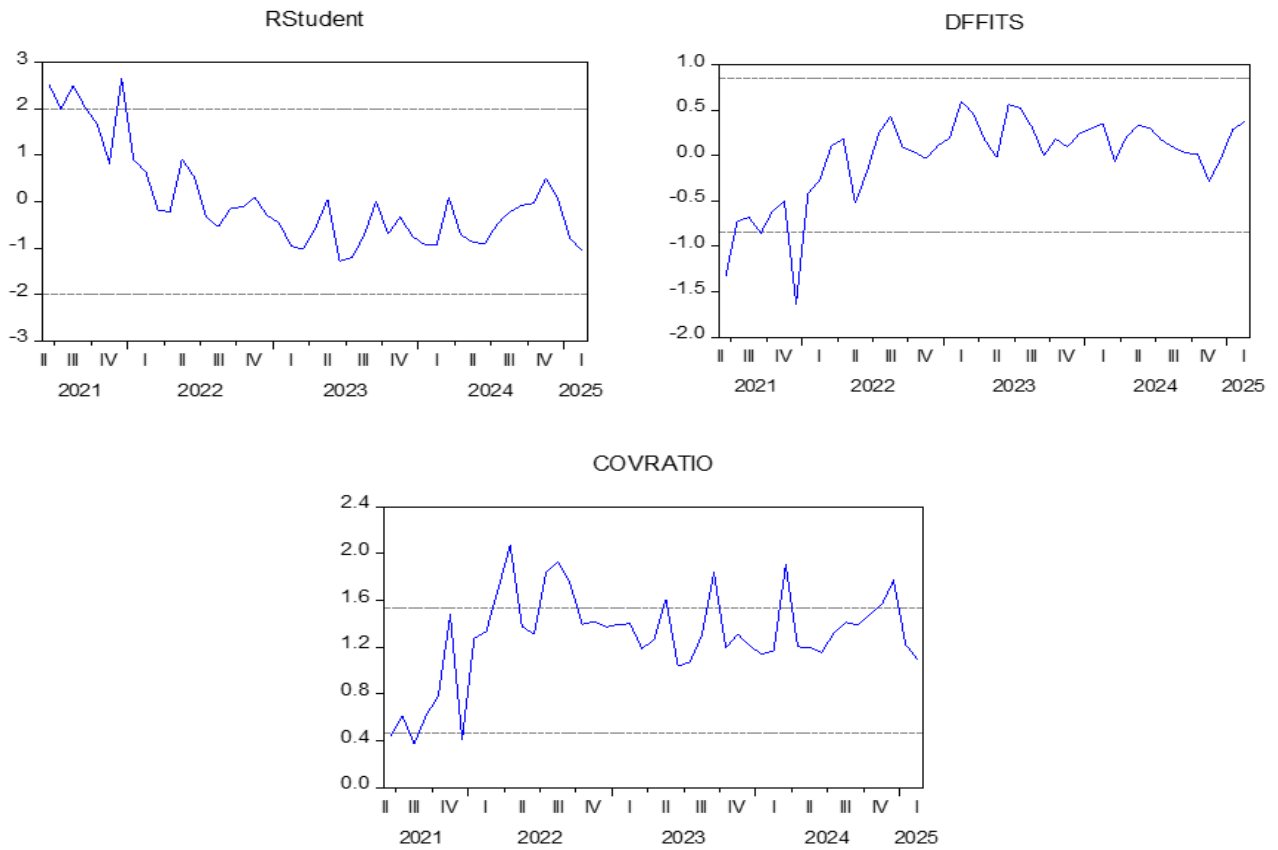
Figure 5. Influence Statistics of the Model 3
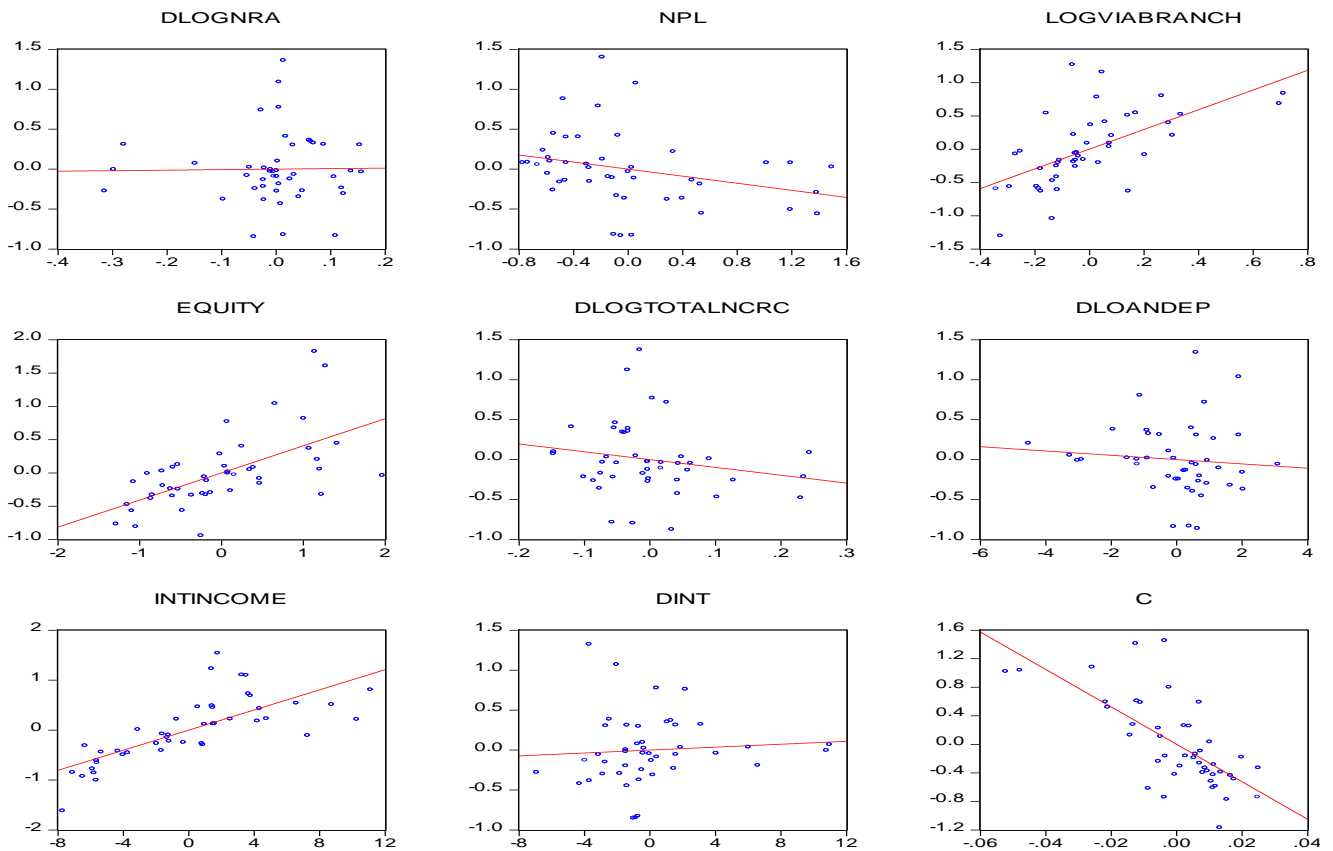
Figure 6. Leverage Plots of the Model 1

In the next stage, the leverage plots of the models were also examined, and outliers were detected in the variables. Outliers are observations that do not follow the typical distribution of the rest of the data and do not conform to

the characteristic pattern of the dataset (Öztürk & Türkay, 2005). The leverage plots of the models are presented in Figures 6, 7 and 8.

ROE vs. Variables (Partialled on Regressors)
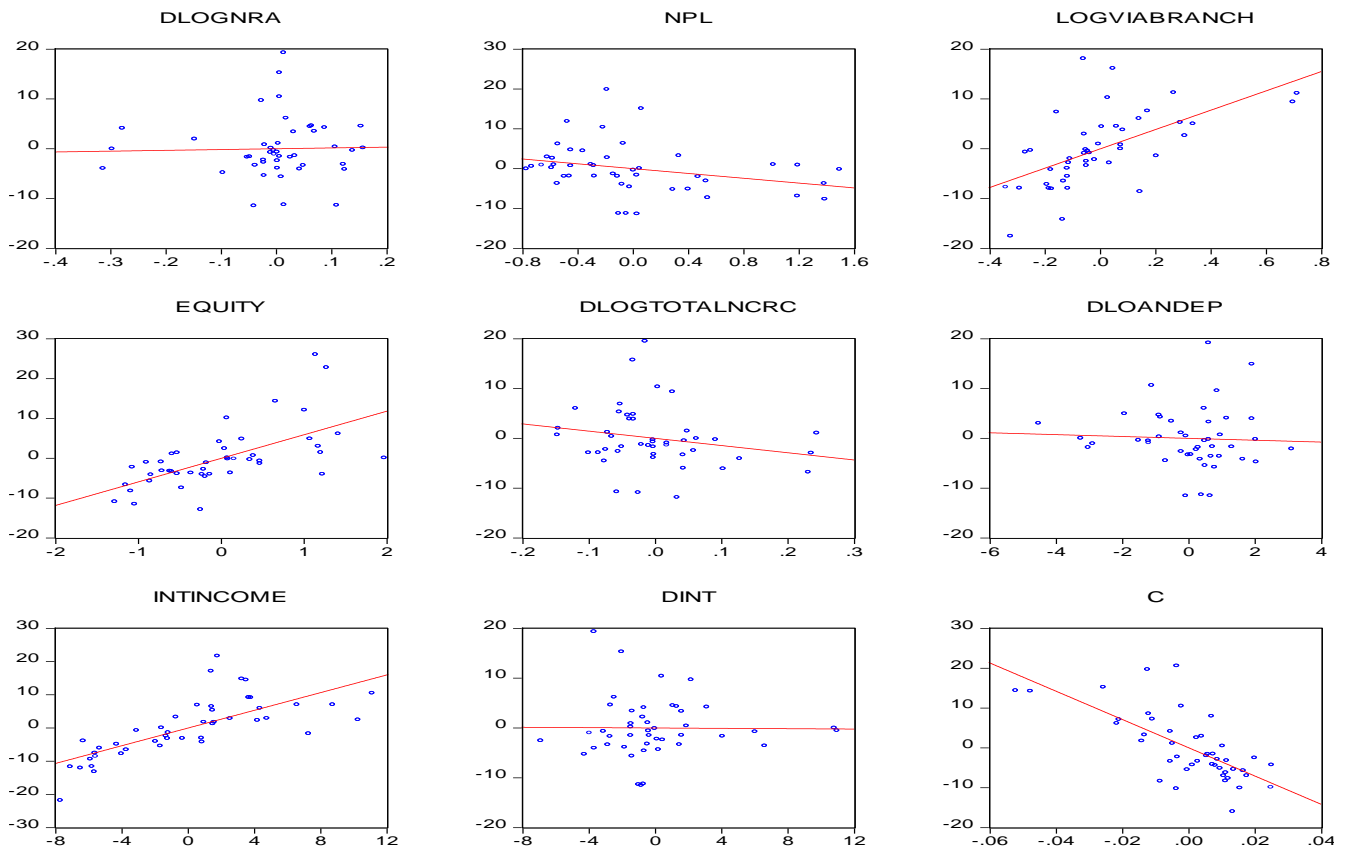
Figure 7. Leverage Plots of the Model 2

NPL vs. Variables (Partialled on Regressors)
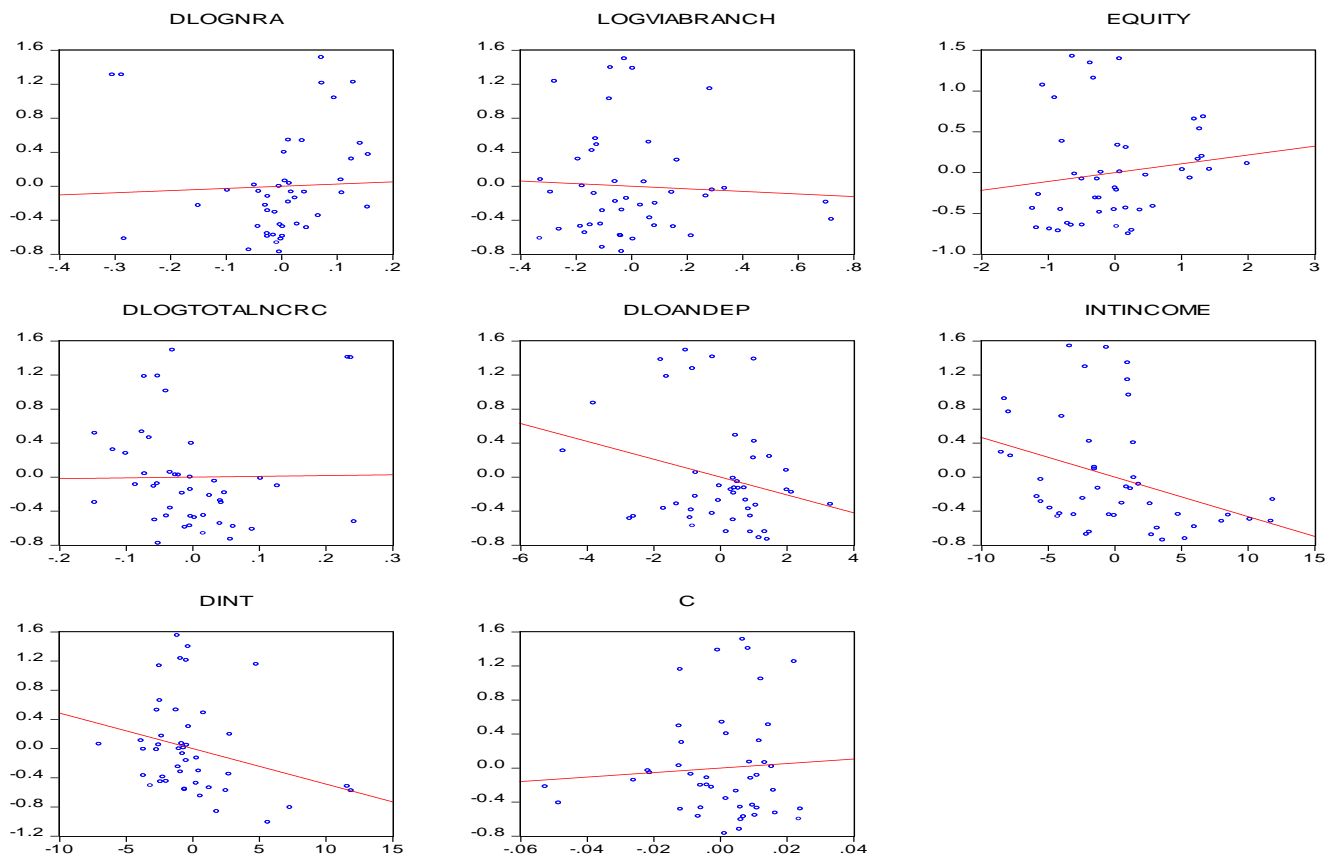
Figure 8. Leverage Plots of the Model 3

In cases where outliers are present in the series or the error terms deviate from normal distribution, the OLS method, which is highly sensitive even to small deviations from the assumptions mentioned above, may not be a reliable estimator. In such cases, using regression methods that can reduce the impact of outliers will lead to more reliable results. To overcome these issues and adopt an approach less sensitive to outliers, the Robust OLS method has been developed as a resilient regression technique (Öztürk & Türkay, 2005; Coşkuntuncel, 2009; Susanti et al., 2014; Zaman & Alakuş, 2016).

These methods are resistant to anomalies such as outliers and external shocks in the dataset. In situations where the variances of the data are not constant, robust estimators provide more accurate results compared to traditional OLS methods. Especially in time series analysis, autocorrelation between observations can be effectively controlled with robust methods. Due to these advantages, M-estimators of robust regression are used in conjunction with machine learning techniques (Ibidoja et al., 2023). The combined use of machine learning and M-robust regression is particularly recommended for big data and high-performance computing (Mukhtar et al., 2022).

M-estimation (Huber, 1964; 1973) is one of the three different regression estimators in the Robust OLS method. Along with M-estimation, which focuses on outliers in dependent variables, S-estimation (Rousseeuw & Yohai, 1984) focuses mainly on outliers in independent variables, and MM-estimation (Yohai, 1987) are a combination of both M-estimation and S-estimation, considering outliers in both dependent and independent variables.

In this study, the M-estimation, which focuses on outliers in the dependent variable and adapts the model accordingly, has been preferred. The M-estimation is an extension of the maximum likelihood estimation (MLE) method and is also a robust estimation technique (Susanti et al., 2014).

4. EMPIRICAL FINDINGS

In the first stage, the stationarity of all variables used in the model was examined. Because, to be able to obtain meaningful and reliable relationships from an econometric perspective, the series of the variables being analyzed should not contain a unit root. Otherwise, the resulting relationship might lead to a misleading outcome, known as a spurious regression, rather than a genuine relationship (Mert & Çağlar, 2019). In this context, the Augmented Dickey-Fuller (ADF) unit root test was applied using the Eviews 10 software to determine the stationarity of the variables. The results of the unit root tests are presented in the table below. As a result of the tests, it was observed that some variables were not stationary at the level, but became stationary when their first differences were taken.

Table 2. Results of the Unit Root Test for the Series

	ADF (H_0: There is a unit root)					
	Level			First Difference		
Serial	Test Sta. (No-trend)	.05 Critical value (No-Trend)	Stationary	Test Sta. (No-Trend)	.05 Critical Value (No-Trend)	Stationary
LOGNRA	-2,44	-2,92	Not Stationary	-7,37	-2,93	Stationary
LOGTOTALNCRC	-2,35	-2,92	Not Stationary	-6,77	-2,93	Stationary
ROA	-3,16	-2,92	Stationary			
ROE	-3,13	-2,92	Stationary			
NPL	-3,45	-2,92	Stationary			
LOGVIABRANCH	-3,94	-2,92	Stationary			
EQUITY	-3,19	-2,92	Stationary			
LOANDEP	-2,56	-2,92	Not Stationary	-5,47	-2,93	Stationary
INTINCOME	-3,12	-2,92	Stationary			
INT	-0,93	-2,92	Not Stationary	-4,00	-2,93	Stationary

Model 1 is as follows:

$$ROA = C(1)*DLOGNRA + C(2)*NPL + C(3)*LOGVIABRANCH + C(4)*EQUITY + C(5)*DLOGTOTALNCRC + C(6)*DLOANDEP + C(7)*INTINCOME + C(8)*DINT + C(9) \tag{1}$$

In the model, ROA is the dependent variable, and DLOGNRA, NPL, LOGVIABRANCH, EQUITY, DLOGTOTALNCRC, DLOANDEP, INTINCOME, and DINT are the independent variables.

Model 2 is as follows:

$$ROE = C(1)*DLOGNRA + C(2)*NPL + C(3)*LOGVIABRANCH + C(4)*EQUTY + \\ C(5)*DLOGTOTALNCRC + C(6)*DLOANDEP + C(7)*INTINCOME + C(8)*DINT + C(9)$$

(2)

In the model, ROE is the dependent variable, and DLOGNRA, NPL, LOGVIABRANCH, EQUITY, DLOGTOTALNCRC, DLOANDEP, INTINCOME and DINT are the independent variables.

Model 3 is as follows:

$$NPL = C(1)*DLOGNRA + C(2)*LOGVIABRANCH + C(3)*EQUITY + C(4)*DLOGTOTALNCRC + \\ C(5)*DLOANDEP + C(6)*INTINCOME + C(7)*DINT + C(8)$$

(3)

In the model, NPL is the dependent variable, and DLOGNRA, LOGVIABRANCH, EQUITY, DLOGTOTALNCRC, DLOANDEP, INTINCOME and DINT are the independent variables.

The findings obtained using this method are presented in the table below.

Table 3. Robust M Estimator Results

Model 1				
Variable	**Variable**	**Variable**	**Variable**	**Variable**
DLOGNRA	0.025896	0.417573	0.062017	0.9505
NPL	-0.140648	0.069779	-2.015640	0.0438
LOGVIABRANCH	1.489892	0.189159	7.876397	0.0000
EQUITY	0.198866	0.052803	3.766199	0.0002
DLOGTOTALNCRC	-0.707123	0.484305	-1.460078	0.1443
DLOANDEP	-0.067491	0.028257	-2.388441	0.0169
INTINCOME	0.087624	0.008957	9.783278	0.0000
DINT	0.025984	0.012229	2.124811	0.0336
C	-22.86612	2.618835	-8.731410	0.0000
R-Squared	0.647296	Adjusted R- squared		0.568917
Rw-squared	0.923400	Adjusted Rw-squared		0.923400
Rn-squared statistic	270.0086	Prob (Rn-squared stat.)		0.000000
Model 2				
Variable	**Coefficient**	**Std. Error**	**Z**	**p**
DLOGNRA	1.018243	5.071076	0.200794	0.8409
NPL	-1.880055	0.847402	-2.218610	0.0265
LOGVIABRANCH	19.42352	2.297181	8.455371	0.0000
EQUITY	2.886317	0.641247	4.501098	0.0000
DLOGTOTALNCRC	-10.33631	5.881487	-1.757432	0.0788
DLOANDEP	-0.773289	0.343163	-2.253414	0.0242
INTINCOME	1.153828	0.108769	10.60803	0.0000
DINT	0.227825	0.148512	1.534052	0.1250
C	-304.2157	31.80358	-9.565456	0.0000
R-squared	0.637034	Adjusted R-squared		0.556375
Rw-squared	0.930714	Adjusted Rw-squared		0.930714
Rn-squared statistic	314.9757	Prob (Rn-squared stat.)		0.000000
Model 3				
Variable	**Coefficient**	**Std. Error**	**Z**	**p**
DLOGNRA	1.937172	0.640993	3.022140	0.0025
LOGVIABRANCH	-0.010965	0.290177	-0.037789	0.9699
EQUITY	0.250280	0.080296	3.116947	0.0018
DLOGTOTALNCRC	-2.092334	0.744051	-2.812085	0.0049
DLOANDEP	-0.050041	0.041934	-1.193319	0.2327
INTINCOME	-0.039450	0.012827	-3.075446	0.0021
DINT	-0.052445	0.018049	-2.905673	0.0037
C	-2.052435	4.013683	-0.511360	0.6091
R-Squared	0.315435	Adjusted R- squared		0.185923
Rw-squared	0.612184	Adjusted Rw-squared		0.612184
Rn-squared statistic	38.76951	Prob (Rn-squared stat.)		0.000002

As seen in the table above, the findings obtained from Model 1 provide significant insights into the effects of digital transformation and traditional banking activities on financial performance in the banking sector. The F-statistic (or the P-value) for Model 1, which determines whether the model is statistically significant as a whole, was found to be 0.0, indicating that the model is statistically significant. The R-squared value, which shows the proportion of variation in the dependent variable explained by the independent variables, is 0.64, while the Adjusted R-squared value is 0.56. According to the R-squared value, it can be said that the independent variables explain 64% of the changes in the dependent variable. On the other hand, the Rw-squared value is 0.92, which is considered a more robust and therefore more appropriate measurement tool than the R-squared value, even for small samples (Renaud & Victoria-Feser, 2010).

Excluding the variables related to remote customer acquisition, it has been observed that the relationships of other variables with Return on Assets (ROA) are statistically significant. Specifically, the number of remote applications (DLOGNRA) and the number of applications processed via customer representatives and couriers (DLOGTOTALNCRC) do not show a statistically significant relationship with ROA.

However, transactions concluded through branches (LOGVIABRANCH) have a positive and statistically significant relationship with ROA at the 1% error level. Similarly, the ratio of interest income to average assets (INTINCOME) also shows a positive and statistically significant relationship with ROA at the 1% error level. These results indicate that credit activities carried out through traditional branches have a positive impact on banks' return on assets. The positive and significant relationship between branch-based applications and ROA suggests that traditional banking activities still play an important role. The positive relationship between interest income and ROA also confirms that traditional credit activities contribute positively to banks' profitability. This finding shows that, despite digitalization, branch channels continue to perform the main functions of banking, and interest income remains an important source of profit.

After all, it is remarkable that the number of remote applications (DLOGNRA) and applications concluded through couriers does not show a statistically significant relationship with ROA. This finding suggests that the impact of digitalization on bank performance may not be immediately evident when compared to traditional methods. Specifically, applications concluded via customer representatives and couriers may show lower efficiency compared to applications processed in physical branches. This suggests that such digital services may not yet directly affect banks' profitability, which could be related to the risks associated with remote customer acquisition (Yıldırım, 2024; Ezrokh, 2020). Therefore, as these risks decrease and digital banking services develop, this result may change over time.

Moreover, the relationship between the credit interest rate (DINT) and asset profitability is positive and statistically significant. The finding that credit interest rates positively affect profitability is coherent with some studies in the economic literature (Macit, 2012), while other studies present the opposite view (Al-Homaidi et al., 2018).

The relationship between the equity ratio and ROA is also positive and statistically significant at the 1% error level. This indicates that a strong equity structure positively influences banks' lending behavior, helping to increase asset profitability. The positive relationship between equity ratio and ROA demonstrates that a strong equity structure in banks positively affects their lending behavior, which in turn increases asset profitability. This finding confirms that having strong capital structures in lending processes contributes to increased credibility and financial success.

On the other hand, the relationship between the loan-to-deposit ratio (DLOANDEP) and ROA is negative and statistically significant at the 5% error level. This can be explained by the fact that as lending increases, credit risk also rises. In addition, the ratio of non-performing loans to cash loans (NPL) also has a negative and statistically significant relationship with ROA at the 5% error level.

Furthermore, the negative relationships between the loan-to-deposit ratio (DLOANDEP) and non-performing loans (NPL) with ROA indicate that banks are facing credit risks and that an increase in non-performing loans negatively impacts profitability. This shows that banks' efforts to increase their loan portfolios and acquire new customers do not always have a positive effect; rather, they may increase risk and weaken financial performance. It is important for banks to manage their credit risks carefully and optimize their lending strategies.

Looking at the findings of Model 2, the F-statistic and P-value were found to be zero (0.0), which also indicates that the model is statistically significant. This result suggests that the independent variables in the model are sufficient to explain the changes observed in the dependent variable. The R-squared value is 63%, and the Adjusted R-squared value is 55%. The R-squared value shows that the independent variables explain 63% of the

changes in the dependent variable, while the Adjusted R-squared value of 55% suggests that some variables may have limited contribution to the model, considering that the model includes more independent variables. Furthermore, the Rw-squared value of 0.93 indicates that it is a more reliable measure than R-squared. This view, as expressed by Renaud and Victoria-Feser (2010), confirms that Rw-squared provides a more robust evaluation criterion.

The relationship between the number of remote applications (DLOGNRA) and Return on Equity (ROE) is not statistically significant. This shows that remote applications through digital channels do not contribute to banks' equity profitability. The results suggest that digitalization, compared to traditional banking methods, does not create a direct and significant impact on banks' profitability in the short term. This indicates that the potential of digitalization for remote customer acquisition has not yet been fully realized. This result could change if data from all banks in the sector are included.

The relationship between transactions concluded through customer representatives and couriers (DLOGTOTALNCRC) and equity profitability (ROE) is negative and statistically significant at the 10% level. This suggests that remote applications may have a negative effect on equity profitability. However, it should be noted that the remote customer acquisition application is relatively new, and its usage may be limited due to certain risks associated with its implementation. As the application becomes more widespread and data from all banks in the sector are obtained, the result may change.

The relationship between branch-based applications (LOGVIABRANCH) and equity profitability is positive and statistically significant at the 1% error level, indicating that traditional banking still has a strong influence on profitability. Despite the increase in digitalization, branches continue to play an important role in increasing equity profitability, particularly through credit activities. In addition, the ratio of interest income to average assets (INTINCOME) also shows a positive and statistically significant relationship with equity profitability. This demonstrates that interest income, particularly from credit transactions conducted through branch channels, continues to be an important tool for increasing equity profitability.

Although the relationship between credit interest rate (DINT) and equity profitability (ROE) is positive, it is not statistically significant. This suggests that credit interest rates may have a limited or indirect effect on banks' profitability. However, it is important to note that there are varying results in the literature on this topic. For example, some studies have concluded that the INT variable positively affects equity profitability (Alper & Anbar, 2011) while other studies have reached the opposite conclusion (Al-Homaidi et al., 2018).

The positive and significant relationship between the equity ratio and ROE shows that a strong capital structure positively influences banks' lending behavior and increases their equity profit. Banks with a high equity structure are better equipped to manage credit risks effectively, thereby enhancing their financial stability. This finding is in line with existing literature, suggesting that banks can improve the security and efficiency of future credit activities by strengthening their capital structures (Sarı & Konukman, 2021).

The negative relationship between the loan-to-deposit ratio (DLOANDEP) and ROE suggests that as lending increases, credit risk rises, which negatively impacts profitability. This finding emphasizes the importance of banks managing credit risk and optimizing deposit management and loan conversion rates. Furthermore, the negative relationship between the non-performing loan ratio (NPL) and ROE indicates that banks need to manage their credit portfolios more effectively, as credit risk negatively impacts profitability.

Model 3 examines the impact of different digital customer acquisition channels on the non-performing loan (NPL) ratio in the Turkish banking sector. The F-statistic (or the P-value) for Model 3 was found to be 0.0, indicating that the model is statistically significant. As expressed above, the Rw-squared value of 0.61 indicates that it is a more reliable, more robust measure than R-squared. The results indicate that an increase in the number of remote applications (DLOGNRA) is positively and significantly associated with higher NPL ratios. On the other hand, remote applications that are finalized through customer representatives or couriers (DLOGTOTALNCRC)—a hybrid model that combines digital initiation with human-assisted completion—are negatively and significantly associated with NPLs. This indicates that incorporating human involvement into digital onboarding processes enhances credit quality, likely through more effective identity verification and borrower assessment procedures.

The equity ratio (EQUITY) is found to have a positive and significant relationship with the NPL ratio. This may reflect increased risk-taking behavior by better-capitalized banks, as strong capital buffers allow greater flexibility in extending credit to higher-risk segments (Tunay, 2015). This finding is coherent with some studies' results (Tabak et al., 2012; Sarı & Konukman, 2021). Meanwhile, both higher interest income (INTINCOME) and increases in commercial loan interest rates (DINT) are associated with lower NPLs. In the literature, NPL is

expected to be positively related with interest rates (Nkusu, 2011). However, the higher interest rates affects NLP negatively. These findings suggest that banks with more profitable lending operations and those adjusting lending rates in response to market conditions tend the o maintain better asset quality.

Customer acquisition through physical branches (LOGVIABRANCH) and the loan-to-deposit ratio (DLOANDEP) exhibit negative but statistically insignificant relationships with NPLs. This implies that these factors do not have a significant explanatory effect on credit risk within the current sample period.

Overall, the results highlight the importance of balancing digital efficiency with human oversight in the customer acquisition process. In particular, the findings support the strategic value of hybrid onboarding models—where digital tools are supported by human interaction—in managing credit risk during the ongoing digital transformation of the banking sector.

5. CONCLUSION

This study investigates the effects of remote customer acquisition on the profitability and credit risk performance of the Turkish banking sector, offering key insights into the ongoing digital transformation. The empirical results based on robust least squares models reveal that, while digital customer acquisition practices are expanding, their direct contribution to profitability—measured by Return on Assets (ROA) and Return on Equity (ROE)—remains statistically limited in the short term. In contrast, traditional banking activities, particularly branch-based customer acquisition and interest income from lending, continue to have a strong and significant impact on bank profitability.

A critical finding of this research is the differentiated impact of digital onboarding channels on credit risk. Fully digital applications (DLOGNRA), are associated with higher non-performing loan (NPL) ratios, indicating elevated credit risk. However, remote applications completed through customer representatives or couriers (DLOGTOTALNCRC)—representing a hybrid approach—are significantly associated with lower NPLs, suggesting that integrating human oversight into digital processes enhances loan quality and risk control. These findings highlight that the design and execution of digital banking services play a crucial role in managing credit risk.

Additionally, the study confirms that a strong equity structure affects positively both profitability and credit risk. Higher equity ratios are positively related to ROA and ROE, but also to NPLs, possibly due to more aggressive lending behavior by well-capitalized banks. These findings suggest that, despite digitalization, banks need to develop careful and strategic approaches in critical areas such as credit risk and deposit management. The combination of digitalization strategies and traditional banking practices may yield more effective results in enhancing profitability. In this context, effective management of risks will be crucial for the success of digital transformation strategies.

Moreover, higher interest income and elevated loan interest rates are associated with reduced NPL ratios, indicating stronger asset quality under tighter credit conditions. Conversely, the loan-to-deposit ratio shows a negative and significant relationship with profitability, underlining the risks associated with aggressive lending strategies.

In conclusion, while strong empirical evidence was not found that remote customer acquisition directly contributes to profitability, it is believed that this application gives banks a competitive advantage and plays a significant role in developing sustainable digital banking strategies. The findings emphasize the importance of balancing technological efficiency with human judgment, particularly in credit risk assessment. Hybrid customer acquisition models appear to offer a more sustainable and risk-sensitive path forward in the digitalization of banking services. Although there were challenges in the early stages of the implementation, such as security risks, remote customer acquisition is expected to become more widespread and play a critical role in the digitalization processes of banks. The impact of digitalization on financial performance is expected to become more evident in the long term. However, it should be noted that the impact of digital banking on financial performance may vary depending on the banks' institutional structures, capacity, risk management culture, and ability to integrate digital tools with traditional practices. As data obtained from the application increases over time, the results of the analysis are expected to become more concrete and evident.

AUTHORS' DECLARATION:

There is no need to obtain ethical permission for the current study as per the legislation.

AUTHORS' CONTRIBUTIONS:

Conceptualization, writing-original draft, editing – **SS** and **BE**, data collection, methodology, formal analysis – **SS** and **BE**, Final Approval and Accountability – **SS** and **BE**

REFERENCES

Abaenewe, Z. C., Ogbulu, O. M., & Ndugbu, M. O. (2013). Electronic banking and bank performance in Nigeria. *West African Journal of Industrial and Academic Research*, *6*(1), 171-187. Available at: https://www.ajol.info/index.php/wajiar/article/view/87447

Akbaş, F. (2023). Bankacılıkta dijital dönüşüm ve FinTech. *Uluslararası Ekonomik Araştırmalar Dergisi*, *9*(2), 1-12. Available at: https://dergipark.org.tr/tr/download/article-file/3253863

Akın, F. (2020). Dijital dönüşümün bankacılık sektörü üzerindeki etkileri. *Balkan & Near Eastern Journal of Social Sciences (BNEJSS)*, *6*(2), 15-27. Available at: https://ibaness.org/bnejss/2020_06_02/03_Akin.pdf

Akyüz, G. Ç. (2023). İnternet ve mobil bankacılık uygulamalarının bankacılık sektörüne etkisi. *Anadolu İktisat ve İşletme Dergisi*, *7*(2), 74-94. https://doi.org/10.59293/anadoluiid.1360102

Al-Homaidi, E. A., Tabash, M. I., Farhan, N. H., & Almaqtari, F. A. (2018). Bank-specific and macro-economic determinants of profitability of Indian commercial banks: A panel data approach. *Cogent Economics & Finance*, *6*(1), 1548072. https://doi.org/10.1080/23322039.2018.1548072

Alper, D., & Anbar, A. (2011). Bank specific and macroeconomic determinants of commercial bank profitability: Empirical evidence from Turkey. *Business & Economics Research Journal*, *2*(2). Available at: https://www.berjournal.com/wp-content/plugins/downloads-manager/upload/BERJ%202(2)2011%20article8%20pp139-152.pdf

Bakırtaş, T., & Ustaömer, K. (2019). Türkiye'nin bankacılık sektöründe dijitalleşme olgusu. *Ekonomi İşletme ve Yönetim Dergisi*, 3(1), 1-24. Available at: https://dergipark.org.tr/en/download/article-file/751176

BRSA (Banking Regulation and Supervision Agency-Bankacılık Düzenleme ve Denetleme Kurumu, BDDK). *Monthly banking sector data (Basic display)*, Available at: https://www.bddk.org.tr/BultenAylik

BRSA. (2022). *Regulation on the remote identification methods to be used by banks and the establishment of the contractual relationship in electronic environment.* Available at: https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=38568&MevzuatTur=7&MevzuatTertip=5

Berger, A. N. (2003). The economic effects of technological progress: Evidence from the banking industry. *Journal of Money, Credit and Banking*, *35*(2), 141-176. Available at: https://www.jstor.org/stable/3649852

Beybur, M. (2022). Şubesiz dijital bankacılık ve Türk bankacılık sektörü için öneriler. *Ankara Hacı Bayram Veli Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *24*(1), 286-303. https://doi.org/10.26745/ahbvuibfd.997689

Bulut, E., & Akyüz, G. Ç. (2020). Türkiye'de dijital bankacılık ve ekonomik büyüme ilişkisi. *Marmara Üniversitesi İktisadi ve İdari Bilimler Dergisi*, *42*(2), 223-246. https://doi.org/10.14780/muiibd.854325

Çalış, N., Yıldırım, H. H., & Sakarya, Ş. (2025). Dijital bankacılık uygulamalarının bankaların karlılığına etkisi: Bankacılık sektörü üzerine bir uygulama. *İşletme Araştırmaları Dergisi*, *17*(1), 215-225. https://doi.org/10.20491/isarder.2025.1967

Capasso, S. (2004). Financial markets, development and economic growth: Tales of informational asymmetries. *Journal of Economic Surveys*, *18*(3), 267-292. https://doi.org/10.1111/j.0950-0804.2004.00222.x

Çelik, S. B., & Mangır, F. (2020). Bankacılık sektörünün dijitalleşmesi: Dünyada ve Türkiye'de durum analizi. *Cyberpolitik Journal*, 5(10), 260-282. Available at: http://www.cyberpolitikjournal.org/index.php/main/article/view/117

Çetiner, E. M., & Karaman, A. C. (2021). Türk bankacılık sektöründe internet bankacılığının banka karlılığı üzerindeki etkisinin irdelenmesi. *Social Sciences Studies Journal*, 7(92), 5776-5786. http://dx.doi.org/10.26449/sssj.3427

Ciciretti, R., Hasan, I., & Zazzara, C. (2009). Do internet activities add value? Evidence from the traditional banks. *Journal of Financial Services Research*, 35(1), 81-98. https://doi.org/10.1007/s10693-008-0039-2

Çon, Z., & Arıca, F. (2024). Dijital bankacılığın geleceği: Türkiye'deki yenilikler ve küresel trendler. *Girişimcilik ve Kalkınma Dergisi*, 19(2), 21-32. Available at: https://dergipark.org.tr/tr/download/article-file/4121875

Coşkuntuncel, O. (2011). Eğitimle ilgili sapan değer içeren veri kümelerinde en küçük kareler ve robust M tahmin edicilerin karşılaştırılması. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, 5(2), 251-262. https://doi.org/10.17860/efd.07462

Dağıdır Çakan, C., Turan, Y., & Çakmakçı, G. (2022). A new approach in banking branchless (digital) banking and customer acquisition: Case study of Kuveyt Turk bank. *Finans Ekonomi ve Sosyal Araştırmalar Dergisi*, 7(1), 177-192. https://doi.org/10.29106/fesa.1059930

Danacı, M. C., & Çetintaş, Ö. (2020). Bankalarda finansal teknoloji ve yenilikler. *Turkish Business Journal*, 1(2), 179-187. Available at: https://dergipark.org.tr/tr/download/article-file/1398410

TÜSİAD. (2016). *CEO perspective on digital transformation in Turkey* (*Türkiye'deki dijital değişime CEO bakışı*). Available at: https://tusiad.org/tr/yayinlar/raporlar/item/8867-tu-rkiye-deki-dijital-deg-is-ime-ceo-bakis-i-raporu

Demirel, D. S. (2021). Covid-19 pandemi sürecinin dijital bankacılık işlemleri üzerinde etkisi. *Bankacılık ve Sermaye Piyasası Araştırmaları Dergisi*, 5(11), 49-64. Available at: https://dergipark.org.tr/en/download/article-file/1817588

Deniz, F. (2023). Dijital bankacılık hizmetlerinin banka performansına etkisi. *Üçüncü Sektör Sosyal Ekonomi Dergisi*, 58(3), 2654-2669. https://doi.org/10.15659/3.sektor-sosyal-ekonomi.23.09.2257

Diener, F., & Špaček, M. (2021). Digital transformation in banking: A managerial perspective on barriers to change. *Sustainability*, 13(4), 2032. https://doi.org/10.3390/su13042032

Ergün, T. (2023). Dijitalleşme ile bankacılık kârlılığı arasındaki etkileşim: ARDL sınır testi yaklaşımı. *Dicle Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, (34), 206-227. https://doi.org/10.15182/diclesosbed.1313624

Ezrokh Y. S. (2020). Problems of establishing the institution of remote client identification in the Russian banking system (economic aspects). *St. Petersburg University Journal of Economic Studies*, 36(2), 266-286. https://doi.org/10.21638/spbu05.2020.205

Ganioğlu, A., & Us, V. (2014). *The structure of the Turkish banking sector before and after the global crisis.* CBRT Working Paper, No. 14/29. Available at: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Publications/Research/Working+Paperss/2014/14-29

Gümüş, E., Medetoğlu, B., & Tutar, S. (2020). Finans ve bankacılık sisteminde yapay zekâ kullanımı: Kullanıcılar üzerine bir uygulama. *Bucak İşletme Fakültesi Dergisi*, 3(1), 28-53. https://doi.org/10.38057/bifd.690982

Hakizimana, S., Wairimu, M. M. C., & Muathe, S. (2023). Digital banking transformation and performance-where do we stand. *International Journal of Management Research and Emerging Sciences*, 13(1), 179-196. https://doi.org/10.56536/ijmres.v13i1.404

Huber, P. J. (1964). Robust Estimation of a Location Parameter. *The Annals of Mathematical Statistics*, 35(4), 73-101. https://doi.org/10.1214/aoms/1177703732

Huber, P. J. (1973). Robust regression: asymptotics, conjectures and Monte Carlo. *The Annals of Statistics*, 799-821. https://doi.org/10.1214/aos/1176342503

Ibidoja, O. J., Shan, F. P., Sulaiman, J., & Ali, M. K. M. (2023). Robust M-estimators and machine learning algorithms for improving the predictive accuracy of seaweed contaminated big data. *Journal of the Nigerian Society of Physical Sciences*, *5*(1), 1137. https://doi.org/10.46481/jnsps.2023.1137

İslamoğlu, M., & Bayrak, M. (2022). Dijital bankacılık ürünlerinin sektörün büyüme performansı üzerindeki etkileri. *Finans Ekonomi ve Sosyal Araştırmalar Dergisi*, *7*(3), 403-416. https://doi.org/10.29106/fesa.1127589

Karadeniz, M., & Karadeniz, Y. A. S. İ. N. (2023). Türkiye'de dijital bankacılık ve ekonomik büyüme ilişkisinin incelenmesine yönelik teorik bir araştırma. *Parion Academic Review Journal*, *2*(2), 1-17. Available at: https://dergipark.org.tr/tr/download/article-file/3194662

Korkmazgöz, Ç., & Ege, İ. (2020). Finansal teknolojilerin Türk bankacılık sektörünün finansal performansına etkisi: Mobil bankacılık üzerine uygulama. *Mersin Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *3*(2), 106-125. Available at: https://dergipark.org.tr/tr/download/article-file/1173723

Macit, F. (2012). Bank specific and macroeconomic determinants of profitability: Evidence from participation banks in Turkey. *Economics Bulletin*, *32*(1), 586-595. Available at: http://www.accessecon.com/Pubs/EB/2012/Volume32/EB-12-V32-I1-P55.pdf

Mert, M., & Çağlar, A. E. (2019). *Eviews ve Gauss uygulamalı zaman serileri analizi.* Ankara: Detay Yayıncılık.

Mukhtar, M., Ali, M. K. M., Ismail, M., Hamundu, F. M., Alimuddin, A., Akhtar, N., & Fudholi, A. (2022). Hybrid model in machine learning-robust regression applied for sustainability agriculture and food security. *IJECE*, 9(4), 101-113. https://doi.org/10.11591/ijece.v12i4.pp4457-4468

Nkusu, M. (2011). *Nonperforming loans and macrofinancial vulnerabilities in advanced economies*. IMF Working Papers, No. WP/11/161. Available at: https://www.imf.org/external/pubs/ft/wp/2011/wp11161.pdf

Öztürk, L., & Türkay, H. (2005). Aşırı değer içeren veri kümelerinde hata terimlerinin binom dağılıma uyduğu durumda EKK ve robust LTS regresyon tahmincilerinin simulasyon çalışması ile karşılaştırılması. *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *10*(1), 263-279. Available at: https://dergipark.org.tr/en/download/article-file/194944

Pilatin, A. (2023). Türkiye'de bankacılık sektörü, dijital ve mobil bankacılığın gelişimi. In F. Kalay (Eds.) *güncel iktisadi ve idari bilimler araştırmaları kavramlar, araştırmalar ve uygulama*, (pp. 133-154), Livre de Lyon, Fransa. Available at: https://avesis.erdogan.edu.tr/yayin/5e1b617a-2bc4-450f-8a29-43465e29fd34/turkiyede-bankacilik-sektoru-dijital-ve-mobil-bankaciligin-gelisimi

Renaud, O., & Victoria-Feser, M. P. (2010). A robust coefficient of determination for regression. *Journal of Statistical Planning and Inference*, *140*(7), 1852-1862. https://doi.org/10.1016/j.jspi.2010.01.008

Resmi Gazete. (2021a). *Bankalarca kullanılacak uzaktan kimlik tespiti yöntemlerine ve elektronik ortamda sözleşme ilişkisinin kurulmasına ilişkin yönetmelik.* Available at: https://www.resmigazete.gov.tr/eskiler/2021/04/20210401-7.htm

Resmi Gazete (2021b). *Dijital bankaların faaliyet esasları ile servis modeli bankacılığı hakkında yönetmelik.* Available at: https://www.resmigazete.gov.tr/eskiler/2021/12/20211229-6.htm

Resmi Gazete (2023). *Bankalarca kullanılacak uzaktan kimlik tespiti yöntemlerine ve elektronik ortamda sözleşme ilişkisinin kurulmasına ilişkin yönetmelikte değişiklik yapılmasına dair yönetmelik.* Available at: https://www.resmigazete.gov.tr/eskiler/2023/05/20230525-1.htm

Rousseeuw, P., & Yohai, V. (1984). Robust regression by means of S-estimators. In D. Brillinger, S. Fienberg, J. Gani, J. Hartigan, & K. Krickeberg (Eds.), *Robust and nonlinear time series analysis: Lecture Notes in Statistics,* (pp. 256-272), New York, NY: Springer US. https://doi.org/10.1007/978-1-4615-7821-5_15

Sadr, S. M. H. (2013). Consideration the effect of e-banking on bank profitability; Case study selected Asian countries. *Journal of Economics and Sustainable Development*, *4*(11), 112-117. Available at: https://iiste.org/Journals/index.php/JEDS/issue/view/739

Sarı, S. (2022). Türkiye'de dijital bankacılık ve ekonomik büyüme ilişkisinin incelenmesi. *International Symposium of Economics Finance and Econometrics, Çanakkale, 18-19 June 2019, (pp. 203-2011).* Available at: https://isefe.comu.edu.tr/dosyalar/Isefe/tam-bildiri-kitapcigi-pdf-2.pdf

Sarı, S., & Konukman, A. (2021). Türk bankacılık sektöründe sektörel kredi yoğunlaşması ve risk-karlılık ilişkisi. *Anadolu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *22*(1), 1-28. Available at: https://dergipark.org.tr/en/download/article-file/1512890

Susanti, Y., Pratiwi, H., Sulistijowati, S., & Liana, T. (2014). M estimation, S estimation, and MM estimation in robust regression. *International Journal of Pure and Applied Mathematics*, *91*(3), 349-360. http://dx.doi.org/10.12732/ijpam.v91i3.7

Tabak, B. M., Fazio, D. M., & Cajueiro, D. O. (2011). The effects of loan portfolio concentration on Brazilian banks' return and risk. *Journal of Banking & Finance*, *35*(11), 3065-3076. https://doi.org/10.1016/j.jbankfin.2011.04.006

Tarı, R. (2008). *Ekonometri*. Kocaeli Üniversitesi Yayını, no: 172. Available at: http://kutuphane.kocaeli.edu.tr/kou-kitaplar.php

TBB (Türkiye Bankalar Birliği). (2022). *Bankaların dijital yolculukları ve Türkiye bankalar birliği çalışmaları.* Available at: https://www.tbb.org.tr/faaliyetler/teknoloji-ve-odeme-sistemleri/dijital-bankacilik/pdf/3214

TBB. (2025). *Dijital, internet ve mobil bankacılık istatistikleri (Mart 2006-Aralık 2024).* Available at: https://www.tbb.org.tr/istatistiki-raporlar/dijital-internet-mobil-bankacilik-istatistikleri-mart-2006-aralik-2024

CBRT (Central Bank of the Republic of Türkiye-Türkiye Cumhuriyet Merkez Bankası, TCMB). (2021). *Interest and dividend statistics.* Available at: https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket

Tunay, K. B. (2015). Kredi portföylerinde sektörel yoğunlaşma ve risk ilişkisi: Türk ticari bankacılık sektörü üzerine bir analiz. *BDDK Bankacılık ve Finansal Piyasalar Dergisi*, *9*(1), 127-147. Available at: https://dergipark.org.tr/tr/download/article-file/1351994

Tunay, K. B., & Akhisar, İ. (2017). Avrupa Birliği'nde internet bankacılığı ve banka performansı arasındaki uzun dönem ilişkiler. *Eurasian Econometrics Statistics & Emprical Economics Journal*, (6), 74-88. https://doi.org/10.17740/eas.stat.2017-V6-05

Türkiye İş Bankası. (2025). *Hakkımızda.* Available at: https://www.isbank.com.tr/bankamizi-taniyin/tarihimiz

Turkmen, S. Y., & Yigit, I. (2012). Diversification in banking and its effect on banks' performance: Evidence from Turkey. *American International Journal of Contemporary Research*, *2*(12), 111-119. Available at: https://www.aijcrnet.com/journals/Vol_2_No_12_December_2012/12.pdf

Ulusoy, A. (2022). Türk bankacılık sisteminde dijitalleşme-kârlılık etkileşimi. *Hacettepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *40*(1), 184-200. https://doi.org/10.17065/huniibf.931120

Uzun, U. (2021). Türkiye'de dijital bankacılık kullanımı üzerinde Covid-19 pandemisinin etkileri. *Fiscaoeconomia*, *5*(1), 309-323. https://doi.org/10.25295/fsecon.844266

Yang, S., Li, Z., Ma, Y., & Chen, X. (2018). Does electronic banking really improve bank performance? Evidence in China. *International Journal of Economics and Finance*, *10*(2), 82-94. https://doi.org/10.5539/ijef.v10n2p82

Yıldırım, S. (2024). Bankacılıkta uzaktan kimlik tespitinde karşılaşılan riskler ve çözüm önerileri. *Mülkiye Dergisi*, *48*(1), 243-276. Available at: https://dergipark.org.tr/en/download/article-file/3565903

Yohai, V. J. (1987). High breakdown-point and high efficiency robust estimates for regression. *The Annals of Statistics*, *15*(2), 642-656. https://doi.org/10.1214/aos/1176350366

Zaman, T., & Alakuş, K. (2016). Some robust estimation methods and their applications. *Alphanumeric Journal*, *3*(2), 73-82. https://doi.org/10.17093/aj.2015.3.2.5000152703

Appendix 1. List of Banks Providing Information on Remote Customer Acquisition as of 2025

1	Akbank T.A.Ş.	10	Misyon Yatırım Bankası A.Ş.
2	Alternatifbank A.Ş.	11	Odea Bank A.Ş.
3	Anadolubank A.Ş.	12	QNB Bank A.Ş.
4	Burganbank A.Ş.	13	Şekerbank T.A.Ş.
5	Denizbank A.Ş.	14	Türk Ekonomi Bankası A.Ş.
6	Fibabanka A.Ş.	15	Türkiye Cumhuriyeti Ziraat Bankası A.Ş.
7	Golden Global Yatırım Bankası A.Ş.	16	Türkiye Garanti Bankası A.Ş.
8	HSBC Bank A.Ş.	17	Türkiye Halk Bankası A.Ş.
9	ING Bank A.Ş.	18	Türkiye İş Bankası A.Ş.
10	Misyon Yatırım Bankası A.Ş.	19	Türkiye Vakıflar Bankası T.A.O.
11	Odea Bank A.Ş.	20	Yapı ve Kredi Bankası A.Ş.

Appendix 2. Program Output of the Model 1

Dependent Variable: ROA
Method: Robust Least Squares
Date: 04/28/25   Time: 21:28
Sample (adjusted): 2021M06 2025M02
Included observations: 45 after adjustments
Method: M-estimation
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)
Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
DLOGNRA	0.025896	0.417573	0.062017	0.9505
NPL	-0.140648	0.069779	-2.015640	0.0438
LOGVIABRANCH	1.489892	0.189159	7.876397	0.0000
EQUITY	0.198866	0.052803	3.766199	0.0002
DLOGTOTALNCRC	-0.707123	0.484305	-1.460078	0.1443
DLOANDEP	-0.067491	0.028257	-2.388441	0.0169
INTINCOME	0.087624	0.008957	9.783278	0.0000
DINT	0.025984	0.012229	2.124811	0.0336
C	-22.86612	2.618835	-8.731410	0.0000

Robust Statistics				
R-squared	0.647296	Adjusted R-squared		0.568917
Rw-squared	0.923400	Adjust Rw-squared		0.923400
Akaike info criterion	80.54416	Schwarz criterion		101.9872
Deviance	3.476173	Scale		0.226553
Rn-squared statistic	270.0086	Prob (Rn-squared stat.)		0.000000

Non-robust Statistics				
Mean dependent var	1.412956	S.D. dependent var		0.950091
S.E. of regression	0.564534	Sum squared resid		11.47316

Appendix 3. Program Output of the Model 2

Dependent Variable: ROE
Method: Robust Least Squares
Date: 05/15/25 Time: 18:48
Sample (adjusted): 2021M06 2025M02
Included observations: 45 after adjustments
Method: M-estimation
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)
Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
DLOGNRA	1.018243	5.071076	0.200794	0.8409
NPL	-1.880055	0.847402	-2.218610	0.0265
LOGVIABRANCH	19.42352	2.297181	8.455371	0.0000
EQUITY	2.886317	0.641247	4.501098	0.0000
DLOGTOTALNCRC	-10.33631	5.881487	-1.757432	0.0788
DLOANDEP	-0.773289	0.343163	-2.253414	0.0242
INTINCOME	1.153828	0.108769	10.60803	0.0000
DINT	0.227825	0.148512	1.534052	0.1250
C	-304.2157	31.80358	-9.565456	0.0000
Robust Statistics				
R-squared	0.637034	Adjusted R-squared		0.556375
Rw-squared	0.930714	Adjust Rw-squared		0.930714
Akaike info criterion	79.76084	Schwarz criterion		102.0965
Deviance	568.3801	Scale		2.894594
Rn-squared statistic	314.9757	Prob (Rn-squared stat.)		0.000000
Non-robust Statistics				
Mean dependent var	17.61051	S.D. dependent var		12.82481
S.E. of regression	7.823295	Sum squared resid		2203.342

Appendix 4. Program Output of the Model 3

Dependent Variable: NPL
Method: Robust Least Squares
Date: 08/26/25   Time: 15:22
Sample (adjusted): 2021M06 2025M02
Included observations: 45 after adjustments
Method: M-estimation
M settings: weight=Bisquare, tuning=4.685, scale=MAD (median centered)
Huber Type I Standard Errors & Covariance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
DLOGNRA	1.937172	0.640993	3.022140	0.0025
LOGVIABRANCH	-0.010965	0.290177	-0.037789	0.9699
EQUITY	0.250280	0.080296	3.116947	0.0018
DLOGTOTALNCRC	-2.092334	0.744051	-2.812085	0.0049
DLOANDEP	-0.050041	0.041934	-1.193319	0.2327
INTINCOME	-0.039450	0.012827	-3.075446	0.0021
DINT	-0.052445	0.018049	-2.905673	0.0037
C	-2.052435	4.013683	-0.511360	0.6091
Robust Statistics				
R-squared	0.315435	Adjusted R-squared		0.185923
Rw-squared	0.612184	Adjust Rw-squared		0.612184
Akaike info criterion	77.28212	Schwarz criterion		96.97319
Deviance	8.576080	Scale		0.359061
Rn-squared statistic	38.76951	Prob (Rn-squared stat.)		0.000002
Non-robust Statistics				
Mean dependent var	2.193778	S.D. dependent var		0.708302
S.E. of regression	0.742758	Sum squared resid		20.41249