THE EFFECT OF DIGITAL
TRANSFORMATION ON UKRAINIAN
BANKS' PERFORMANCE

by

Valerii Kulalaiev

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Thesis Supervisor: _____ Professor Olesia Verchenko

Approved by _____
          Head of the KSE Defense Committee, Professor [Type surname, name]

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          Date _____

ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS

AC Active Cards

BR Branches

CE Commission Expenses

CIR Cost-to-Income Ratio

CR Commission Revenue

DEP_OP Deposit Opening

DP Deposit Portfolio

DT Digital Transformation

IB Internet Banking

LOA_ACQ Loan Acquiring

LP Loan Portfolio

LT Long-term

MB Mobile Banking

NBU National Bank of Ukraine

NCR Net Commission Revenue

NI Net Income

NIR Net Interest Revenue

OOR Other Operating Revenue

OPEX Operating Expenses

RDP Retail Deposit Portfolio

RIE Retail Interest Expenses

RIR Retail Interest Revenue

RLP Retail Loan Portfolio

RNIR Retail Net Interest Revenue

ROA Return on Assets

ROE Return on Equity

SS Self-Service Devices

ST Short-term

TA Total Assets

TE Total Equity

TIE Total Interest Expenses

TIR Total Interest Revenue

TL Total Liabilities

TOR Total Operating Revenue

CHAPTER 1. INTRODUCTION

One of the most important factors of banking system stability is the success of the banks' financial performance, especially profitability. Crisis occurrences in Ukraine caused by the War in 2014-2022 and COVID-19 in 2020 catalyze the necessity of banks to optimize their operations both on the client experience with necessary services and operational efficiency. Digital transformation is one of the most crucial sets of activities that improves banks' financial performance and might strengthen the stability of the whole system.

There have been plenty of empirical studies on digital transformation elements' impact on the performance of companies, starting from the middle of the 20th century. The first quantitative evidence of IT-related tools and services' efficient integration into commercial operations was provided by Woodward (1959), Burns and Stalker (1961), and Hickson (1969). They have shown the potential for financial improvements for organizations with the integration of innovations.

With the development and increase of technological penetration, "digital transformation" components implementation impact had become an interesting research field (Agbolade (2011), Arora (2013), etc.), as banks are unique holders of a significant amount of client data and providers of a varied bunch of services for their customers. Thus, the profitability indicator may be optimized by the IT investments either on the revenue side or the costs (operational) side of the business.

However, there is still no strong evidence of the positive impact of digital transformation on banks' profitability, considering European countries and especially Ukraine. There are still no quantitative studies, which explore the effect of digital tools integration on the financial performance of the Ukrainian banks, especially with distribution on short and long-term perspectives. Moreover, the absolute majority of related research from Asia and North Africa focuses on high-level indicators, which may be impacted by the non-relevant to digital transformation macro-factors, thus being less accurate.

The goal of this study is to analyze the effect of digital transformation elements of banking operations (new products or services and optimized banking branches) on specific financial performance indicators with a newly developed methodology. This is the first quantitative study of digital transformation's impact on banks' financial performance in Ukraine.

The study is aimed to answer the following research questions:

1. Does digital transformation affect the financial performance of Ukrainian banks significantly both in the short- and long-term?

2. Is the effect of digital transformation on profitability indicators negative in the short-term and positive in the long-term?

The following hypothesis will be tested in this research:

Hypothesis 1: Digital Transformation (integration of digital distribution channels, products & services, etc.) has a positive effect on the profitability indicators of banking performance in the long-term.

Hypothesis 2: Digital Transformation (integration of digital distribution channels, products and services, etc.) has a negative effect on the profitability indicators of banking performance in the short-term.

This research uses panel data econometric models with a newly developed methodology, which comes from strategies and operations consulting projects aimed at improving the performance of financial institutions in Ukraine. The data has been collected from the National Bank of Ukraine website, official websites of Ukrainian banks, relevant industry reports, data aggregators and mobile apps stores.

The remaining content of this thesis is organized in such a manner. Chapter 2 provides an overview of the Ukrainian banking industry and relevant studies. Next, in Chapter 3 the methodology of this paper is shown with regression equations and clarification of short- and long-term approaches. Further, Chapter 4 provides a description of the data used. In Chapter 5 key results of the regression analysis are presented and interpreted. And finally, Chapter 6 is aimed to construct a conclusion on the received results and provide recommendations for banking sector players and further research.

CHAPTER 2. INDUSTRY OVERVIEW AND RELATED STUDIES

2.1. Early studies on technologies' impact on enterprise performance

The effect of implementing new technologies into companies' business and operating models has received a relatively large amount of attention in the literature since the middle of the last century. The first studies were focused on task technology production impact evaluation in industrial companies (Woodward 1959, Hickson et al. 1969, Burns and Stalker 1961, Blauetal. 1976). These researches were aimed to assess the effect of new organizational technologies (activities structuring, workflow controlling, procedures standardization, roles formalization, etc.) on firm production volume and % of manufacturing defects. Although the number of relevant studies was not so massive to prove the hypothesis of the positive impact of technology implementation, the authors found a positive correlation between organizational innovations integration and increased production, which might be an indicator of implicit evidence.

Decades ahead, when informational technologies penetrated industries widely, at first, there was no significant convincing evidence that such investments considerably impact financial performance positively, especially in the service sector (Roach 1988). Some studies in the 1980s focused on the evaluation of technology investments' impact on a firm value and found little evidence of positive results (Kauffman and Weill 1989). However, the number of studies was not so significant, and a lack of considerable evidence was common. The reasons for it might be broad: from the unclear definition of informational technology to significant variation in units analyzed or different measurement methodologies.

With industrial technological development in the late 1990s, the researchers finally found strong evidence of improved financial performance (profitability) thanks to innovations implementation as one of the production factors, alongside labor and capital (Dewan and Min, 1997), and especially in cost drivers (Mitra and Chaya, 1996).

2.2. Digital transformation impact on banking performance studies

As the banking sector is usually an early adaptor of new technologies, considering the variety of operations that it holds both internally and externally, the first studies about digital tools integration in banking operational and business models were published in the 1990s and focused on improvements' evaluation of the banks' financial performance after innovations integration or investments into informational technologies.

The convincing evidence of the financial performance improvements after informational technology investments was presented in various studies. For example, Berger in his research suggests "improvements in costs and lending capacity" as a result of technology tools integration into an internal operational model and "consumer benefits" as a result of innovations implemented into the banks' business models (Berger, 2003).

Jalal-Karim and Hamdan (2010), in their study also break down banking operations into financial and operational performance parts. From the financial side, they evaluate the effect of investments in Hardware, Internet Banking, the number of ATMs, cyber-branches, SMS banking, etc., on Market Value-Added, Return on Investment, and Earnings per Share. From the operational side, they assess the impact of information technology investments on Net Profit Margin, Operating Return on Assets, and Employee Profitability. They found strong evidence of the positive effects of IT investments on the Market Value Added, Earnings per Share, Return on Assets, and Net Profit Margin for Jordanian banks.

Agbolade (2011), in his research, presents significant evidence of a relationship between the investments and the adoption of Information and Communication Technology and banks' organizational performance in the form of profitability in Nigeria. He found that a marginal change in the level of investments and adoption of ICT will result in an increase in the level of profit. He confirms it with the factor analysis in which the absence of ICT implementation results in a low change in organizational performance.

Arora (2013), in his study, also tried to find evidence of a connection between investments in information technology and banks' performance in the forms of the amount of Operating Profits, Profits per Employee, Business per Employee, and Return on Assets in the Indian public sector banks. With the help of two-stage GLS and GMM models, the statistically significant positive impacts of IT investments were found on Operating Profits and Profits per Employee. So, in that case, substantial evidence was noticed for profitability and the amount of profit.

However, some other studies show the absence or negative effect of innovation integration on banks' financial performance. For example, Akhisar and Tunay (2015), in their research covering the data from 23 developed and developing countries, have tried to find evidence of the relationship between digital banking services customers' penetration and profitability measurements: Return on Assets and Return on Equity. Results show that the relationship between profitability and electronic banking services penetration is insignificant.

2.3. Ukrainian digital banking overview

The amount of digital operations in the Ukrainian banking industry has been overgrowing over the previous five years, especially relative to other financial services subsectors: insurers, investment funds, stock market operators, etc. The key factors of such fast growth may be an increase in domestic consumption, digital tools penetration, and rising tolerance to online banking operations in cases of trust and security.

Despite the Russian-Ukrainian War, domestic consumption had a stable growth from 2016 until the COVID crisis in 2020. The compound annual growth rate of real wages has reached 10-15% in most industries, causing an increase in total consumer demand. In turn, that had become a catalyzer for the growth of transactional and payments services, savings maintenance, currency exchange, consumer loans, etc.

The internet penetration reached about 72% of the total population in Ukraine at the beginning of 2022, showing the 5-7 p. p. compound annual growth rate from 2016. Simultaneously, the increase in smartphone population coverage, jointly with the

simplification and expansion of digital services availability, has resulted in the rapid growth of digital tool usage. Such digital phenomena as "Diia" – government services platform or "Prozorro" – a government e-procurement system, showed the significant potential of the population of Ukraine in adopting new digital instruments.

Moreover, the increased tolerance of online banking operations in cases of trust and security may be another significant factor in digital banking's rapid growth. The underestimated factor of increased credibility of the Ukrainian banking system might be the successful reforms of the National Bank of Ukraine focused mainly on the "purification" from banks that may probably collapse in case of occurring crisis. The attention from the media and society on the transformation process triggered a severe interest in banking transparency and the reputation of its stakeholders. Increased credence to banks that had gotten through the 2015-2016 reform and strengthened supervision from the National Bank of Ukraine and society through the last six years might be an undisputable factor of digital banking operations growth.

As mentioned before, the Ukrainian banking system went through fundamental reform in 2015-2016, resulting in a dramatic drop in the number of banks in Ukraine from nearly 180 at the beginning of 2015 to about 70 at the end of 2021. However, the banking system's total assets have doubled (from 1.2 to 2.4 UAH trillion) through the observed period. Moreover, the amount of equity increased by 2.5 times from around 100 to 255 UAH billion. That is the result of the new capital size regulations provided by NBU called to improve the stability and risk resistance of the Ukrainian banking sector. All this led the industry to the massive achievement of turning from non-profit conditions (160 UAH billion total losses of the banking system; -115% ROE; -12% ROA in 2016) to highly profitable operations (77 UAH billion total profit; 32% ROE; 3% ROA in 2021) (Figure 1).

Figure 1. Ukrainian banking system ROA Dynamics (2016-2021), %

56 p. p.

1%   3%   2%   3%

-13%

2016   2018   2019   2020   2021
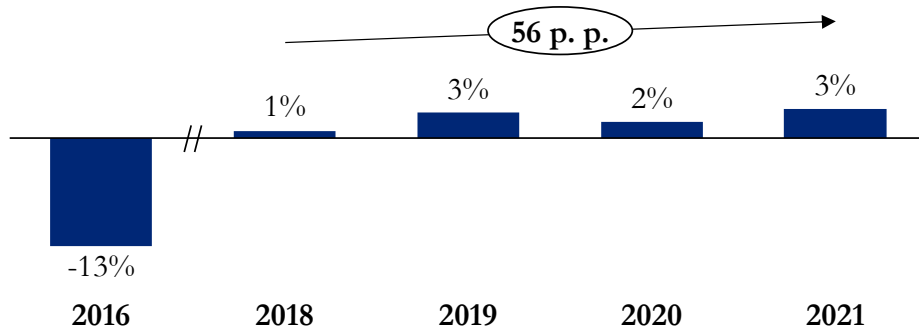
Source: National Bank of Ukraine

Moreover, the total number of banking branches reduced dramatically from around 10 to 6 thousand over the previous six years. However, the number of active cards increased from 30 to 46 million, which resulted in the total reinvention of customer experience and cost optimization, as well as profitability (Figure 2).

Figure 2. Commission revenue / Active cards Dynamics (2016-2021), thsd UAH

+7%

0.75   1.02   1.04   1.15   1.25

2016   2018   2019   2020   2021
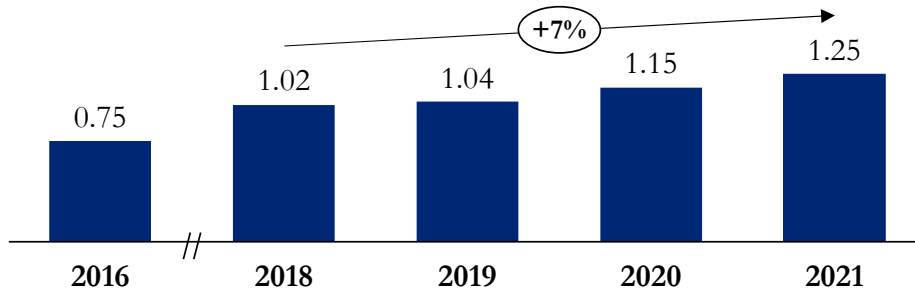
Source: National Bank of Ukraine

The Ukrainian digital banking subsector is presented by ~50 banks, which provide internet- or mobile banking services, such as P2P transactions, payments, currency exchange, loan or deposit operations, etc., either for "retail," "small and medium enterprises," or "corporate" business streams. Moreover, such banks also

focus on operational efficiency enhancement by reducing or reorganizing old banking branches, integrating new self-service systems, and increasing non-cash operations.

2.4. Relevance of the study

While the positive effect of banking digital transformation on financial performance in developing countries of Asia found strong evidence in various studies, the European banking sector's information technology integration impact on profitability remains insufficiently explored. This research is an opportunity to add to the existing literature about banking digitalization with the aim of a scope extension and a methodology deepening.

First, studies about digital transformation with a focus on both operational and business models in banking with the use of panel data are extremely rare, even in the Asian region, where there is strong evidence of the significance of informational technologies' impact on financial performance.

Second, there has been no quantitative study on the evaluation of digital transformation's impact on profitability or any other financial indicator in the Ukrainian banking sector.

Finally, the existing methodology of related European and Asian studies with high-level indicators such as ROA, ROE, Operating Profit, etc., is insufficient to analyze and assess the real potential changes in banking performance. Thus, a new methodology, previously applied in strategy and operations management consulting projects, was used.

CHAPTER 3. METHODOLOGY

The methodology presented in this paper is based on various studies focused on evaluating information technology tools integration and investments on both operational (internal) and business (external) levels of banking operations with a management consulting deep approach in the detailed micro-level indicators, such as NCR/AC, NCR/DP, CIR, etc.

First, the hypothesis of the significant impact of external digital banking tools integration on the revenue side of banking operations indicators will be tested. Second, the hypothesis of the significant impact of internal digital banking tools integration on the cost side of banking operations indicators will be tested. The effects of digital banking tools implementation will be tested in the short term (up to 1 year, quarterly) and in the long term (on the horizon of 3-5 years, yearly).

3.1. Digital transformation in banking definition

Digital transformation is a process of integration of digital technology features and tools into all areas of business, with the foundational change in value creation and operations. Banking digital transformation consists of two sides: business model digital transformation and operational model digital transformation.

Business model digital transformation characteristics in this paper will be presented by the Internet- and Mobile-banking general availability and the considerable available products (P2P transactions/payments, deposit opening, currency exchange, and loan acquiring, etc.). They will be used in a form of dummy variables.

Operational model digital transformation characteristics in this paper will be presented by the number of working branches, a number of self-service appliances (including a number of automated teller machines (ATMs), and a number of payment terminals.

3.2. Digital transformation effect on the revenue side of banking performance

To test the first hypothesis that digital transformation (integration of digital distribution channels, products, and services, etc.) has a positive effect on the revenue (business) side indicators of banking performance, the following regressions are used.

1. Evaluation of the effect of the Internet-/Mobile-banking launching on the Net Commission Revenue / Active Cards indicator:

$$NCR/AC = \beta_0 + \beta_{1A}IB_t\ (\beta_{1B}MB_t) + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it} \qquad (1a\ (1b))$$

The dependent variable is defined as Net Commission Revenue / Active Cards – the ratio of a difference between Commission Revenue and Commission Expenses to a Number of Active Cards. The variable of interest is MB or IB – the dummy variable that characterizes the general availability of the internet-/mobile-banking (with P2P transactions, Payments, and Currency exchange services) to the bank's retail, SME, and corporate clients. A statistically significant and positive effect of the coefficient $\beta1$ would suggest the Internet-/Mobile-banking positive impact on the company's average Net Commission Revenue, thus supporting our hypothesis.

Control variables are the following:

- TA – ln (Total Assets);
- TOR – ln (Total Operating Revenue);
- Br – Number of physical branches;

2. Evaluation of the effect of the Internet-/Mobile-banking launching on the Net Commission Revenue / Deposit Portfolio indicator:

$$NCR/DP = \beta_0 + \beta_{1A}IB_t\ (\beta_{1B}MB_t) + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it} \qquad (2a\ (2b))$$

The dependent variable is defined as Net Commission Revenue / Deposit Portfolio – the ratio of a difference between Commission Revenue and Commission Expenses to a

Deposit Portfolio (average). The variable of interest is MB or IB – the dummy variable that characterizes the general availability of the internet-/mobile-banking (with P2P transactions, Payments, and Currency exchange services) to the bank's retail, SME, and corporate clients. A statistically significant and positive effect of the coefficient β1 would suggest the Internet-/Mobile-banking positive impact on company deposits' efficient utilization, thus supporting our hypothesis.

Control variables are the following:

- TA – ln (Total Assets);
- TOR – ln (Total Operating Revenue);
- Br – Number of physical branches;

3. Evaluation of the effect of the Internet-/Mobile-banking deposit opening availability launching on the Interest Expenses / Deposit portfolio indicator:

$$RIE/RDP = \beta_0 + \beta_1 DO_t + \beta_2 ln(RLP)_t + \beta_3 ln(TOR)_t + u_{it} \qquad (3)$$

The dependent variable is defined as Retail Interest Expenses / Retail Deposit Portfolio – the ratio of Retail Interest Expenses to a Retail Deposit Portfolio (average). The variable of interest is DO – the dummy variable that characterizes the availability of opening the deposit in the internet-/mobile-banking to the bank's retail clients. A statistically significant and negative effect of the coefficient β1 would suggest the Internet-/Mobile-banking positive impact on company deposits' acquiring profitability, thus supporting our hypothesis.

Control variables are the following:

- RLP – ln (Retail loan portfolio);
- TOR – ln (Total Operating Revenue);

4. Evaluation of the effect of the Internet-/Mobile-banking loan acquiring availability launching on the Net Interest Revenue / Loan portfolio indicator:

$$RNIR/RLP = \beta_0 + \beta_1 LA_t + \beta_2 ln(RDP)_t + \beta_3 ln(TOR)_t + u_{it} \qquad (4)$$

The dependent variable is defined as Retail Net Interest Revenue / Retail Loan Portfolio – the ratio of a difference between Retail Interest Revenue and Retail Interest Expenses to a Retail Loan Portfolio (average). The variable of interest is LA – the dummy variable that characterizes the availability of acquiring the loan in the internet-/mobile-banking to the bank's retail clients. A statistically significant and positive effect of the coefficient β1 would suggest the Internet-/Mobile-banking positive impact on company Retail Net Interest Revenue, thus supporting our hypothesis.

Control variables are the following:

- RLP – ln (Retail loan portfolio);
- TOR – ln (Total Operating Revenue);

To test the second hypothesis that digital transformation (internal operational processes' digitalization and innovations integration) has a negative effect on the costs (operational) side indicators of banking performance, the following regression is used.

5. Evaluation of the effect of the Operational processes' optimization on the Cost-Income ratio:

$$CIR = \beta_0 + \beta_1 Br_t + \beta_2 SS_t + \beta_3 TERM_t + \beta_4 ln(TA)_t + \beta_5 ln(TOR)_t + u_{it} \qquad (5)$$

The dependent variable is defined as the Cost-Income ratio – the ratio of Operating Costs to an Operating Income. The variables of interest are Br – the number of branches operating, SS – the number of self-service appliances operating, and TERM – the number of payment terminals operating. A statistically significant and negative effect of the coefficient β_1, and a positive effect of the coefficients β_2, and β_3 would suggest the digital optimization's positive impact on the company's Cost-Income Ratio, thus supporting our hypothesis.

Control variables are the following:

- TA – ln (Total Assets);
- TOR – ln (Total Operating Revenue)

3.3. Evaluation of the effects from a short and a long-term perspective

Panel data models 1-4 will be tested both from a short-term and a long-term perspective. To assess the impact in the short term, the panel data regression models will be used with a four-quarter step. To evaluate the effect in the long term, the panel data regression models will be used with a twelve-twenty quarter step.

Such an approach will help to test the hypothesis that digital transformation affects financial performance negatively before and right after the launch of the digital transformation process and positively with a 3–5-year lag after the majority of the client base adapts to the new digital features of the bank.

CHAPTER 4. DATA

The primary data has been collected from the National Bank of Ukraine Statistics service. The dataset is provided with the quarterly data for the period from December 2015 to December 2021 due to availability and ease of data collection (portability of the datasets). Moreover, it was more logical to collect the data after the banking system transformation: (1) due to massive reorganizations of the sector. A lot of banks collapsed due to the crisis of 2009 and 2014, which might negatively affect the model. (2) Also, exactly after the NBU reforms, banks started to invest in digital tools (both on the business and operational sides). Furthermore, data from the banks that have collapsed through the observation period was dropped and data from the banks that operate extraordinarily (without physical branches, active cards, and/or full focus on corporate business) was also dropped as either an outlier or a "N/A" typo.

The additional data on digital product implementation periods had been collected from the official websites of the banks, information from the mobile app stores, and industry reports (either web aggregators or publications).

The relevant variables and their descriptions are provided below:

- Total assets – the sum of Total non-current assets and Total current assets (incl. loans);
- Loan portfolio – the sum of retail and corporate loan portfolio;
- Retail loan portfolio – the sum of all provided funds to the retail clients (individuals and (in some cases) individual entrepreneurs);
- Total liabilities – all current and non-current liabilities, including both short-term and long-term debt (incl. deposits);
- Deposit portfolio – the sum of retail and corporate deposit portfolio;
- Retail deposit portfolio – the sum of all acquired funds from the retail clients (individuals and (in some cases) individual entrepreneurs);

- Total operating revenue – the sum of net interest revenue, net commission revenue, other operating revenue, and a trade result;

- Total interest revenue – the sum of retail interest revenue and corporate interest revenue (incomes from the provided loans);

- Total interest expenses – the sum of retail interest expenses and corporate interest expenses (outcomes to the acquired deposits);

- Net interest revenue – the difference between total interest revenue and total interest expenses;

- Retail interest revenue – incomes from the provided loans to the retail customers (individuals and (in some cases) individual entrepreneurs);

- Retail interest expenses – outcomes to the acquired deposits from the retail customers (individuals and (in some cases) individual entrepreneurs);

- Retail net interest revenue – the difference between retail interest revenue and retail interest expenses;

- Commission revenue – incomes from the provided transactional services;

- Commission expenses – outcomes to the provided transactional services;

- Net commission revenue – the difference between commission revenue and commission expenses;

- Operational expenses – banking operations expenses (administrative expenses, staff expenses, marketing costs, assets maintenance, etc.).

- Net income/loss – bank's profit/loss after taxes;

- Total Equity – the sum of capital equity and retained earnings;

- Active cards – the total number of issued cards for which at least one spending transaction was made during the reporting period (1 quarter);

- Self-service banking devices – the total number of active self-service banking devices;

- Payment terminals – the total number of active payment terminals.

- Branches – total number of active banking branches;

- Calculated expected dependent variables: Net Commission Revenue / Active Cards, Net Commission Revenue / Deposit Portfolio, Retail Interest Expenses / Retail Deposit Portfolio, Retail Net Interest Revenue / Retail Loan Portfolio, Cost-to-Income Ratio – described in the previous chapter.

The variables of interest are dummy variables: IB, MB, DEP_OP, and LOA_ACQ, which are described in the previous chapter. The dataset consists of 25 quarterly periods in which financial and operational data of ~60 Ukrainian banks is presented. For long-term period analysis, the yearly panel data was used without any adjustments. For short-term period analysis, the panel data was adjusted for banks which implemented digital tools within the observation period (2016-2021) with a four-quarter lag.

The summary statistics of long-term and short-term datasets regarding other relevant variables are presented in Tables A.1-5.

CHAPTER 5. RESULTS

5.1. Long-term effect of digital transformation on banking financial performance

In order to evaluate the effect of the Internet-/Mobile-banking launching on the Net Commission Revenue / Active Cards indicator, IB and MB dummy variables were regressed on the NCR/AC ratio, using Equations 1a and 1b. The control variables were described in the Methodology chapter.

According to the results presented in Table 1a, the long-term effect of internet-banking integration on the average net commission revenue per client is positive and statistically significant at a 1% confidence level. Thus, the hypothesis of the positive impact of internet-bank implementation on NCR/AC business indicator is supported.

However, the results presented in Table 1b show that the long-term effect of mobile-banking integration on the average net commission revenue per client is not statistically significant. Thus, the hypothesis of the significant and positive impact of mobile-bank implementation on NCR/AC business indicator is not supported. Such results may be caused by the relatively low mobile customer base of observed banks.

Table 1a. Internet banking availability long-term effect on the NCR/AC indicator

The results of the following regression are reported:

$$NCR/AC = \beta_0 + \beta_1 IB_t + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it}$$

The dependent variable is the ratio of the net commission revenue of the bank to the total amount of active cards. Individual fixed effects are estimated but not reported.

IB_t	**7.853****
	(3.00)
$ln\ (TA)_t$	1.749
	(3.19)
$ln\ (TOR)_t$	7.049*
	(3.01)
BR_t	0.004
	(0.01)
No. of observations	233
R^2	0.16

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

Table 1b. Mobile banking availability long-term effect on the NCR/AC indicator

The results of the following regression are reported:

$$NCR/AC = \beta_0 + \beta_1 MB_t + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it}$$

The dependent variable is the ratio of the net commission revenue of the bank to the total amount of active cards. Individual fixed effects are estimated but not reported.

MB_t	**-3.055**
	(2.63)
$ln\ (TA)_t$	5.123
	(3.40)
$ln\ (TOR)_t$	7.487*
	(3.05)
BR_t	0.004
	(0.01)
No. of observations	233
R^2	0.14

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

To evaluate the effect of the Internet-/Mobile-banking launching on the Net Commission Revenue / Deposit Portfolio indicator, IB and MB dummy variables were

regressed on the NCR/DP ratio, using Equations 2a and 2b. The control variables were described in the Methodology chapter.

According to the results presented in both Tables 2a and 2b, the long-term effect of the internet- or mobile-banking integration on the deposit portfolio utilization efficiency is statistically insignificant. Thus, the hypothesis of the significant and positive impact of the internet- and mobile-bank implementation on NCR/DP business indicator is not supported. Such results may be caused by unrelated factors that may influence the deposit portfolio of the commercial bank.

Table 2a. Internet banking availability long-term effect on the NCR/DP indicator

The results of the following regression are reported:

$$NCR/DP = \beta_0 + \beta_1 IB_t + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it}$$

The dependent variable is the ratio of the net commission revenue of the bank to the deposit portfolio. Individual fixed effects are estimated but not reported.

IB_t	**0.002** **(0.00)**
ln $(TA)_t$	-0.035*** (0.00)
ln $(TOR)_t$	0.004*** (0.00)
BR_t	0.000 (0.00)
No. of observations R^2	233 0.13

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

Table 2b. Mobile banking availability long-term effect on the NCR/DP indicator

The results of the following regression are reported:

$$NCR/DP = \beta_0 + \beta_1 MB_t + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it}$$

The dependent variable is the ratio of the net commission revenue of the bank to the deposit portfolio. Individual fixed effects are estimated but not reported.

MB_t	**-0.002** **(0.00)**
ln $(TA)_t$	-0.033*** (0.00)
ln $(TOR)_t$	0.036*** (0.00)
BR_t	0.000 (0.00)
No. of observations	233
R^2	0.13

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

In order to evaluate the effect of the Internet-/Mobile-banking deposit opening availability launching on the Retail Interest Expenses / Retail Deposit Portfolio indicator, the DEP_OP dummy variable was regressed on RIE/RDP ratio, using Equation 3. The control variables were described in the Methodology chapter.

According to the results presented in Table 3, the long-term effect of internet-/mobile-banking deposit launching availability integration on the retail interest expenses and retail deposit portfolio ratio is negative and statistically significant at a 1% confidence level. Thus, the hypothesis of the significant and positive impact of such internet- / mobile-bank feature implementation on company deposits' acquiring profitability is supported.

Table 3. Deposit opening IB/MB feature long-term effect on the RIE/RDP indicator

The results of the following regression are reported:

$$RIE/RDP = \beta_0 + \beta_1 DO_t + \beta_2 ln(RLP)_t + \beta_3 ln(TOR)_t + u_{it}$$

The dependent variable is the ratio of the retail interest expenses of the bank to the retail deposit portfolio. Individual fixed effects are estimated but not reported.

DO_t	**-0.014****
	(0.00)
ln $(RLP)_t$	-0.000*
	(0.00)
ln $(TOR)_t$	-0.021***
	(3.01)
No. of observations	233
R^2	0.33

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

To evaluate the effect of the Internet-/Mobile-banking loan acquiring availability launching on the Net Interest Revenue / Loan portfolio indicator, the LOA_ACQ dummy variable was regressed on RNIR/RLP ratio, using Equation 4. The control variables were described in the Methodology chapter.

According to the results presented in Table 4, the long-term effect of the internet- or mobile-banking loan-acquiring feature integration on the retail net interest revenue is statistically insignificant. Thus, the hypothesis of the significant and positive impact of such internet- and mobile-bank function implementation on loan portfolio utilization efficiency business indicator is not supported. Such results may be caused by unrelated factors that may influence the loan portfolio of the commercial bank.

Table 4. Loan acquiring IB/MB feature long-term effect on the RNIR/RLP indicator

The results of the following regression are reported:

$$RNIR/RLP = \beta_0 + \beta_1 LA_t + \beta_2 ln(RDP)_t + \beta_3 ln(TOR)_t + u_{it}$$

The dependent variable is the ratio of the retail net interest revenue of the bank to the retail loan portfolio. Individual fixed effects are estimated but not reported.

LA_t	**0.277**
	(0.68)
ln $(RDP)_t$	-1.356**
	(0.44)
ln $(TOR)_t$	1.683***
	(0.37)
No. of observations	230
R^2	0.08

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

In order to evaluate the effect of the Operational processes' optimization on the Cost-to-Income indicator, the BR, SS, and TERM variables were regressed on the CIR ratio, using Equation 5. The control variables were described in the Methodology chapter.

According to the results presented in Table 5, the long-term effect of physical banking branches' net optimization on the cost-income ratio is statistically insignificant. Thus, the hypothesis of the significant and positive impact of this type of operational optimization is not supported statistically. Such results may be caused by the complexity of the CIR indicator, which may be affected by a variety of other factors which are unrelated to the model.

Table 5. Operational optimization's long-term effect on the CIR indicator

The results of the following regression are reported:

$$CIR = \beta_0 + \beta_1 Br_t + \beta_2 SS_t + \beta_3 TERM_t + \beta_4 ln(TA)_t + \beta_5 ln(DP)_t + u_{it}$$

The dependent variable is the ratio of the operating expenses of the bank to the total operating revenue. Individual fixed effects are estimated but not reported.

BR_t	**0.000**
	(0.00)
SS_t	**0.000**
	(0.00)
$TERM_t$	**0.000**
	(0.00)
$ln(TA)_t$	-0.395**
	(0.02)
$ln(DP)_t$	0.290*
	(0.02)
No. of observations	233
R^2	0.03

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

5.2. Short-term effect of digital transformation on banking financial performance

In order to evaluate the effects in the short-term period, adjusted datasets were used. However, the initial Equations 1-5 remained the same.

According to the results presented in Table 6a, the short-term effect of internet-banking integration on the average net commission revenue per client is negative and statistically insignificant. Thus, the hypothesis of the negative impact of internet-bank implementation on NCR/AC business indicator in the short-term period is not supported.

Moreover, the results presented in Table 6b show that the short-term effect of mobile-banking integration on the average net commission revenue per client is not statistically significant. Thus, the hypothesis of the negative impact of mobile-bank implementation on NCR/AC business indicator in the short-term period is also not supported.

Table 6a. Internet banking availability short-term effect on the NCR/AC indicator

The results of the following regression are reported:

$$NCR/AC = \beta_0 + \beta_1 IB_t + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it}$$

The dependent variable is the ratio of the net commission revenue of the bank to the total amount of active cards. Individual fixed effects are estimated but not reported.

IB_t	**-48.338**
	(138.42)
ln $(TA)_t$	-1045.206***
	(272.22)
ln $(TOR)_t$	-200.752
	(143.22)
Br_t	3.702
	(11.40)
No. of observations	161
R^2	0.15

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

Table 6b. Mobile banking availability short-term effect on the NCR/AC indicator

The results of the following regression are reported:

$$NCR/AC = \beta_0 + \beta_1 MB_t + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it}$$

The dependent variable is the ratio of the net commission revenue of the bank to the total amount of active cards. Individual fixed effects are estimated but not reported.

MB_t	**-0.902**
	(1.62)
ln $(TA)_t$	2.190
	(3.52)
ln $(TOR)_t$	2.307
	(2.63)
Br_t	0.003
	(0.02)
No. of observations	203
R^2	0.01

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

According to the results presented in both Tables 7a and 7b, the short-term effect of the internet- or mobile-banking integration on the deposit portfolio utilization

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efficiency is positive and statistically significant (in the IB case). Thus, the hypothesis of the negative impact of the internet- and mobile-bank implementation on NCR/DP business indicator is not supported. Such results may be caused by unrelated factors that may influence the deposit portfolio of the commercial bank. However, the results show evidence of a potential "quick win" for a bank in launching the internet bank to increase the profitability of customer acquisition.

Table 7a. Internet banking availability short-term effect on the NCR/DP indicator

The results of the following regression are reported:

$$NCR/DP = \beta_0 + \beta_1 IB_t + \beta_2 ln(TA)_t + \beta_3 ln(TOR)_t + Br_t + u_{it}$$

The dependent variable is the ratio of the net commission revenue of the bank to the deposit portfolio. Individual fixed effects are estimated but not reported.

IB_t	**0.011***
	(0.01)
$ln\,(TA)_t$	-0.040***
	(0.01)
$ln\,(TOR)_t$	0.014**
	(143.217)
Br_t	-0.000
	(0.00)
No. of observations	161
R^2	0.07

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

Table 7b. Mobile banking availability short-term effect on the NCR/DP indicator

The results of the following regression are reported:

$$NCR/DP = \beta_0 + \beta_1 MB_t + \beta_2 ln(DP)_t + \beta_3 ln(TOR)_t + Br + u_{it}$$

The dependent variable is the ratio of the net commission revenue of the bank to the deposit portfolio. Individual fixed effects are estimated but not reported.

MB_t	**0.002**
	(0.00)
ln $(DP)_t$	-0.012**
	(0.00)
ln $(TOR)_t$	0.002***
	(0.00)
Br_t	0.000
	(0.00)
No. of observations	204
R^2	0.11

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

According to the results presented in Table 8, the short-term effect of internet-/mobile-banking deposit launching availability integration on the retail interest expenses and retail deposit portfolio ratio is negative and statistically significant at a 1% confidence level. Thus, the hypothesis of the negative impact of such internet- / mobile-bank feature implementation on company deposits' acquiring profitability is not supported, however the results show a potential "quick win" to the bank, as company deposits' acquiring profitability may increase in a short term.

Table 8. Deposit opening IB/MB feature short-term effect on the RIE/RDP indicator

The results of the following regression are reported:

$$RIE/RDP = \beta_0 + \beta_1 DO_t + \beta_2 RLP_t + \beta_3 ln(TOR)_t + u_{it}$$

The dependent variable is the ratio of the retail interest expenses of the bank to the retail deposit portfolio. Individual fixed effects are estimated but not reported.

DO_t	**-0.005*****
	(0.00)
RLP_t	0.00
	(00.00)
ln $(TOR)_t$	-0.008***
	(0.00)
No. of observations	106
R^2	0.18

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

According to the results presented in Table 9, the short-term effect of the internet- or mobile-banking loan-acquiring feature integration on the retail net interest revenue is statistically insignificant. Thus, the hypothesis of the negative impact of such internet- and mobile-bank function implementation on loan portfolio utilization efficiency business indicator is not supported. Such results may be caused by the unrelated factors that may influence the loan portfolio of the commercial bank.

Table 9. Loan acquiring IB/MB feature short-term effect on the RNIR/RLP indicator

The results of the following regression are reported:

$$RNIR/RLP = \beta_0 + \beta_1 LA_t + \beta_2 ln(RDP)_t + \beta_3 ln(TOR)_t + u_{it}$$

The dependent variable is the ratio of the retail net interest revenue of the bank to the retail loan portfolio. Individual fixed effects are estimated but not reported.

LA_t	**-0.013** **(0.03)**
ln $(RDP)_t$	-0.019 (0.09)
ln $(TOR)_t$	0.050 (0.04)
No. of observations R^2	44 0.05

t statistics in parentheses; industry fixed effects are not reported in the table
* p <0.1,** p <0.05,*** p <0.01

Moreover, the models were checked for error correlation across the equations for the individual bank with the help of the Seemingly Unrelated Regressions (SUR) methodology, but no additional results were gained, as no significant changes in the models occurred.

5.3. Comparison with the existing body of literature

As it was mentioned in Chapter 2, there are a few papers with a focus on both operational and business models in banking with the use of panel data models and there is no academic research that evaluates digital tools integration effect on banking performance in Europe, thus it is very hard to compare the received results to related studies. Moreover, there are no quantitative studies on the Ukrainian banking sector's digital transformation effect on financial performance evaluation.

However, the existing research focused on effects assessment on high-level indicators (ROA/ROE/OP, etc.) shows different results, either with or without evidence, and both positive and negative effects in the long-term.

CHAPTER 6. CONCLUSIONS AND RECOMMENDATIONS

The goal of this academic paper was to discover and evaluate the effect of digital transformation on the financial performance of Ukrainian banks. To be more specific, two main research questions were set:

1. Does digital transformation affect the financial performance of Ukrainian banks significantly both in the short- and long term?

2. Is the effect of digital transformation on profitability indicators negative in the short term and positive in the long term?

The existing literature answers both questions differently. Some papers find evidence of the significant impact of digital transformation elements on banking performance (Jalal-Karim and Hamdan, 2010), and some of them provide another conclusion (Akhisar and Tunay, 2015). In a bunch of studies, we may find the statistically significant and positive results of IT-related systems or services implementation, and also there are several pieces of research where the impact is privative.

Considering the absence of such quantitative research for the Eastern European banking market of Ukraine with a completely new methodology from management consulting practice and a deeper understanding of the industry specifics, this study is an opportunity to add to the existing literature new methods of validation and assessing the real digital transformation value.

With an updated methodology from the relevant studies of the IT investments impact evaluation, the results provided solid evidence of digital transformation's positive impact on financial performance in the long-term. The Ukrainian banks with the help of launched digital features may become more sustainably profitable than their competitors without internet- / mobile-banking products on the horizon of 3-5 years. Their clients may bring them more commission revenue on average and they use their deposit portfolio more efficiently. The hypothesis of the positive long-term effect of digital transformation on banking financial performance was partially supported.

However, it will be very hard for Ukrainian banks to get a "quick win". There is partial evidence of a non-negative effect on the profitability indicators in the short term, which allows us to support the alternative hypothesis of the negative short-term effect of digital transformation tools integration on banking financial performance. Thus, banks may develop optimized strategies covering both business and operational sides to remain profitable on the horizon of 4 quarters, before and right after the digital features' launch.

Further research may benefit from the deep dive into specifics of banking costs analysis as this paper has not found evidence of the positive impact of physical branches' net optimization on the Cost-to-Income ratio, probably because of insufficient depth of such indicator.

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APPENDIX

Table A.1. Summary statistics of a long-term dataset

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
bank_id	281	29.523	16.76	1	15	43	60
year	281	2018.544	1.705	2016	2017	2020	2021
IB	281	0.765	0.425	0	1	1	1
MB	281	0.52	0.501	0	0	1	1
DEP_OP	281	0.335	0.473	0	0	1	1
LOA_ACQ	281	0.107	0.309	0	0	0	1
TA	281	34654286.216	85085264.205	132695.948	1209353.508	23969047.146	583162255.078
LP	281	10907706.245	18935013.652	2298.73	439975.171	13312655.473	117564950.959
RLP	281	2638157.411	6648497.678	0	19453.61	2687789.809	50487675.054
TL	281	25427522.713	54739511.165	3875.507	860412.83	20226504.63	330965846.161
DP	281	21378324.242	46460095.779	2800.373	802392.014	16020530.853	310310496.659
RDP	281	11060149.154	30779211.392	411.966	323925.714	7377348.652	221926072.638
TOR	281	2494573.321	6221295.385	13338.124	121965.375	2099949.122	53125351.854
TIR	281	2744134.714	5781388.046	13038.661	124587.447	2588078.18	35853529.441
TIE	281	1329926.803	3324368.948	0.241	48512.465	810742.927	29065661.208
NIR	281	1414207.911	3168727.698	-214131.126	67247.01	1490852.546	29316918.577
RIR	281	833788.184	2429240.889	0	4475.764	604550.951	19021038.287
RIE	281	617462.743	1911814.451	0	23943.257	386545.711	17204855.809
RNIR	281	216325.44	1560623.62	-6939566.504	-43550.642	141708.389	12033015.866
CR	281	1147443.009	3581265.157	528.175	46662.003	739440.703	35057118.552
CE	281	362065.401	1121653.557	210.34	5837.122	251405.377	11839816.319
NCR	281	785377.609	2500655.256	-68637.045	33116.269	473048.121	23217302.234
OOR	281	133777.488	316093.429	-1161363.639	4739.929	96483.035	2213912.187
TRADE	281	172972.394	984029.478	-4445154.982	5863.813	96921.263	11696545.865
OPEX	281	1422681.088	3047490.663	12746.665	107823.451	1315046.658	22934950.452
NI	281	163342.728	8905958.386	-135309076.291	2347.794	331059.395	35050410.738
TE	281	3130472.165	7207280.971	77515.997	254394.8	2481915.109	59966749.097
AC	281	816241.48	3238229.152	51	4815	209942	24429820
SS	281	727.114	2987.107	0	10	166	20564
TERM	281	6423.815	28653.471	0	16	588	251089
BR	281	162.021	467.406	0	17	86	3648
ROE	281	0.045	0.661	-8.248	0.007	0.2	0.658
ROA	281	0.007	0.051	-0.55	0.001	0.026	0.103
CIR	281	0.877	0.589	0.245	0.578	1.018	6.749
NCR_AC	281	9.327	22.748	-0.065	1.621	7.074	232.394
NCR_DP	281	0.049	0.051	-0.002	0.025	0.054	0.493
RIE_RDP	281	0.068	0.036	0	0.041	0.087	0.188
RNIR_RLP	278	-1.22	2.629	-23.958	-1.401	0.11	5.556

Table A.2. Summary statistics of a first (IB-adjusted) short-term dataset

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
bank_id	197	31.604	14.718	3	21	42	60
IB	197	0.838	0.37	0	1	1	1
MB	197	0.279	0.45	0	0	1	1
DEP_OP	197	0.152	0.36	0	0	0	1
LOA_ACQ	197	0.036	0.186	0	0	0	1
TA	197	10986799.656	32406443.372	251841.16	1031432.052	5029535.743	227384572.692
LP	197	4715645.42	11473591.814	4082.678	413799.012	3104046.482	64249679.32
RLP	197	628012.273	1374293.097	0	8072.606	311877.214	9227308.784
TL	197	9123689.229	27253118.337	26099.128	713898.355	3908817.193	154127521.031
DP	197	6456758.528	16260049.395	23269.365	653092.384	3420983.275	87115758.278
RDP	197	2601659.534	5180131.167	4013.988	244642.508	2427536.002	24580531.424
TOR	197	807095.802	1686394.042	-115784.306	119253.171	642861.675	9778718.961
TIR	197	1014745.653	2400184.341	20373.454	117613.976	788932.967	13676714.859
TIE	197	518935.725	1632774.563	227.062	40539.882	382145.758	10446696.008
NIR	197	495809.928	1085211.572	-214131.126	59630.93	390489.878	6557575.788
RIR	197	204607.889	550929.583	0	1670.844	61522.431	5713019.627
RIE	197	168158.316	291628.663	124.942	18710.1	229261.432	2006317.505
RNIR	197	36449.574	495878.06	-1934423.616	-47007.079	-245.379	4270764.506
CR	197	286889.623	634399.563	2595.83	29513.363	201662.294	3977987.378
CE	197	89792.309	214037.192	778.618	4048.297	67280.006	1458351.211
NCR	197	197097.314	430805.752	1817.212	25393.659	143987.839	2628342.939
OOR	197	68466.377	235491.358	81.609	3140.369	34317.138	2409973.294
TRADE	197	51393.3	207726.916	-446030.59	3220.524	28140.288	2085977.288
OPEX	197	422756.243	746578.483	30834.795	83952.829	440191.766	4890478.471
NI	197	221508.938	913640.894	-1011106.496	1132.162	89253.229	5795995.363
TE	197	1144344.099	2649981.181	-257793.418	239295.395	588792.95	14803075.919
AC	197	131102.817	381072.755	2	1937	67478	2244859
SS	197	155.452	500.149	0	5	72	2959
TERM	197	1123.503	4299.155	0	3	189	26205
BR	197	52.325	90.746	0	9	59	510
ROE	197	0.11	1.026	-8.248	0.007	0.169	11.307
ROA	197	0.009	0.054	-0.274	0.001	0.033	0.222
CIR	197	1.328	5.053	-4.42	0.55	0.984	63.933
NCR_AC	197	65.138	668.575	0.319	1.765	9.366	9383.065
NCR_DP	197	0.057	0.065	0.002	0.03	0.057	0.405
RIE_RDP	197	0.079	0.037	0.008	0.051	0.096	0.188
RNIR_RLP	192	-9.813	84.216	-1149.501	-1.858	-0.032	5.556

Table A.3. Summary statistics of a second (MB-adjusted) short-term dataset

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
bank_id	249	28.651	15.435	2	15	42	59
IB	249	0.831	0.375	0	1	1	1
MB	249	0.783	0.413	0	1	1	1
DEP_OP	249	0.329	0.471	0	0	1	1
LOA_ACQ	249	0.076	0.266	0	0	0	1
TA	249	22817031.224	47497758.534	330083.789	1497144.749	19661305.663	243519720.652
LP	249	9322182.534	15448780.657	113451.61	604127.594	12436824.894	67791417.128
RLP	249	1294093.582	2081164.863	0	27148.054	2246403.283	10950710.374
TL	249	18292575.515	37983717.228	54264.795	1104632.963	16974515.647	198116692.97
DP	249	14267658.879	27232734.985	38322.579	928962.838	11998077.02	150354038.619
RDP	249	5773200.773	11183605.917	15076.738	406354.443	6036218.461	72261490.27
TOR	249	1475322.379	2421898.198	-4851847.285	148236.578	1625993.052	11199152.65
TIR	249	2103531.154	3812697.131	43631.336	172896.442	2207281.686	20797403.098
TIE	249	1086892.326	2539492.188	1529.797	61274.578	775276.918	14240964.388
NIR	249	1016638.829	1655257.443	-214131.126	105972.512	1101142.15	7211769.101
RIR	249	391742.414	708544.251	-1337.441	6158.452	450647.561	3768414.118
RIE	249	379533.321	905197.069	28.628	27537.856	394196.597	6012300.987
RNIR	249	12209.093	1009666.361	-5277934.46	-54706.746	164859.007	2635825.202
CR	249	519910.656	886934.559	1539.424	61839.895	529046.485	4809697.858
CE	249	160505.309	345167.98	163.97	9247.164	147421.321	2178286.121
NCR	249	359405.347	574803.341	-68637.045	41368.951	359135.04	2812126.38
OOR	249	86925.13	276592.157	-1639145.92	3500.471	69443.403	2409973.294
TRADE	249	26252.181	880588.573	-9788328.256	8242.726	75420.74	3285456.942
OPEX	249	877507.547	1266380.211	31207.713	126252.937	742880.258	6400285.712
NI	249	304377.877	1195912.413	-8296691.265	11312.163	300483.99	5525234.578
TE	249	2056993.217	3521344.585	-20258.541	305217.948	2060543.17	25852787.699
AC	248	299051.758	871838.846	17	8335	154035.25	5439861
SS	248	268.657	655.465	0	15	150.75	5252
TERM	248	1808.641	5640.927	0	17.75	571.5	38794
BR	249	159.514	569.156	0	18	83	4027
ROE	249	0.167	0.745	-1.237	0.033	0.232	11.307
ROA	249	0.018	0.028	-0.096	0.005	0.032	0.222
CIR	249	0.752	0.675	-6.866	0.544	0.94	4.749
NCR_AC	248	10.063	22.001	-0.259	1.561	9.02	201.778
NCR_DP	249	0.042	0.03	-0.015	0.026	0.051	0.19
RIE_RDP	249	0.069	0.036	0.001	0.045	0.088	0.162

Table A.4. Summary statistics of a third (DEP_OP-adjusted) short-term dataset

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
bank_id	124	22.548	13.364	2	10	32	50
IB	124	0.935	0.247	0	1	1	1
MB	124	0.782	0.414	0	1	1	1
DEP_OP	124	0.823	0.384	0	1	1	1
LOA_ACQ	124	0.073	0.26	0	0	0	1
TA	124	28995404.213	57589887.636	778288.744	2670317.766	25889511.381	296813136.85
LP	124	12046583.591	16572578.179	144463.655	963544.342	16422047.314	73230630.637
RLP	124	1960560.689	2046583.713	0	72923.675	3964964.294	6218239.169
TL	124	22589745.45	42871081.21	536241.564	1913327.718	21952105.194	199430538.377
DP	124	18620305.657	33179884.427	527102.778	1736721.075	15878665.397	152443078.873
RDP	124	8851163.823	17859517.689	245795.072	859788.763	8383908.782	93610548.594
TOR	124	2089462.264	2636393.538	84949.359	293740.292	2334571.095	10589616.245
TIR	124	2641806.812	4272137.377	104853.737	329598.428	2568432.21	19819457.915
TIE	124	1255721.244	2971954.58	26937.774	172263.499	1111795.43	14329448.24
NIR	124	1386085.569	1801343.37	-214131.126	127365.118	1616288.323	7064778.874
RIR	124	559468.211	636844.933	-1337.441	19416.665	995502.615	2290892.259
RIE	124	543982.025	1268124.403	9031.943	72454.137	451325.284	6103174.156
RNIR	124	15486.187	1316398.836	-5331421.404	-136156.367	657155.667	1829920.172
CR	124	805023.239	1262924.525	21904.903	101619.217	802850.358	5151215.88
CE	124	256180.839	475616.309	1381.645	18496.563	226898.034	2178286.121
NCR	124	548842.4	804130.379	-68637.045	64439.354	546526.607	3356677.013
OOR	124	124295.84	294999.783	-34966.288	13494.2	93751.574	2409973.294
TRADE	124	36461.74	568457.429	-4357365.696	14859.149	109321.293	1153253.162
OPEX	124	1268723.916	1825585.352	68108.73	296559.401	1286521.465	8939318.525
NI	124	593170.224	1176031.931	-652146.708	16937.374	568548.392	5525234.578
TE	124	3087572.755	5681290.854	-20258.541	301878.795	2939630.148	31169975.997
AC	124	538358.169	1280860.518	427	17355	263959.25	5853620
SS	124	545.79	1349.787	0	11.75	289	6212
TERM	124	4065.315	10795.523	0	26.5	614.25	49150
BR	124	242.548	665.226	3	20	111	3382
ROE	124	0.251	1.033	-1.045	0.044	0.3	11.307
ROA	124	0.019	0.028	-0.096	0.005	0.034	0.098
CIR	124	0.783	0.608	0.188	0.504	0.954	4.749
NCR_AC	124	8.374	14.618	-0.065	1.292	8.78	70.155
NCR_DP	124	0.04	0.021	-0.002	0.024	0.049	0.118
RIE_RDP	124	0.076	0.036	0.008	0.053	0.101	0.16
RNIR_RLP	119	-36.828	393.222	-4290.287	-1.162	0.173	0.441

Table A.5. Summary statistics of a fourth (LOA_ACQ-adjusted) short-term dataset

Variable	N	Mean	Std. Dev.	Min	Pctl. 25	Pctl. 75	Max
bank_id	54	22.296	12.379	6	9	34.75	40
IB	54	0.944	0.231	0	1	1	1
MB	54	0.852	0.359	0	1	1	1
DEP_OP	54	0.852	0.359	0	1	1	1
LOA_ACQ	54	0.815	0.392	0	1	1	1
TA	54	31560677.465	31586738.431	2589087.451	4665459.783	59777513.958	99917236.829
LP	54	13468289.692	13391926.448	331482.832	1606421.512	25142973.466	40318536.048
RLP	54	4638831.844	5051635.995	14243.475	588594.262	5496770.61	19570809.285
TL	54	25219474.971	25013685.141	1490634.362	4113400.328	46840674.992	72436510.648
DP	54	23300604.343	23784807.837	1454082.693	2846755.353	44035157.064	66869223.33
RDP	54	10849538.506	12049228.838	499432.176	1854537.492	16414924.228	41130243.922
TOR	54	3320670.88	3103600.94	181211.109	596304.861	5709090.826	11540470.592
TIR	54	2930029.386	2796239.351	197294.298	599211.527	4319706.997	9818487.993
TIE	54	1045358.287	1270896.757	70462.639	198820.366	904204.002	4275645.897
NIR	54	1884671.1	1656208.627	118175.236	363948.538	3340896.448	5552145.361
RIR	54	1431000.128	1532002.771	12050.915	167472.779	2079663.63	5706650.712
RIE	54	516093.672	721541.366	23943.257	108655.637	719713.677	2576505.049
RNIR	54	914906.456	884881.395	-27119.401	58693.577	1498920.016	3134462.197
CR	54	1140515.288	1196623.628	64099.825	315133.053	1569245.323	4315292.841
CE	54	322909.409	303299.308	9762.426	50830.055	472145.837	1120546.114
NCR	54	817605.879	916169.147	31475.264	107361.069	1101803.347	3194746.727
OOR	54	362625.689	509269.408	7595.911	28204.084	666155.66	2409973.294
TRADE	54	266744.755	354956.26	-502.467	21239.669	387585.864	1593435.804
OPEX	54	1959709.112	1876643.775	135017.246	531487.246	3313126.452	6189481.351
NI	54	671904.713	725721.202	-5606.132	47087.74	1325673.307	2008507.74
TE	54	3233435.751	3167272	265540.608	558990.386	6002405.152	9125127.953
AC	54	426741.37	426887.056	1922	22392.25	759478	1326665
SS	54	317	385.037	0	18	701.75	1080
TERM	54	2657.685	4403.186	0	17	3884.75	15150
BR	54	122.815	106.185	5	17	229.25	283
ROE	54	0.171	0.107	-0.01	0.1	0.245	0.389
ROA	54	0.019	0.012	-0.002	0.01	0.027	0.044
CIR	54	0.639	0.17	0.188	0.527	0.75	1.11
NCR_AC	54	5.089	10.425	0.508	1.392	4.142	58.021
NCR_DP	54	0.043	0.027	0.014	0.026	0.054	0.17
RIE_RDP	54	0.058	0.035	0.006	0.033	0.07	0.144
RNIR_RLP	54	0.13	0.2	-0.396	0.069	0.295	0.412