

UNRAVELING THE NEXUS BETWEEN DIGITAL BANKING TRANSACTIONS AND BANK PROFITABILITY: INSIGHTS FROM TURKEY'S DEPOSIT BANKS

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Abstract

This study estimates the relationship between digital banking transactions and bank net profit through regression analysis using the data of deposit banks in Turkey between 2011 and 2021. The data from 11 Turkish banks are analyzed with the least squares method (OLS) in the Stata package program. For this purpose, the relationship between digital banking transactions and bank net profit is estimated by constructing three models. In the first model, online banking transactions have a positive effect on bank profitability. The number of internet banking customers, the number of Automated Teller Machine (ATM), and the number of Point of Sale (POS) are found to have a negative effect on net profit, but these coefficients are not statistically significant. In the second model, mobile banking transactions have a positive effect on bank net profit. ATM has a positive and statistically significant effect on bank net profit, while the number of POS has a negative coefficient on bank net profit, but this coefficient is not statistically significant. In the third and last model, the digital banking transactions have a positive effect on the net profit of the bank. ATM and POS numbers have a negative effect on bank net profit, but these coefficients are not statistically significant. In conclusion, both internet and mobile banking transactions have a positive effect on bank profits in Turkey. Digital banking transaction, which is a combination of internet and mobile banking transactions, is also found to have a positive effect on bank profits. Additionally, it has been revealed that internet banking services contribute more to bank profits than both mobile and digital banking services.

Keywords

Digital banking, Internet Banking, Mobile Banking, Net Profit.

JEL Classification

G20, G21, O33

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Introduction

Advances in information and communication technology have led to an increasing diversification of communication channels. Technological advances and intense competition have pushed the banking sector to utilize electronic communication technology in addition to the branch network, which is a one-way distribution channel. Electronic banking refers to the delivery of bank products and services to customers via applications such as the internet or telephone. The banking sector has adopted this technology because of its speed and lower transaction costs compared to branch banking. Today, banks use many electronic banking channels such as ATMs, POS, internet banking, mobile banking, telephone banking, etc. (Vurucu and Arı, 2022, pp. 305–306). The banking system, which is an important element in the financial sector, has kept pace with financial technology, which has been beneficial for both banks and the functioning of economic activities. The adoption of this technological progress has brought new developments such as mobile payments, cryptocurrencies, digital payment network, and blockchain technologies. The customer-oriented progress of banks by adopting these technologies has contributed to maintaining competition and market share (Korkmazgöz and Ege, 2020, pp. 107–108). Many banking transactions such as opening a deposit account, paying bills, electronic fund transfer/transfer/swift, and applying for a loan can be done over the internet or mobile banking without the need for bank personnel and are included in the scope of digital banking (Beybur, 2021, p. 12). Digital banking is basically the digitalization of branch banking services, which is a structure of traditional banking. The digitalization of banks has many advantages not only for banks but also for customer satisfaction. From the customers' point of view, they have the opportunity to perform financial transactions at any time without any space or time constraints, while from the banks' point of view, it contributes to the bank by reducing transaction burdens (Canatan and İpek, 2022, p. 7). In addition, both mobile banking and internet banking can provide convenience, accessibility, cost savings, security, transaction history and record keeping, efficiency, environmental impact, 24/7 account access, enhanced customer experience, real-time alerts and notifications.

The study aims to investigate the relationship between digital banking services and bank performance in Turkey. For this purpose, regression analysis was performed using data from deposit banks in Turkey between 2011 and 2021. The study investigates the impact on banks' net profit by using data on digital banking, which consists of internet banking, mobile banking and both of them. The difference of this study from other studies is that the effect of both internet and mobile banking services and digital banking services, which is a combination of these two services, on bank profitability is analyzed. Thus, the effect of both internet and mobile banking on bank profitability is analyzed separately and tries to reveal which of these services has a greater impact on bank profitability. In addition, the impact of digital banking transactions, where both internet and mobile banking transaction volumes are combined, on bank profitability has been investigated to determine whether this situation has an impact on bank profitability as a whole. In what follows, section 1 provides literature and hypothesis. Section 2 presents data and variables. Section 3 discusses research methodology while Section 4 findings.

1. Review of the scientific literature

As technological developments advance, the types of digital transactions used by banks are also increasing. The increase in this diversity is expected to increase customer satisfaction and customer loyalty, reduce transaction costs and ultimately contribute positively to bank profitability. In the literature, there are many studies on the relationship between digital banking and bank profitability both in Turkey and around the world. When the studies on the relationship between digital banking and bank performance in Turkey are analyzed, some studies have focused on internet banking and some on mobile banking services. The difference of this study from the other studies is that the effect of both internet and mobile banking services and the digital banking service, which is a combination of these two services, on bank profitability is analyzed. Thus, the effect of both internet and mobile banking on bank profitability is analyzed separately and it is tried to reveal which one of them has more impact on bank profitability. In addition, the impact of digital banking transactions, where both internet and mobile banking transactions are combined, on bank profitability has been investigated to determine whether this situation has an impact on bank profitability as a whole.

The literature is summarized in two ways. Firstly, the studies conducted in Turkey and then the studies conducted in European countries, developed and developing countries or individual countries are included. These studies are as follows:

Islamoglu & Bayrak (2022) investigated the relationship between digital banking services and financial performance of banks in Turkey. According to the findings, digital banking services have a positive effect on bank performance. Deniz (2023), who investigated the impact of digital banking services on bank performance, found that digital banking transactions positively affect bank performance and mobile banking transactions are higher than internet banking transactions in terms of affecting the performance of banks. Ulusoy & Demirel (2022) examined the relationship between digitalization and profitability in Turkey and found that there is a positive relationship between digitalization and profitability. They found that internet and mobile banking transactions as well as the number of customers have a positive effect on return on assets. Uzun & Berberoglu (2018) investigated the impact of internet banking practices on bank performance. According to the findings obtained from the analysis, it is revealed that internet banking transactions and the number of customers have a positive effect on bank income. Kayakus et al. (2021) examined the effect of internet banking services on bank performance in Turkey and found that the number of active customers and internet transactions had no effect on bank profitability. Sevim & Ozkan (2017) conducted a regression analysis on the effect of electronic banking services on bank performance in Turkey for the period 2011-2016. According to the findings, it is revealed that internet banking transactions and POS terminal have a positive effect on bank performance. Korkmazgoz & Ege (2020) conducted cointegration analysis on the impact of mobile banking services on bank performance in Turkey for the years 2011-2019. According to the findings, mobile banking transactions have an impact on both return on assets and return on equity. Canatan & Ipek (2022) used quarterly data for the years 2011–2021 and the ARDL bounds test method to examine the impact of mobile banking transactions on

banks' net profit in Turkey. The findings indicate that there is a relationship between mobile banking transactions and bank performance in the short and long run. Scott et al. (2017) investigated the long-run impact of digital innovation structures of European and American banks on bank performance for the years 1997-2006. According to the findings, they found that the adoption of information communication and telecommunication has a positive effect on bank profitability. Tunay et al. (2015) investigated the relationship between internet banking services and bank performance in European countries (including Euro and Non-Euro countries) for the years 2005-2013 using panel causality test. The findings reveal that there is a strong relationship between internet banking and bank performance, but no significant causality in either direction is detected. Ionascu et al. (2023) estimated the relationship between various digital and banking indicators in Romania for the period 2000-2020 using regression analysis. According to the findings, the globalization index has no significant effect on banking system Z-scores, an increase in returns on bank assets increases bank efficiency, internet users have no significant effect on bank Z-scores and mobile phone subscribers have no significant effect on bank Z-scores. Akhisar et al. (2015) investigated the impact of electronic-based banking services on bank profitability in 23 developed and developing countries using dynamic panel data for 2005-2013. The findings reveal that bank performance is significantly affected by both the number of ATMs per branch and electronic banking services. However, the number of POS and the number of customers using internet banking are negatively related to profitability. Shaikh & Anwar (2023) investigated the impact of digital banking transactions on the financial performance of Indian banks. A panel data analysis was conducted by considering the data of 32 public and private banks in India for the period 2011-2020. The findings reveal that speed is important in promoting payment-based transactions, which will contribute positively to bank performance. Muawanah & Gunadi (2018) conducted a study using banking data from 2011-2013 in Indonesia and found that banks' adoption of internet technologies improves firm performance. Itah & Emmanuel (2014) examine the impact of cashless transactions on bank profitability in Nigeria for the quarterly periods 2006-2013. The findings reveal that POS and ATMs have a positive impact on profitability. Valahzaghard & Shakourloo (2013) investigated the relationship between information technology facilities and bank performance using data from 19 private and public banks in Iran for the period 2005-2010. The findings revealed a weak but positive relationship between POS, PinPad and online businesses and bank performance. Siam (2006) investigated the impact of electronic banking on bank profitability in Jordan. According to the findings, the impact of electronic banking on bank profitability will be positive in the long run due to the capital investments of banks in infrastructure and training. Sujud & Hashem (2017) investigated the impact of commercial bank innovations on bank profitability in Lebanon. According to the findings, credit cards and debit cards have a positive impact on return on assets. Mahboub (2018) used banking data from Lebanese banks for the years 2009–2016 to examine the association between ICT (information and communication technology) and bank performance using the least squares approach. The findings reveal that ATM, internet banking, telephone banking and POS terminal do not affect bank

performance. However, mobile application and credit card services are found to directly affect bank performance.

Considering the studies conducted in Turkey, Deniz (2023), Ulusoy & Demirel (2022), Islamoglu & Bayrak (2022) and Uzun & Berberoglu (2018) have revealed a positive relationship between digital banking transactions and bank performance. Based on these studies, the following hypotheses are established for this study:

Hypothesis 1: There is a positive relationship between internet banking transactions and bank net profit.

Hypothesis 2: There is a positive relationship between mobile banking transactions and bank net profit.

Hypothesis 3: There is a positive relationship between digital banking transactions and bank net profit.

2. Research methodology

This study aims to investigate the relationship between digital banking services and bank performance in Turkey. For this purpose, regression analysis is performed using the data of deposit banks in Turkey between 2011 and 2021. The data of 11 Turkish banks used in the study are obtained from the online web address of the Banks Association of Turkey. These 11 banks are analyzed by least squares method (OLS) using STATA package program.

The study investigates the impact on banks' net profit by using data on digital banking, which consists of internet banking, mobile banking and both of them. In terms of digital banking services data, internet and mobile banking services mainly consist of money transfers, payments, investment transactions, credit card, and other financial transactions. Accordingly, three models are constructed and the impact of digital banking transactions is analyzed separately. In addition to digital banking services, variables such as the number of customers, ATM, POS, and internet usage rate are added to the models to make them stronger.

Table no. 1. Explanation of variables

Variable	Definition	Time interval	Source
NetProfit	Profit/loss after deducting taxes and other liabilities from the profit of the entity.	2011-2021	The Banks Association of Turkey
IBV	Internet banking transaction volume.	2011-2021	The Banks Association of Turkey
MBV	Mobile banking transaction volume.	2011-2021	The Banks Association of Turkey
DBV	Both internet and mobile banking transaction volume.	2011-2021	The Banks Association of Turkey
NIBC	Number of customers using internet banking.	2011-2021	The Banks Association of Turkey

NMBC	Number of customers using mobile banking.	2011-2021	The Banks Association of Turkey
ATM	Number of ATMs.	2011-2021	The Banks Association of Turkey
POS	Number of POS.	2011-2021	The Banks Association of Turkey
IUR	Ratio of internet use to population.	2011-2021	The World Bank

Source: Author processing

Table 1 presents the description, time period and source of the variables used in the study. Three models are established through the variables included here. The dependent variable of these three models is NetProfit. IBV, MBV, and DBV are independent variables while NIBC, NMBC, ATM, POS, and IUR are control variables.

Table no. 2. Descriptive statistics

Variable	Obs	Mean	Std. Dev	Min	Max
NetProfit	11	39949.09	20430.59	19042	87483
IBV	11	1209938	768734.1	411871.3	2995001
NIBC	11	1.33e+07	3217555	8606145	2.04e+07
MBV	11	1145602	1805680	4077.651	5832001
NMBC	11	2.72e+07	2.62e+07	445723	7.52e+07
DBV	11	2.84e+07	2.69e+07	857594.3	7.82e+07
ATM	11	42267.91	5823.427	30328	46998
POS	11	2744862	601894.5	2169471	4253501
IUR	11	.61	.14	.43	.81

Source: Author processing

Table 2 presents the descriptive statistics of the variables. Accordingly, the table includes the number of observations, mean value, standard deviation, minimum, and maximum values. NetProfit, IBV, MBV, and DBV variables are abbreviated as million Turkish Liras. ATM and POS variables are included in the analysis as number and IUR as percentage.

Table no. 3. Pearson correlation matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
NetProfit (1)	1								
IBV (2)	0.99*	1							
NIBC (3)	-0.05	-0.01	1						
MBV (4)	0.93*	0.96*	-0.16	1					
NMBC (5)	0.95*	0.97*	-0.06	0.90*	1				
DBV (6)	0.95*	0.97*	-0.06	0.90*	1*	1			
ATM (7)	0.69*	0.71*	0.46	0.50	0.75*	0.75*	1		
POS (8)	0.86*	0.91*	-0.11	0.96*	0.86*	0.85*	0.49	1	
IUR (9)	0.91*	0.92*	0.03	0.80*	0.98*	0.98*	0.85*	0.76*	1

Note: * indicates significance at the 5% level.

Source: Author processing

Table 3 presents the Pearson correlation coefficients of the variables. When the table is examined in detail, it is seen that there is a high positive correlation between some variables. This table shows whether there is a positive or negative relationship between the variables. There is a high correlation between some variables. Since the correlation coefficient does not carry any cause and effect relationship, high correlation between variables does not mean that it will negatively affect the models to be established. In addition, using the multicollinearity test, it will be possible to identify which independent variables have a high correlation with one another and reject them from the model.

Three models are developed in the context of digital banking to look into how internet and mobile banking services affect bank profitability. After the internet banking service transactions, the impact of mobile banking transactions on bank profitability will be examined. In addition, the impact of digital banking transactions, which are a combination of internet and mobile banking services, on bank profitability will also be examined. The models established to investigate the impact of digital banking transactions on bank profitability are as follows:

$$NetProfit_t = \beta_0 + \beta_1 IBV_{1t} + \beta_2 NIBC_{2t} + \beta_3 ATM_{3t} + \beta_4 POS_{4t} + \beta_5 IUR_{5t} + u_t \quad (1)$$

$$NetProfit_t = \beta_0 + \beta_1 MBV_{1t} + \beta_2 NMBC_{2t} + \beta_3 ATM_{3t} + \beta_4 POS_{4t} + \beta_5 IUR_{5t} + u_t \quad (2)$$

$$NetProfit_t = \beta_0 + \beta_1 DBV_{1t} + \beta_2 NIBC_{2t} + \beta_3 NMBC_{3t} + \beta_4 ATM_{4t} + \beta_5 POS_{5t} + \beta_6 IUR_{6t} + u_t \quad (3)$$

where it is constructed model (1) for internet banking, model (2) for mobile banking and model (3) for digital banking. To explain the model in general, NetProfit is defined as the dependent variable; β_0 , is the value of the dependent variable, i.e. NetProfit, if the independent variables are zero; $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$, and β_6 indicate how much the dependent variable will change in response to a one-unit change in the independent variables when the factors expressed by the error term u are constant.

The IUR variable in model (1), the NMBC and IUR variables in model (2) and the NIMC, NMBC, and IUR variables in model (3) are excluded from the models during the analysis due to multicollinearity.

The impact of digital banking transactions on bank profitability was measured with a multiple regression model. Regression can be explained as the prediction of the average value of the dependent variable through one or more independent variables. In order to estimate the regression model correctly, the dependent and independent variables should be distinguished based on the cause and effect relationship (Tatoğlu, 2023, p. 45). The validity of some assumptions should be tested in order to accurately model the relationships established in economics and finance. Considering that the established model is examined linearly, the existing model can be interpreted in a healthy way if it does not contain multicollinearity, is normally distributed, and does not have heteroscedasticity and autocorrelation problems. Once these assumptions are fulfilled, the models are estimated using the ordinary least squares method (Gujarati, 2004). The basic assumptions behind the model to be estimated with least squares are as follows (Tatoğlu, 2023, pp. 62–65):

1. While the regression model should be linear with respect to its parameters, it does not matter whether it is linear with respect to its variables.
2. Samples are drawn from the population by random sampling.
3. Matrix X is a stochastic, i.e. non-stochastic matrix. Accordingly;
 - a. Independent variables are not randomly selected variables.
 - b. The values of the independent variables do not vary from sample to sample.
 - c. The variances of the independent variables are equal to a constant regardless of the number of sample units.
4. The unconditional and conditional expected value of the error term (u) is zero.
5. There is no multicollinearity problem.
6. The number of observations n should be more than the coefficient to be estimated ($n > k$).
7. There should be no modelling error.
8. Error terms are normally distributed.

3. Results and discussions

This section presents multiple linear regression results to measure the impact of digital banking transactions on bank net profit. In this case, three models—online, mobile, and digital banking—are developed, and their connection to bank net profit is examined. The dependent variable, independent variables, coefficients, model determination coefficient, F value and diagnostic test results are presented in Table 4.

Table no. 4. Regression test results

Dependent Variable : NetProfit	Internet Banking	Mobile Banking	Digital Banking
	Coefficient	Coefficient	Coefficient
IBV	.0315***		
NIBC	-.0003		
MBV		.0136***	
DBV			.0005**
ATM	-.0758	1.0836**	.0842
POS	-.0069	-.0151	.0068
C	28498.61	19950.48	1324.977
R ²	0.9804	0.9453	0.9116
Adjusted R ²	0.9674	0.9218	-
F-Statistic	75.11***	40.29***	31.83***
Diagnostic Test Results			
LM (1978; 1978)	0.1303	0.9862	0.7442
Jarque-Bera (1987)	0.9991	0.6535	0.8866
Breusch-Pagan (1979) / Cook-Weisberg (1983)	0.3645	0.7312	0.0401
Mean VIF	6.67	9.58	5.24

Notes: NetProfit, profit/loss after deducting taxes and other liabilities from the profit of the entity; IBV, internet banking transaction volume; NIMC, number of customers using internet banking; MBV, mobile banking transaction volume; DBV, both internet and mobile banking transaction volume; ATM, number of ATMs; POS, number of POS.

Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Source: Author processing

Table 4 presents the regression analysis of the relationship between internet, mobile and digital banking models and bank net profit. There are three models in the table. The first one is for internet banking. When the coefficients in the internet banking model are analyzed, it is seen that IBV has a positive and significant relationship with NetProfit at 1% level. Accordingly, internet banking transactions positively affect bank profitability. Therefore, the hypothesis "There is a positive relationship between internet banking

transactions and bank net profit" is accepted. The number of NIMC, ATM, and POS have a negative effect on NetProfit, but the statistical value of these coefficients is not significant. The IUR variable, which refers to the rate of internet usage, is excluded from the model as it causes multicollinearity. The coefficient of determination R^2 in the model is approximately 98%. The F-statistic indicating whether the model is significant or not is significant at the 1% level. According to the diagnostic tests, there is no autocorrelation problem in the model according to the LM test, the error terms are normally distributed according to the Jarque-Bera test and there is no heteroskedasticity in the model according to the Breusch-Pagan/Cook-Weisberg test. On the other hand, the multicollinearity test was conducted to determine whether the independent variables in the model have effects on each other. Accordingly, the average VIF value of 6.67 reveals that there is no multicollinearity problem in the model. Secondly, the mobile banking model is included. MBV, which expresses the coefficient of mobile banking transaction, is positive and significant at the 1% level. In other words, mobile banking transaction volume has a positive effect on banks' net profit. Therefore, the hypothesis "There is a positive relationship between mobile banking transactions and bank net profit" is accepted. On the other hand, the number of ATMs positively affects the NetProfit variable, while the number of POS negatively affects NetProfit, but the coefficient of the POS variable is not statistically significant. NMBC and IUR variables are excluded from the model as they cause multicollinearity problem. The coefficient of determination R^2 in the model is approximately 91%. The F-statistic indicating the significance of the model is significant at the 1% level. On the other hand, according to the diagnostic tests, there is no autocorrelation problem in the model according to the LM test, the error terms are normally distributed according to the Jarque-Bera test and there is no heteroskedasticity in the model according to the Breusch-Pagan/Cook-Weisberg test. According to the multicollinearity test performed to determine whether the variables in the model have effects on each other, it can be said that there is no multicollinearity problem in the model since the average VIF value of 9.58 is below the threshold value of 10. The last model, the digital banking model, is the model that investigates the impact of both internet and mobile banking data on bank net profit. Accordingly, DBV positively affects the NetProfit variable and is statistically significant at the 5% level. In other words, digital banking transaction volume positively affects bank profit. Therefore, the hypothesis "There is a positive relationship between digital banking transactions and bank net profit" is accepted. The number of ATMs and POS have a negative effect on NetProfit, but these coefficients are not statistically significant. On the other hand, IUR, NIBC and NMBC variables are excluded from the model as they cause multicollinearity problem. The R^2 value of the model is 91% and the F-statistic is statistically significant at the 1% level. According to the diagnostic tests, there is no autocorrelation problem in the model according to the LM test and the error terms are normally distributed according to the Jarque-Bera test. According to the Breusch-Pagan/Cook-Weisberg test, there is heteroskedasticity in the model. To solve the heteroskedasticity problem, the model is estimated with robust standard errors. The multicollinearity test was conducted to determine whether the variables in the model have effects on each other. According to

this test, the average VIF value of 5.24 reveals that there is no multicollinearity problem in the model.

Conclusions

This study investigates the relationship between digital banking transactions and bank net profit in Turkey. For this purpose, regression analysis was performed using the data of deposit banks in Turkey between 2011 and 2021. The study investigates the impact on banks' net profit by using data on digital banking, which consists of internet banking, mobile banking and both of them. Internet and mobile banking transactions mainly consist of money transfers, payments, investment transactions, credit card and other financial transactions. In addition to internet and mobile banking transactions, variables such as the number of customers, number of ATMs, number of POS, and internet usage rate were added to the models and estimated.

In the study, three models were established for the relationship between digital banking and bank net profit. According to the findings obtained in the first model, volume of online banking transaction positively affects bank profitability. The number of internet banking customers, the number of ATMs and the number of POS have a negative effect on net profit, but these coefficients are not statistically significant. According to the findings obtained in the second model, volume of mobile banking transaction has a positive effect on bank net profit. ATM has a positive and statistically significant effect on bank net profit, while the number of POS has a negative coefficient on bank net profit, but this coefficient is not statistically significant. In the third and final model, volume of digital banking transaction has a positive effect on bank net profit. ATM and POS numbers have a negative effect on bank net profit, but these coefficients are not statistically significant. In conclusion, both internet and mobile banking transactions positively affect bank profits in Turkey. The volume of digital banking transaction, which are a combination of internet and mobile banking transactions, is also found to positively affect bank profits. Moreover, internet banking services contribute more to bank profits than both mobile and digital banking services. When these results are compared with the literature, Uzun & Berberoglu (2018), Kayakus et al. (2021) and Sevim & Ozkan (2017) found similar findings between internet banking and bank profitability; Korkmazgoz & Ege (2020) and Canatan & Ipek (2022) between mobile banking and bank profitability; Islamoglu & Bayrak (2022), Deniz (2023), Ulusoy & Demirel (2022) between digital banking and bank profitability. However, Deniz (2023) found that mobile banking transactions were higher than internet banking transactions, while this study found that internet banking transactions were more effective than mobile banking transactions.

The scope of the study is limited to Turkish banks. For future studies, it is recommended to analyze digital banking data from different countries.

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