
The Impact of Digitalization on Banks' Capital: A Case Study of Poland

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Abstract:

Purpose: Over the past decade, the banking sector has undergone significant changes due to the impact of digitalization. The digital revolution has changed both the way banks interact with their customers and the very operation model. Digitalization is becoming a key factor determining the competitiveness and stability of banking institutions. Technological transformations are fundamentally changing conventionally approaches to financial management in banks, opening up new opportunities to improve their efficiency. The purpose of this article is to study the impact of digitalization on bank capital drawing on the example of Polish banks.

Design/Methodology/Approach: The OLS (Ordinary Least Squares Method) method was used to build an econometric model of the impact of e-banking development indicators of bank capital. Three synthetic indicators characterizing the development of e-banking in Poland were used. The first indicator reflects the number of Internet banking clients, the second – the intensity of using e-banking services, and the third – the cost of e-banking transactions. The data of the National Bank of Poland and the Polish Bank Association for 2012-2023 was used.

Findings: The intensity of service use and the value of transactions indicate that the effective use of online banking channels is crucial for improving the capital position of banks. Banks investing in the development of digital tools and encourage customers to actively use online banking can increase their equity. Banks should focus on increasing the activity of existing customers and the value of transactions rather than solely on attracting new users.

Practical Implications: The practical implications of the study is to help increase the competitiveness of banking institutions and create innovative approaches to bank capital management, taking into account the impact of digitalization.

Originality/Value: The results confirm the positive impact of the development of Internet banking on the increase of bank capital. It is also proved that the growth of banks' capital is related to the quality and intensity of the use of online banking services rather than to their quantity.

Keywords: Digitalization, bank capital, Internet banking, online banking.

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1. Introduction

The modern financial market is affected by digitalization processes and requires the constant use of innovative technologies to ensure a high level of customer service and adaptation of conventional business processes of financial institutions to the new reality in the virtual environment. Over the past decade, the banking sector has undergone significant changes due to the impact of digitalization.

The digital revolution has changed both the way banks interact with their customers and the very operation model. Digitalization is becoming a key factor determining the competitiveness and stability of banking institutions. Technological transformations are fundamentally changing conventional approaches to financial management in banks, opening up new opportunities to improve their efficiency.

There are numerous studies of the impact of financial technologies on the efficiency of banks in today's world. In particular, role of digitalization in increasing the profitability and competitiveness of banks (Wang, Xiuping, and Zhang, 2021; Dwivedi, Alabdooli, and Dwivedi, 2021; Zhang, Wang, and Zhang, 2024), managing various types of risks (Vierescu and Toader, 2023; Wang, Huang, and Hong, 2024; Li, Xia, Sun, and Sun, 2025), accumulating customer deposits and savings (Abubakar, 2014; Shen, Hu, and Hueng, 2021; Rojek and Stoika, 2025), user satisfaction (Harb, Thoumy, and Yazbeck, 2022; Chouhan, Ali, Sharma, and Sharma, 2023; Kim and Yang, 2025; Balios *et al.*, 2021) are in the focus.

Still, the publications on the impact of digitalization on bank capital, which is one of the main indicators of bank performance, are scarce (Grima and Thalassinos, 2018).

Equity capital allows attracting additional financial resources, implementing a wide range of banking operations, ensuring stable operations, and maintaining customers' trust to the bank.

The purpose of this article is to study the impact of digitalization on bank capital drawing on the example of Polish banks. The research question is as follows: *does the growing use of Internet banking services lead to the growth of bank capital?*

To find out the answer to this question, an econometric model of the dependence of bank capital on indicators of e-banking development was built. The data of the National Bank of Poland and the Polish Bank Association for 2012-2023 was used.

The structure of this publication is as follows. The first part describes the theoretical aspects of the impact of digitalization and bank capital on banks' efficiency. The second part presents the results of modeling the dependence of bank capital on three groups of synthetic indicators of the Internet banking development in Poland. The article concludes with the study findings.

2. Literature Review

2.1 Digitalization and Bank Efficiency

Digitalization has become one of the main sources for banks to increase profitability, differentiate themselves in the market, change the core business of banking, reduce costs, improve quality, and enable the development of new financial products (Shanti, Siregar, Zulbainarni, and Tony, 2023). Results suggest that, for commercial banks, development of Fintech leads to increased profitability, financial innovation, and improved control of risk.

Overall, by using financial technology, commercial banks can improve their traditional business model by reducing bank operating costs, improving service efficiency, strengthening risk control capabilities, and creating enhanced customer-oriented business models for customers thereby, improving comprehensive competitiveness (Wang, Xiuping, and Zhang, 2021; Grima *et al.*, 2023).

The findings of the study by Dwivedi, Alabdooli, and Dwivedi (2021) confirm that the launch of FinTech has had a significant impact on the competitiveness and efficiency of the banking industry in the United Arab Emirates. The authors emphasize that the proper FinTech implementation and its alignment with technology management have a direct impact on the efficiency of banks in the UAE.

Having analyzed the data of 131 banks in China, Shen, Wu, Li, and Chen (2025) concluded that digital transformation significantly increases the efficiency of banks. Still, the authors note that digital transformation affects the cost efficiency of banks through four intermediary channels: promoting business diversification, reducing information asymmetry, increasing the efficiency of funds use, and reducing risk.

In their study, Zhang, Wang, and Zhang, (2024) also conclude that digitalization has a positive impact on bank efficiency. The authors note that digital transformation contributes to bank efficiency through two mechanisms: increased revenue diversification and reduced credit risk.

Reinforcing the construction of new digital infrastructure and activating the digital lending function can help digital transformation improve bank efficiency.

Juma Ally, Kulindwa, and Mataba, (2025) also confirm the positive impact of digitalization on the efficiency of commercial banks in Tanzania. The study findings show that the FinTech index measuring the development of banks' financial technologies significantly increases the efficiency of all banks, with the greatest impact on large banks due to their high level of financial technology development. The authors emphasize that it is required to integrate financial technologies into core banking systems in order to improve banks' efficiency and financial stability.

Kumar (2022), studying the impact of digitalization on the operations and competitiveness of Indian banks, concludes that the number of online transactions correlates positively with the ROA of Indian banks. Besides, the author proves that digitalization has a positive impact on increasing competition in the banking business and contributes to efficiency at all levels of the banking sector. Ultimately, a strong banking system promotes good investment decisions, which has the potential to stimulate economic growth.

Thus, the banking sector digitalization is an inevitable process that is changing the rules of the game in the financial services market. It promotes the emergence of new business models and innovative technologies that improve the efficiency, accessibility, and convenience of banking services. Ultimately, this has a positive impact on the competitiveness and stability of banking institutions.

2.2 Bank Capital and Banks' Efficiency

The level of bank capital is an important indicator of a bank's financial strength. A higher level of capital means that a bank is better able to bear losses without having to resort to bailout by the government or other creditors. Consequently, bank capital serves as a true and representative indicator of a bank's developmental and growth prospects (Murrar, Asfour, and Paz, 2024).

Berger and Bouman, (2013) examine how capital affects bank performance and how this effect varies with banking crises, market crises, and normal times that have occurred in the United States over the past quarter century. The authors conclude that, first, capital helps small banks to increase their probability of survival and market share consistently (both during banking crises, market crises, and normal times). Second, capital improves the performance of medium and large banks, mainly during banking crises.

Mosko and Bozdo, (2016) also confirm in their publication the impact of bank capital on bank efficiency. Capital requirements enhance financial stability and improve bank efficiency by using more capital as a buffer and reducing goodwill risks. Capital and risk regulation have a positive impact on bank efficiency.

M. Ma'aji, Barnett, Bin-Nashwan, Roslan, and Abas, (2025) revealed that return on average assets (ROAA) is increased by bank capital. To increase profits, bank management should focus on capital buffers. According to the researchers, policymakers should ensure compliance with capital adequacy standards and guide the liquidity optimization without compromising profit.

Thanh and Ngo, (2023) also conclude that bank capital has a positive impact on stability through its intermediary role in liquidity creation. The empirical results show that an increase in bank capital reduces liquidity creation, which in turn increases bank stability.

In their study, Riani and Maulani, (2021) analyze the determinants of the performance of commercial banks in Indonesia. The authors prove that operating expenses to operating income (BOPO), return on equity (ROE), return on assets (ROA), and non-performing loans (NPL) have a significant impact on bank efficiency. However, the capital adequacy ratio (CAR) does not affect banking efficiency that much.

The study by Abbas, Iqbal, and Aziz (2019) shows that bank capital and credit risk affect profitability in developed Asian economies similarly to US commercial banks. The authors prove the positive impact of bank capital on profitability and argue that a 6% increase in capital leads to a 1% increase in bank's profit.

Equity capital is one of the most important indicators of a bank's efficiency, as it reflects its reliability, solvency, and financial stability. Almost any aspect of the bank's operations is directly or indirectly related to the availability or adequacy of equity capital. An adequate amount of the bank's equity promotes its stable operation and neutralization of various risks arising in the course of its activities. Equity capital compensates for potential losses and thereby creates the basis for maintaining confidence in the bank on the part of depositors and customers.

3. Research Results and Discussion

The aim of the study was to assess the impact of online banking in Poland on banks' equity. Within the research process, using econometric modeling, the sequence of actions was as follows:

1. Construction of synthetic indicators characterizing the Polish online banking market using the Zeroed Unitarization Method (Kowalik, 2011) (these indicators served as explanatory variables for the formation of banks' equity):
 - a) Selection of variables describing the studied phenomenon.
 - b) Normalization of the values of diagnostic variables, presented in the form of stimulants or destimulants (removing the units of measurement and unifying the orders of magnitude in order to make them comparable).
 - c) Selection of the aggregation formula and calculation of the synthetic value on its basis.
2. Construction of econometric models using the synthetic indicators:
 - a) Estimation of model parameters (time series 2012 Q4-2023 Q4) using OLS.
 - b) Elimination of insignificant variables using the omitted variable test.
 - c) Verification of the econometric model.

Three synthetic indicators were constructed to characterize the Polish online banking market (these indicators served as explanatory variables for the formation of banks' equity). The data used in this process were collected on the basis of periodic reports of the Polish Bank Association. The developed indicators are as follows: the number

of online banking clients (x1). This indicator comprises information on the number of contracts granting access to online banking, the number of active individual clients with access to online banking, and the number of SME clients with access to online banking.

The next indicator is the intensity of the use of online banking services (x2). This indicator comprises information on the average number of transfers per active online banking client, the number of transactions in the Elixir system, and the average number of settlements per SME online banking client. The last synthetic indicator is the value of online banking transactions (x3).

This indicator comprises information on the average value of transfers per online banking client, the average value of settlements per active online banking client, and the average value of Elixir system transactions.

The OLS estimation made it possible to construct a model in which all explanatory variables (synthetic indicators) - at the indicated two-sided critical region $\alpha = 0.05$ - are statistically significant. The model is as follows:

$$\hat{1}_Y = 26,4 + 0,200*1_{x2} + 0,308*1_{x3}$$

It follows that, from the group of constructed synthetic indicators, the intensity of the use of online banking services (x2) and the value of transactions (x3) have a statistically significant, positive impact on banks' equity (Y).

A stronger effect was observed in the case of the value of transactions (x3). It was also found that the number of online banking clients (x1) did not have a statistically significant impact on banks' equity during the analyzed period.

A higher intensity of online banking usage (x2) may increase banks' operational efficiency by reducing customer service costs (e.g., reduction of expenses related to physical branches). Moreover, banks can generate additional revenues from fees on online transactions, which contributes to the growth of their equity.

The econometric modeling indicates that a 1 percentage point increase in the intensity of online banking usage translates into an average increase in banks' equity by 0.2 percentage points (*ceteris paribus*).

In turn, a higher transaction value (x3) implies greater revenues from commissions (e.g., payment transactions, international transfers, etc.). An increase in transaction value may also reflect greater economic activity of clients, which positively affects banks' financial condition (e.g., through growth in deposits, client investments, or loan repayments).

Based on the obtained model, it can be stated that a 1 percentage point increase in the value of transactions carried out in online banking leads to an average increase in banks' equity by 0.3 percentage points (*ceteris paribus*).

The mere number of clients using online banking (x_1) does not directly affect banks' equity. What matters more is their activity (intensity) (x_2) and the value of transactions (x_3). An increase in the number of clients may include both active and inactive users, which dilutes the impact of this variable.

The economic effect of the number of clients is more indirect and may manifest itself in other variables (e.g., operating revenues, growth in deposits, or acquisition of new products).

The constructed model contains statistically significant estimates of structural parameters - both jointly and individually. Their degree of fit to the actual data, as measured by the coefficient of determination, is high (Table 1).

Table 1. The Ordinary Least Squares Method, observations used 2012:4-2023:4 ($N = 45$)

Specification	Coefficient	Std. Error	t-ratio	p-value	
Const.	26.3528	0.0476787	552.7	9.76e-083	***
1 x_2	0.199769	0.0583373	3.424	0.0014	***
1 x_3	0.307977	0.0963862	3.195	0.0027	***
Statistics based on the weighted data:					
Arith. avg. of the dependent variable	25.94126	S.D. of the dependent variable	0.221139		
Sum squared resid.	0.282465	S.E. of regression	0.082008		
R-squared	0.868726	Adjusted R-squared	0.862474		
F (2, 42)	0.868726	P-value (F)	3.03e-19		
Log-likelihood	50.24220	Akaike criterion	-94.48440		
Schwarz criterion	-89.06441	Hannan-Quinn	-92.46388		
Rhol	0.643776	Durbin-Watson	0.667230		

Note: *** statistical significance at the level 1%.

Source: Own study.

The model explains approximately 86.87% of the variability of the dependent variable. The adjusted R-squared (0.862474) is also high, indicating that the model fits the data well, taking into account the number of variables.

The value of the F-statistic (138.97) and the very low P-value (F) (3.03e-19) indicate that the model as a whole is statistically significant. Based on the conducted VIF test, it was also determined that multicollinearity among the variables is not present. Confidence intervals were also tested. The purpose of this procedure was to determine whether the estimated parameters fall within the assumed probability (95%) of the true value. The test results indicate that all estimated parameter values lie within the confidence intervals (Table 2).

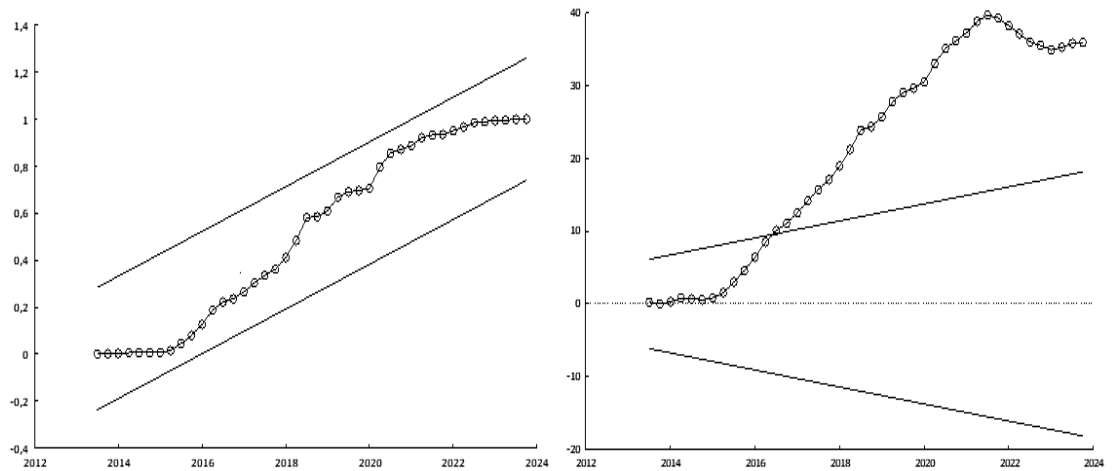
Table 2. Confidence intervals for explanatory variables of the econometric model (95%)

Variable	Value of the estimated parameters	Confidence intervals	
		lower	upper
const	26.3528	26.2566	26.4490
x2	0.199769	0.0820391	0.317498
x3	0.307977	0.113461	0.502492

Source: Own study.

Stability tests of the econometric model parameters over time were also conducted. For this purpose, the CUSUMSQ and CUSUM tests were applied (Figure 1). The former is designed to detect gradual changes, while the latter captures abrupt structural changes (e.g., sudden shifts in monetary policy, financial crises).

Figure 1. CUSUMSQ (left) and CUSUM (right) test results with 95% confidence interval



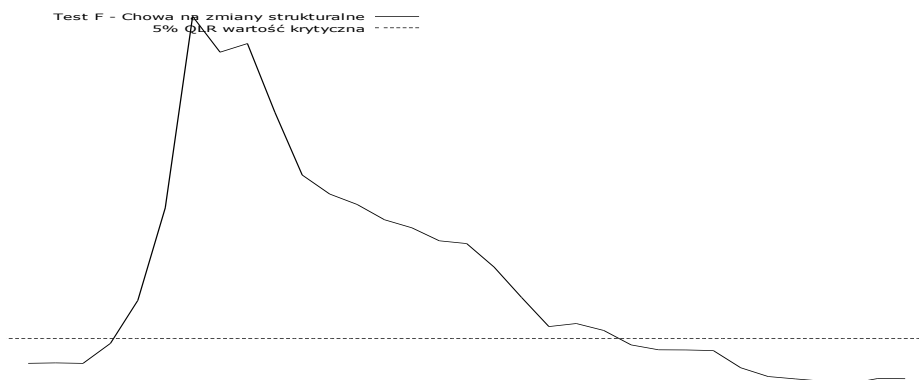
Source: Own study.

The CUSUMSQ test does not indicate significant parameter instability of the model during the analyzed period. The stability of the residual variance means that the model is relatively robust to gradually changing conditions over time.

In contrast, the results of the CUSUM test show that, starting from the third quarter of 2016, the values of the cumulative sum of scaled residuals exceed the boundaries of the 95% confidence interval, which suggests parameter instability. This instability persists throughout the subsequent period, with a slight decrease in values observed in 2022-2023.

The structural break is also confirmed by the QRL stability test (Figure 2). The test indicates that a structural break occurred in the third quarter of 2015.

Figure 2. *QRL test results with 95% confidence interval*



Source: *Own study.*

Possible causes of the observed breaks include structural changes in the system (e.g., significant shifts in the economy, monetary policy, the functioning of online banking, or changes in user preferences), which affected the relationships between the variables used in the model.

In the context of the study of banks' equity and online banking, the year 2015 may have been a turning point, among others, due to the effects of regulatory changes in the banking sector, such as capital requirements resulting from new EU regulations (Capital Requirements Directive IV - CRD IV³, Basel III⁴). The causes of the identified structural changes may also be associated with the development of online banking technology through the growing importance of fintechs⁵.

4. Conclusions, Proposals, Recommendations

The intensity of service usage and the value of transactions indicate that the effective use of online banking channels is of key importance for improving the capital position of banks. Banks that invest in the development of digital tools and encourage clients to actively use online banking may increase their equity. Banks should focus on enhancing the activity of existing clients and the value of transactions, rather than solely on acquiring new users. Online banking services associated with higher-value transactions (e.g., investments, large transfers, online

³Directive of the European Parliament and of the Council on the conditions for the admission of credit institutions to the business and on the prudential supervision of credit institutions and investment firms, which, as of 1 January 2014, entirely replaced the previously applicable provisions.

⁴Including, among others, the requirement of a minimum Tier 1 capital of 6% at all times (starting from 2015).

⁵On 9 February 2015, BLIK (Polish Payment Standard) was launched – a mobile payment system in Poland that revolutionized the national cashless payment system.

loans) should be promoted. In addition, online banking reduces operating costs related to traditional branches, which indirectly improves banks' financial performance and strengthens their equity.

An important element is also the development of cybersecurity, since the increase in the number and value of transactions in online channels raises banks' exposure to the risk of cyberattacks. The implementation of advanced cybersecurity solutions can further strengthen customer trust and thereby support the capital stability of banks.

The results of the study also suggest that banks should focus on client segmentation and the personalization of digital services, which fosters an increase in the volume of higher-value transactions. Strategic investments in technological innovations - such as integration with fintechs or the development of mobile services - may constitute an additional factor strengthening banks' equity.

In conclusion, it can be stated that the growth of banks' equity is more closely related to the quality and intensity of the use of online banking services than to their quantitative reach. In the context of the development of digital banking in Poland (2012-2023), these findings demonstrate that the increasing digitalization of the banking sector supports its capital stability.

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