SIGNIFICANCE OF CREDIT, MARKET, LIQUIDITY, AND OPERATIONAL RISKS IN AFFECTING PROFITABILITY OF UKRAINIAN BANKS

by

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LIST OF ABBREVIATIONS

CoR. Cost of risk

CR. Credit risk

FD. First differences

FE. Fixed effects

FSI. Financial stress index

FX. Foreign exchange rate risk

GDP. Gross domestic product

IR. Interest rate risk

KPR. Key policy rate

LR. Liquidity risk

NIM. Net interest margin

NPL. Non-performing loans

OR. Operational risk

RE. Random effects

ROA. Return on assets

UAH/USD. UAH/USD exchange rate changes

VIF. Variance inflation factor

Abstract

The study investigates the effects of credit, market, liquidity, and operational risks on profitability of the Ukrainian banking system. The academic literature does not explicitly state which type of risk is the most crucial for banks' performance. However, the results of this study show that the impact of risks is heterogenous and nonlinear. The analysis is based on panel data of Ukrainian banks from 2014 to 2025. In addition to analyzing the average effect of these types of risks, local projections are used to estimate the effect of risks over time, and quantile regression is applied to analyze differences among banks with varying levels of profitability. Market risk is proxied by net interest margin (NIM) and yearly percentage change of UAH/USD rate. Credit risk is measured using a non-performing loans ratio (NPL). Bank profitability is estimated using return on assets (ROA). In addition, all examined risks are proxied by banks' assessments, which reflect their perception of such types of risks. The findings reveal that market risk has the most significant impact on banks' profitability, reflecting its impact through interest rate risk. Moreover, the study reveals that inefficient banks are more vulnerable to elevated risks, indicating the importance of improving operational efficiency of banking institutions.

Chapter 1. Introduction

At the beginning of the full-scale invasion, the Ukrainian banking system faced its most severe stress test. Nevertheless, it demonstrated significant resilience: the payment system remained functional and the population was able to access banking services both online and physically in branches. This resilience was supported by strong capitalization and a high liquidity level in the banking sector.

Before the full-scale invasion, the National Bank of Ukraine conducted stress testing of thirty banking institutions, which hold 93% of banking system assets, to assess their ability to withstand shocks outlined in the scenarios ("NBU Approves the Approach to Bank Stress Testing in 2021"). Stress testing is crucial for assessing the financial stability of the banking system, as capital losses of large and systemically important banks during crisis can create systemic risks (*Macroprudential Policy Strategy* 18).

In addition, banks perform internal stress tests for different types of risk, in particular credit, market, liquidity, and operational risks, to be prepared for both market changes and possible further escalation of military actions on the Ukrainian territory. All risks may lead to financial losses, so banks use various scenarios and forecasts to assess the impact on their profitability and capital adequacy to cover these risks and ensure stability.

In this context, the following question arises: how do different types of risk affect banks' profitability? The impact of these risks is not the same for all banks. It depends on the structure of the bank's assets, capital adequacy, and the bank's ability to quickly adapt to various changes in the macrofinancial conditions, such as an economic growth rate, inflation, key policy rate, and the level of financial stress in the country.

The case of Ukraine is unique in today's world. Although there are studies on Ukraine's banking sector, particularly on risk management, most of these papers examine instruments for managing different types of risk (Harkava, Viktoriia et al.; Vovchenko), and even few of them analyze

the impact of risks on banks. For this reason, this study analyzes the impact of each risk individually in a combination with macroeconomic indicators, such as the financial stress index, real GDP growth, and the key policy rate. Furthermore, unlike most previous studies, which focus exclusively on financial indicators (e.g., Vovchenko), this work also includes risk assessments by banks themselves. This allows considering not only financial indicators but also banks' perceptions and subjective assessments of various types of risks. Additionally, the study also analyses whether these effects vary across different time horizons and a distribution of banks' profitability.

Chapter 2. Literature review

In the banking literature, risks are typically classified according to regulatory frameworks. The Basel Committee identifies credit, market, liquidity, and operational risks as key elements of a bank's risk profile (Basel Committee on Banking Supervision, *The Basel Framework*). Similarly, in Ukraine, these risks are considered by the National Bank of Ukraine, and the regulator requires banks to establish a comprehensive risk management system that ensures identification, monitoring, reporting, control, and mitigation of all material risks (*Resolution of the Board of the National Bank of Ukraine No. 64 of 11 June 2018*).

Despite the existence of a generally accepted classification, there is no single opinion in the academic literature regarding which type of risk is the most crucial for banks' performance. Many studies focus on credit risk, reflecting lending as the primary activity of banks (Hrytsenko et al. 20). Moreover, due to the war the share of non-performing loans has significantly increased, indicating heightened credit risk ("Banks' NPL Ratio Rose to 38% in 2022 Due to War"). However, recent studies suggest that credit risk should not be analyzed separately. For instance, Cai and Zhang show that in case of Ukrainian banks credit risk is closely related to liquidity risk, suggesting that different risks may jointly affect banks' performance (31–32).

Liquidity risk has become a focus of particular attention after the global financial crisis of 2008, when banks suddenly lost access to funding. Many banks, despite having adequate capital levels, faced difficulties because they failed to manage their liquidity prudently (*Basel III* 2). According to the National Bank of Ukraine, banks do not face liquidity difficulties. Liquidity ratios are three times higher than the minimum requirements (*Financial Stability Report: December 2025* 4).

In contrast to credit and liquidity risks, market risk is considered less substantial during stable periods. Nevertheless, studies show that its impact actually intensifies significantly during macroeconomic shocks through sharp changes in exchange rates and interest rates. According to the

results of the Internal Capital Adequacy Assessment Process (ICAAP) performed by Ukrainian systemically important banks in 2023, under stress conditions, market risk intensifies and becomes five times higher than in baseline scenarios. The primary reason was consideration of interest rate risk on securities, as an increase of the key policy rate reduces their market value (*Financial Stability Report: December 2024* 39). Furthermore, the results of the NBU's stress testing performed in 2025 highlight that interest rate risk is the most critical in the stress testing. This means that changes in interest rates and a narrowing of the spread between asset yields and the cost of liabilities can have the greatest negative impact on a bank's capital (*Financial Stability Report: December 2025* 39). Meanwhile, some studies indicate that exchange rate fluctuations may significantly impact profitability of banking institutions, especially when FX risk is not mitigated properly (Karimov, Mardon Akram o'g'li 1515). Exchange rate risk arises from the revaluation of an open currency position due to fluctuations in exchange rates. In addition to its direct impact on valuation, exchange rate risk also indirectly affects banks through interactions with credit and interest rate risks (*Description of Model for Stress Testing Banks in 2025* 2).

In earlier approaches of assessing banking risks, operational risk received less attention. However, with the introduction of Basel II, operational risk was identified as a separate component of regulatory capital together with credit and market risks (Conlon et al. 2). In the Ukrainian banking sector, operational risk has become particularly important, especially during wartime. Due to previous implementation of regulatory capital requirements for operational risk, banks had accumulated capital before the full-scale invasion. However, operational risk has increased significantly during the war, requiring banks to maintain sufficient capital. The total amount of bank losses and lost revenues from war-related operational risk amounted to 13 billion UAH. A large share of these losses is related to direct damage to assets, as well as lost revenue due to disruptions in banking operations ("Operational Resilience of Ukraine's Financial Sector during the War"). In 2025, the National Bank of Ukraine paid

more attention to operational risk within its stress-testing framework, reflecting the growing impact of operational disruptions during the war (*Financial Stability Report: December 2025* 39).

Additionally, a key finding of many studies is that the impact of risks is not constant over time. During relatively stable periods, banks focus more on credit risk as the primary factor affecting profitability. However, during periods of significant macroeconomic instability, the importance of market and operational risk increases. Consequently, examining the dynamic effect of risks is essential for assessing their impact on profitability of banks in Ukraine. In this context, Shmygel and Ongena analyze the impact of cyclical systemic risk on profitability of Ukrainian banks during 2001–2023, using a local projection model. Analysing a sample of 43 banks, the results of their study show that an increase in systemic risk reduces ROA by up to 2.3 percentage points over the subsequent five years, depending on the period (Shmygel and Ongena 13).

Unlike the approach in the study by Shmygel and Ongena, this study analyzes credit, market, liquidity, and operational risks separately, using a sample of all banks in the Ukrainian banking system for the period 2014–2025. In addition to banking indicators and macroeconomic variables, the analysis incorporates data from the Survey on Bank Lending Conditions, in which banks evaluate the impact of specific types of risk by themselves, including credit, interest and exchange rates, liquidity, and operational risks. This approach allows for a combination of both objective financial indicators and subjective assessments of banks. Furthermore, the study also examines dynamic effects and effects on banks with different levels of profitability.

Chapter 3. Methodology and Data

3.1 DATA

The study applies a quantitative method of research design. The analysis is based on bank-level panel data collected from the National Bank of Ukraine's website. The dataset includes supervisory statistics and indicators from the Bank Lending Survey. Additionally, data for real GDP growth is collected from the World Bank.

The Bank Lending Survey is conducted by the NBU on a quarterly basis from Q4 2013 to Q4 2025. The estimates are provided by 26 banks, which comprise 96% of the banking system's total assets (*Bank Lending Survey: Q1 2026* 2). The aim of the survey is to estimate conditions and demand of lending to a corporate sector and households. In addition, it captures assessments of banks regarding credit, interest rate, foreign exchange, liquidity, and operational risks. It is important to note, that respondents' answers are weighted by banks' assets, which gives larger institutions proportionally greater influence.

Since survey-based indicators are not available before 2014, the analysis covers a period from 2014 to 2025. The final dataset represents unbalanced quarterly panel data of Ukrainian banks.

3.2 VARIABLES AND OPERATIONALIZATION

Bank profitability is measured through a continuous dependent variable return on assets (ROA), which reflects the efficiency of a bank to generate profit by using its assets. It is measured as annual net

income divided by net assets averaged over a year. Average net assets are calculated as the average value of assets without non-performing loans for four quarters.

Credit risk is proxied by both financial and survey-based indicators, in particular, non-performing loans (NPL) ratio, cost of risk (CoR), and banks' assessments of credit risk. NPL ratio is defined as a ratio of non-performing loans. Cost of risk (CoR) is measured as a ratio of loan loss provisions to total net loans averaged over a year.

Market risk consists of two types, specifically, interest rate risk and exchange rate risk. Interest rate risk includes net interest margin (NIM), UAH/USD rate changes, and banks' interest and exchange rates risk perceptions. NIM reflects the ability of a bank to generate net interest income from its interest earning assets and is calculated as net interest income divided by annual average net assets. In addition to credit risk, the analysis includes banks' perceptions of liquidity and operational risks.

Moreover, the study also captures the impact of macrofinancial conditions on banks' profitability through real GDP growth, financial stress index (FSI), and key policy rate. The financial stress index represents a level of the financial stability in a country, varying from zero to one, where zero is a normal level of stability and one indicates financial distress. Real GDP growth reflects overall economic activity in the country. The key policy rate is an instrument of monetary policy, used for tackling inflation, which in turn directly influences on banks' lending and funding rates.

The variables used in the empirical analysis are summarized in Table 1.

Table 1. Definition and measurement of variables

Variable	Measurement	Notation
Dependent variable		
Return on Assets	$\frac{Net\ income}{\frac{1}{4}\sum_{k=0}^{3} Net\ assets_{i,\,t-k}}$	ROA
Bank-specific variables		
Non-performing loans ratio	$\frac{Non-performing\ loans}{Total\ net\ loans}$	NPL
Net Interest Margin	$\frac{Net\ interest\ income}{\frac{1}{4}\sum_{k=0}^{3} Net\ assets_{i,\,t-k}}$	NIM

Cost of risk	$\frac{Allocations\ to\ provisions}{\frac{1}{4}\sum_{k=0}^{3} Net\ loans_{i,\,t-k}}$	CoR
Macroeconomic variables		
Financial Stress Index	Composite index capturing systemic financial stress (0-1)	FSI
Real GDP growth	Year-on-year real GDP growth	GDP
Key policy rate	Key policy rate (end-of-quarter, %)	KPR
UAH/USD rate changes	Year-on-year UAH/USD exchange rate change	UAH/USD
Survey-based risk variables		
Credit risk perception	Balance of responses (-100 to 100)	CR
Interest rate risk perception	Balance of responses (-100 to 100)	IR
Foreign exchange risk perception	Balance of responses (-100 to 100)	FX
Liquidity risk perception	Balance of responses (-100 to 100)	LR
Operational risk perception	Balance of responses (-100 to 100)	OR

Source: Created by the author.

Note: i – individual bank, t – time periods

Table 2 demonstrates descriptive statistics of the variables used in the analysis by profitability group.

Table 2. Descriptive statistics by profitability group

Variable	Observations	Mean	St. Dev.	Minimum	Maximum
Low-profit banks (below 25th percentile)					
ROA	1,088	-0.131	0.320	-7.406	-0.003
NIM	1,088	0.361	0.291	-0.057	2.617
NPL	1,068	0.305	0.289	0.000	1.000
CoR	1,065	0.610	2.392	-0.051	16.504
FSI	1,088	0.254	0.231	0.007	0.882
GDP	1,082	-0.041	0.084	-0.288	0.055
KPR	1,088	0.165	0.071	0.060	0.300
UAH/USD	1,088	0.314	0.388	-0.145	0.973
CR	1,088	28.313	21.845	-13.706	95.161
IR	1,088	12.995	21.588	-27.802	70.702
FX	1,088	21.850	26.868	-23.329	76.722
LR	1,088	6.213	21.321	-33.808	60.511
OR	1,088	13.721	19.219	-14.122	87.340
Middle-profit banks (25th–75th percentile)					
ROA	2,177	0.007	0.006	-0.003	0.020
NIM	2,177	0.261	0.180	-0.026	1.094
NPL	2,107	0.179	0.183	0.000	1.000

Variable	Observations	Mean	St. Dev.	Minimum	Maximum
CoR	2,145	0.259	1.275	-0.051	16.504
FSI	2,177	0.182	0.201	0.007	0.882
GDP	2,148	-0.029	0.085	-0.288	0.055
KPR	2,177	0.148	0.067	0.060	0.300
UAH/USD	2,177	0.207	0.335	-0.145	0.973
CR	2,177	24.695	22.199	-13.706	95.161
IR	2,177	10.435	20.500	-27.802	70.702
FX	2,177	18.466	24.271	-23.329	76.722
LR	2,177	4.701	19.582	-33.808	60.511
OR	2,177	13.045	18.759	-14.122	87.340
High-profit banks (above 75th percentile)					
ROA	1,088	0.047	0.038	0.020	0.495
NIM	1,088	0.261	0.170	0.025	0.998
NPL	1,057	0.220	0.239	0.000	1.000
CoR	1,072	0.510	2.107	-0.051	16.504
FSI	1,088	0.117	0.148	0.007	0.882
GDP	1,063	-0.008	0.084	-0.288	0.055
KPR	1,088	0.152	0.055	0.060	0.300
UAH/USD	1,088	0.147	0.260	-0.145	0.973
CR	1,088	20.510	20.999	-13.706	95.161
IR	1,088	5.211	18.945	-27.802	70.702
FX	1,088	10.606	20.755	-23.329	76.722
LR	1,088	0.627	17.043	-33.808	60.511
OR	1,088	11.619	18.057	-14.122	87.340

Source: Calculated by the author.

Note: Profitability groups are defined based on the 25th and 75th percentiles of ROA. CoR is winsorized at the 1st and 99th percentiles.

3.3 METHODOLOGY

The analysis is based on three methods. The first method is a panel model with fixed effects, random effects and first-difference, which allows estimating relationships between bank profitability conditioned on mean and bank-specific, regulatory and macroeconomic variables, as well as risk perceptions.

The baseline model with fixed effects examines the influence of explanatory variables and banks' assessments of credit, FX, interest rate, liquidity, and operational risks on banks' profitability.

$$ROA_{i,t} = {}_0 + {}_1 ROA_{i,t-1} + {}_2 NIM_{i,t} + {}_3 NPL_{i,t} + {}_4 CoR_{i,t} + {}_5 FSI_t + {}_6 GDP_t + {}_7 KPR_t + \beta_8 UAH\_USI$$

$ROA_{i,t}$ is a dependent variable, a bank-level return on assets (ROA) for each bank (i), in quarter period (t). $ROA_{i,t-1}$ is one-period lag of ROA, which is included to capture persistence of banks' profitability. $NIM_{i,t}$ is net interest margin. $NPL\ ratio_{i,t}$ is the non-performing loans ratio. $CoR_{i,t}$ is cost of risk. $FSI_{i,t}$ is financial stress index. $Real\ GDP\ growth_{i,t}$ reflects economic growth in the country. $Key\ policy\ rate_{i,t}$ is included to take into account changes in monetary policy. UAH_USD_t is a yearly change of the UAH/USD rate. C $redit\ risk_{i,t}$, $FX\ risk_{i,t}$, $Interest\ rate\ risk_{i,t}$, $Liquidity\ risk_{i,t}$, $Operational\ risk_{i,t}$ represent aggregate assessments of different risks by banks. α_i is unobserved bank-specific fixed effects, which remain constant over time, such as business models, management quality, risk appetite, and organizational structure. ${}_{i,t}$ is an error term.

The same specification is applied in models with random effects and first-difference models. The model with random effects estimates the impact of independent variables on banks' return on assets, assuming that unobserved effects are not correlated with explanatory variables. The first-difference baseline model estimates how changes in independent variables affect changes in banks' profitability.

The second approach is linear local projections (Jordà). This method is based on models, which analyze dynamic effects of risk factors on bank profitability. The models are estimated for horizons (h) up to fifteen quarters ahead, where the coefficients ^{h} vary across horizons and capture the dynamic response of profitability to changes in independent variables.

$$ROA_{i,t+h} = \beta_0^h + \beta_1^h ROA_{i,t-1} + \beta_2^h NIM_{i,t} + \beta_3^h NPL_{i,t} + \beta_4^h CoR_{i,t} + \beta_5^h FSI_t + \beta_6^h GDP_t + \beta_7^h KPR_t + \beta_8^h UA$$

The third method is a quantile regression with fixed effects. It examines heterogeneity of effects across the distribution of bank profitability. This approach demonstrates the impact of explanatory variables at different quantiles (q) of ROA, showing the difference of such effects for low- and high-profitable banks.

$$Q_q(ROA_{i,t} | X_t) = \beta_0^q + \beta_1^\tau NIM_{i,t} + \beta_2^q NPL_{i,t} + \beta_3^q CoR_{i,t} + \beta_5^q FSI_t + \beta_6^q GDP_t + \beta_7^q KPR_t + \beta_8^q UAH\_USD_t +$$

Chapter 4. Results

4.1 PANEL MODELS

To choose a right model by comparing fixed and random effects, the Hausman test was conducted. The results indicate that the null hypothesis can be rejected and the model with fixed effects provides more consistent results, meaning that unobserved bank-specific effects are correlated with explanatory variables (see Appendix B, Table B3). In the context of banks, such effects may include management quality, a bank's strategy, and a business model. Therefore, in this analysis the fixed effects model is chosen over the random effects model to better control for unobserved heterogeneity among banks.

To estimate potential multicollinearity of variables, the Variance Inflation Factor (VIF) test was conducted (see Appendix B, Table B1). The results indicate that almost all variables, except FSI, do not face the multicollinearity issue. The reason for such an issue may be the complexity of the indicator, which captures several factors of financial and macroeconomic stress. Nevertheless, the value for FSI is below the critical threshold.

In addition, the Breusch-Pagan test was conducted to examine heteroskedasticity in the models (see Appendix B, Table B2). According to the results, the null hypothesis can be rejected, which indicates the presence of heteroskedasticity. Therefore, robust standard errors clustered at the bank level using the Arellano method are applied in the analysis.

Regarding credit risk, the fixed effects model does not provide statistically significant results. However, the first difference model shows that the NPL ratio has a negative statistically significant impact on profitability. A one percentage point increase in the NPL ratio is associated with a decline in ROA growth on average by 0,066 percentage points, holding other factors constant.

Meanwhile, market risk has a statistically significant impact on banks' profitability. The fixed effects model shows that UAH/USD rate changes have a statistically significant positive impact on ROA. A one percentage point increase in the exchange rate leads to the estimated average increase of ROA by 9 percentage points, holding other factors constant. In addition, banks' perception of exchange rate risk also has a positive statistically significant impact on their profitability. A one-point increase in the balance of responses regarding exchange rate risk results in the estimated average increase of ROA by 0,01 percentage point, holding other factors constant. At the same time, interest rate risk perception also has a positive statistically significant effect on ROA. A one-unit increase in interest rate risk perception results in the average increase in ROA by 0,04 percentage points, holding other factors constant.

In contrast, banks' perception of liquidity risk has a negative statistically significant influence on bank profitability. A one-point increase in the balance of responses regarding liquidity risk leads to the estimated average decrease of ROA by 0,03 percentage points, holding other factors constant. This can be explained through higher funding costs and maturity mismatch between banks' assets and liabilities.

Additionally, the perception of operational risk has a negative statistically significant effect, reflecting that any business disruptions, system failures, or damages to physical assets reduces bank profitability. A one-point increase in the balance of responses regarding operational risk results in the estimated average decrease of ROA by 0,02 percentage points, holding other factors constant.

Regarding a general indicator of financial stability, the results show that the financial stress index has a statistically significant negative impact on banks' ROA. A 0,01 increase in the FSI results in the estimated average decrease of ROA by 0,072 percentage points, holding other factors constant. Unexpectedly, real GDP growth also appears to have a statistically significant negative impact on banks' profitability. A one percentage point increase in real GDP growth results in the estimated

average decline in ROA by 1,4 percentage points, holding other factors constant. In addition, the fixed effects model shows that the key policy rate has a statistically significant negative impact on ROA. A one percentage point increase in the key policy rate leads to the estimated average decrease of ROA by 6,1 percentage point, holding other factors constant.

Table 3. Panel regression results

	Dependent variable:		
	ROA		
	FE	RE	FD
	(1)	(2)	(3)
Lag ROA	0.609***	0.755***	0.006
	(0.055)	(0.019)	(0.010)
NIM	0.017	0.006	0.033
	(0.015)	(0.012)	(0.033)
NPL	-0.011	-0.027	-0.066*
	(0.018)	(0.018)	(0.035)
CoR	-0.002	-0.005	-0.002
	(0.002)	(0.003)	(0.002)
FSI	-0.072***	-0.099***	-0.051***
	(0.022)	(0.024)	(0.013)
GDP	-0.014*	-0.026***	-0.011*
	(0.008)	(0.009)	(0.006)
KPR	-0.058**	0.018	-0.151***
	(0.023)	(0.028)	(0.048)
UAH/USD	0.009***	0.016***	0.015***
	(0.003)	(0.005)	(0.005)
CR	0.00001	-0.00001	0.00001
	(0.0001)	(0.0001)	(0.0001)
FX	0.0001**	0.0001	0.0001***
	(0.0001)	(0.0001)	(0.00005)
IR	0.0004***	0.0002	0.0002**

	(0.0001)	(0.0001)	(0.0001)
LR	-0.0003***	-0.0003***	-0.0001
	(0.0001)	(0.0001)	(0.0001)
OR	-0.0002***	-0.00000	-0.0002***
	(0.0001)	(0.0001)	(0.0001)
Observations	3,898	3,898	3,674
R^2	0.349	0.452	0.049
Adjusted R^2	0.307	0.450	0.046

Source: Calculated by the author using R.

Note: *p<0.1; **p<0.05; ***p<0.01.

FE – fixed effects, RE – random effects, FD – first differences.

Robust standard errors clustered at the bank level using the Arellano method are reported in parentheses.

4.2 LOCAL PROJECTIONS AND QUANTILE REGRESSION

In this analysis panel regressions estimate an effect of explanatory variables conditioned on mean of the dependent variable. Therefore, to provide more comprehensive analysis, a combination of the results of local projections and quantile regression reveals that the impact of risks on profitability not only varies over time but also differs significantly depending on a bank's level of profitability. In particular, local projections show that the impact of certain variables may emerge with a time lag and become significant in subsequent periods. Local projection models visually demonstrate the dynamic effect of credit, exchange rate, interest rate, liquidity and operational risks on bank profitability over

15-quarter horizon with 95% confidence intervals. Meanwhile, the quantile regression analysis allows to examine how the impact of these risk variables varies across banks with different levels of profitability.

The local projection model confirms that the average influence of the non-performing loans ratio is not statistically significant (see Figure 1). Nevertheless, the quantile regression demonstrates that the NPL ratio has a strong negative impact on banks in lower quantiles and less negative for more profitable banks (see Figure 2). This reveals that weaker banks are more vulnerable to credit risk. In addition to lower profit, these banks may be associated with crediting more risky clients, which in turn leads to higher probability of defaulted loans. In contrast, profitable banks appear better in mitigation of credit risk by more effective provisioning and robust capital.

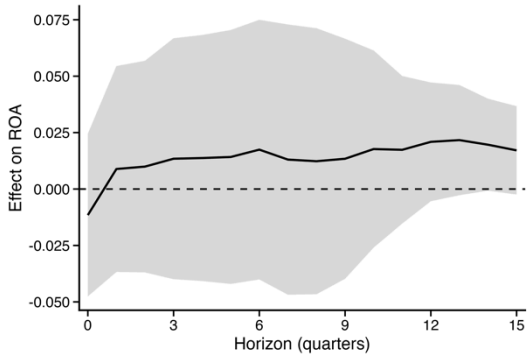

Figure 1. Impulse response of ROA to NPL ratio; created by the author using R.

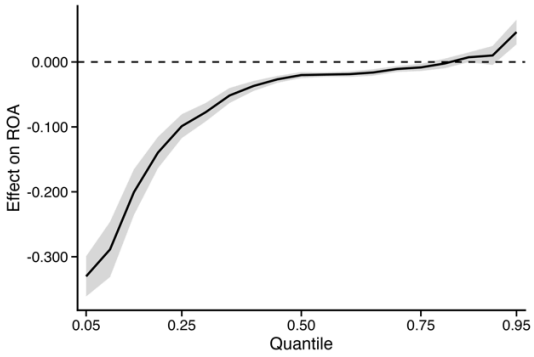

Figure 2. Quantile regression estimates of the effect of NPL ratio on ROA; created by the author using R.

Although, local projection results in Figure 3 also demonstrate insignificant average effect of cost of risk on banks' profitability, the quantile regression in Figure 4 reveals a significant negative impact in lower quantiles of the probability distribution. This also confirms that less profitable banks are more exposed to credit risk, as they are more likely to credit riskier clients, which may have a higher probability of default. Consequently, these banks face higher provisioning requirements.

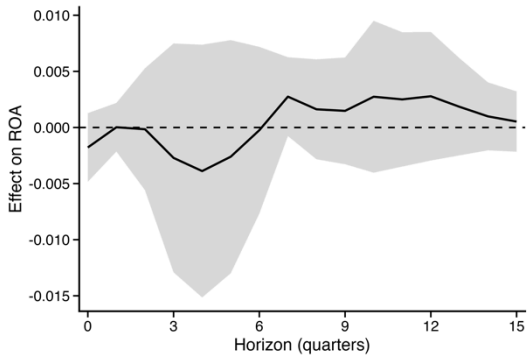

Figure 3. Impulse response of ROA to CoR; created by the author using R.

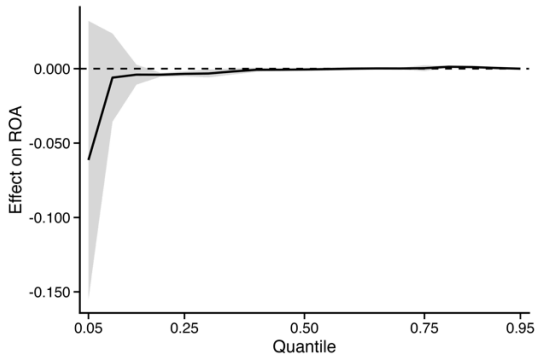

Figure 4. Quantile regression estimates of the effect of CoR on ROA; created by the author using R.

Additionally, as shown in Figure 5, the local projection model demonstrates that the average impact of net interest margin on banks' profitability is insignificant across different time horizons. However, the quantile model reveals that the NIM actually has a significant negative impact on low-profit banks but is a positive factor for highly profitable banks (see Figure 6). The difference in effects observed in the quantile regression suggests that higher margins may reflect a propensity for risk among weaker banks. Low-profitability banks may seek to increase income by investing in higher-risk assets, which may lead to defaults and losses.

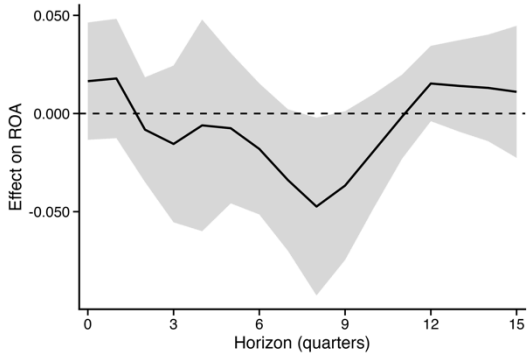

Figure 5. Impulse response of ROA to NIM; created by the author using R.

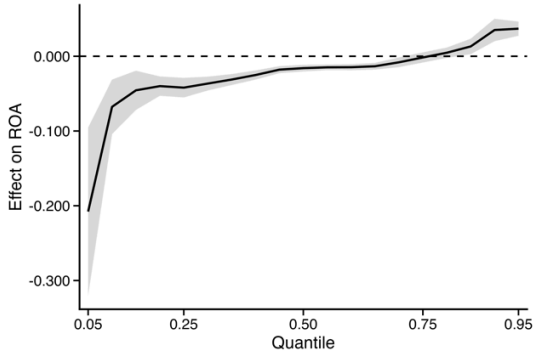

Figure 6. Quantile regression estimates of the effect of NIM on ROA; created by the author using R.

In contrast, the local projection model demonstrates that, in the short term, interest rate risk perception has a positive impact on banks' ROA, which may reflect their ability to profit from interest rate increase (see Figure 7). However, in further periods the influence weakens and turns negative. The negative relationship may result due to lower demand for loans and higher funding costs. Although, the impact varies in different time horizons, the quantile regression demonstrates that the impact of banks' perception of interest rate risk is mainly indifferent both for low-profit and high-profit banks (see Figure 8).

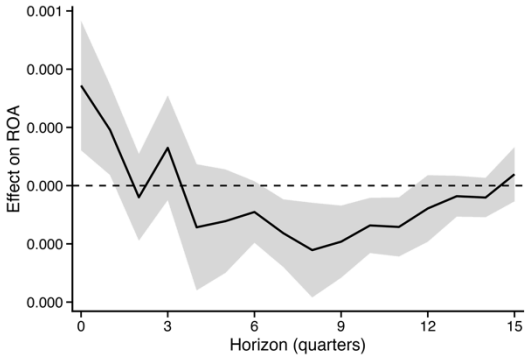

Figure 7. Impulse response of ROA to Interest rate risk; created by the author using R.

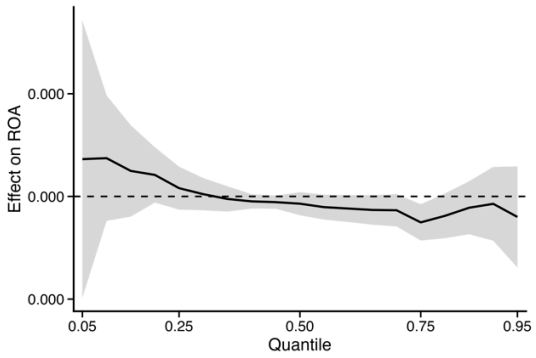

Figure 8. Quantile regression estimates of the effect of Interest rate risk on ROA; created by the author using R.

Figure 9 illustrates that, in the short term, changes in the exchange rate have a negative effect on banks' ROA. However, in the subsequent periods, the effect gradually weakens and stabilizes around zero. This indicates that devaluation of hryvnia results in higher value of foreign currency liabilities, which may decrease banks' profit. Nevertheless, banks may adjust their balance sheets, thereby mitigating the initial negative impact in further periods. In addition, the quantile regression demonstrates that the effect is substantially significant for banks in lower quantiles (see Figure 10).

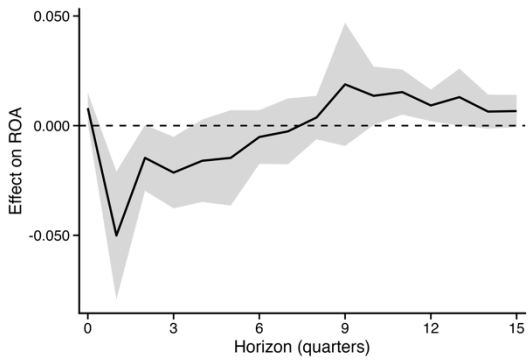

Figure 9. Impulse response of ROA to UAH/USD rate changes; created by the author using R.

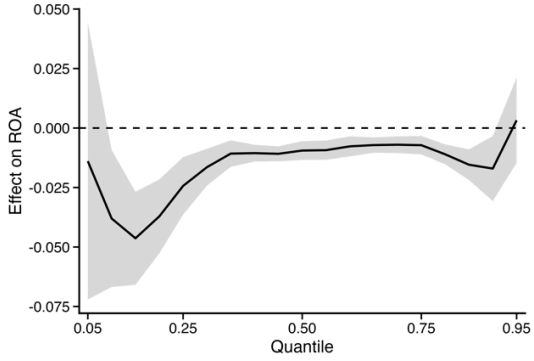

Figure 10. Quantile regression estimates of the effect of UAH/USD rate changes on ROA; created by the author using R.

As shown in Figure 11, the financial stress index has a negatively significant impact in the short run, especially for banks with low profitability, confirming their sensitivity to risks. In addition, in lower quantiles the impact of FSI on banks' profitability is stronger comparing to higher quantiles, where it is neutral (see Figure 12). This confirms the fact that highly profitable banks better overcome risks by sufficient capital buffers and diversified sources of income. Nevertheless, the local projection model and the quantile regression model demonstrate that this effect weakens over time, indicating that banks are capable to react and mitigate the risks rapidly, in particular, highly profitable banks.

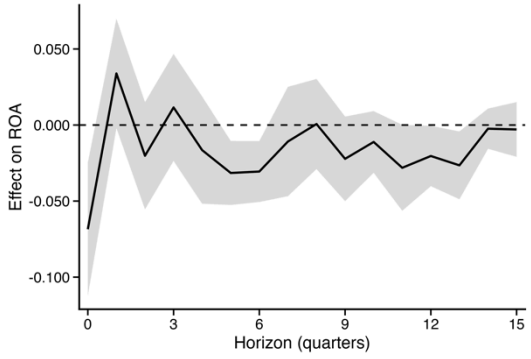

Figure 11. Impulse response of ROA to FSI; created by the author using R.

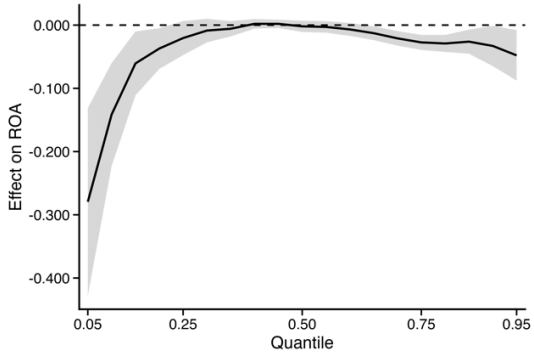

Figure 12. Quantile regression estimates of the effect of FSI on ROA; created by the author using R.

Nevertheless, Figure 13 demonstrates that the key policy rate has a negative short-term effect on banks' profitability, reflecting tight monetary policy regime and higher funding costs. Monetary policy leads to short-term losses but generates long-term benefits, demonstrating its efficiency. During times of crisis, the monetary policy tightening through increase in the key policy rate leads to higher borrowing costs and decline in demand for loans. However, in the long-term, the effect gradually weakens and becomes positive, indicating decrease in inflation and economic stabilization. In addition, the quantile regression demonstrates that the impact of key policy rate varies across different quantiles. Figure 14 reveals that the most notable effect is observed among banks with low and high profitability, whereas for banks with medium profitability, this impact is moderate. For low-profit banks, the key policy rate increase allows increasing their interest rates for loans, which may stimulate interest income. At the same time, banks with high profitability have a bigger share of loans and are more active in securities operations. Consequently, increase in the key policy rate results in higher interest income.

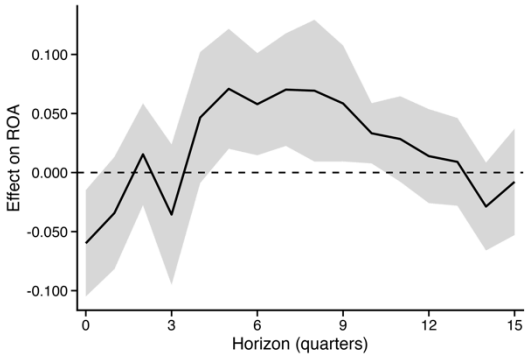

Figure 13. Impulse response of ROA to Key policy rate; created by the author using R.

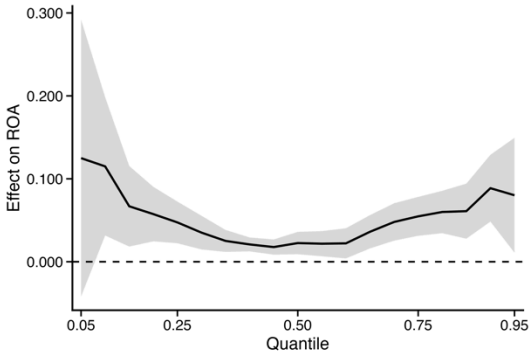

Figure 14. Quantile regression estimates of the effect of Key policy rate on ROA; created by the author using R.

The local projection model shows that the effect on banks' profitability becomes statistically significant in the short run (see Figure 15). This may reflect that during expansion of the economy, borrowers' solvency improves and probability of credit risk decreases. In addition, better economic

activity increases demand for loans, resulting in better profitability of banks. Figure 16 shows that the real GDP growth has a positive impact on ROA for low- and middle-profit banks, but for highly profitable banks the influence may be neutral. This shows that less profitable banks benefit more from favorable macroeconomic conditions. Conversely, this also may indicate that these banks are more exposed to economic shocks.

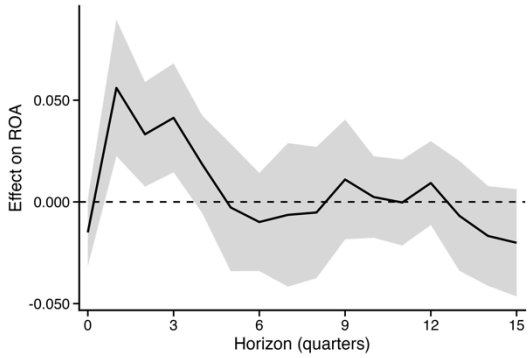

Figure 15. Impulse response of ROA to Real GDP growth; created by the author using R.

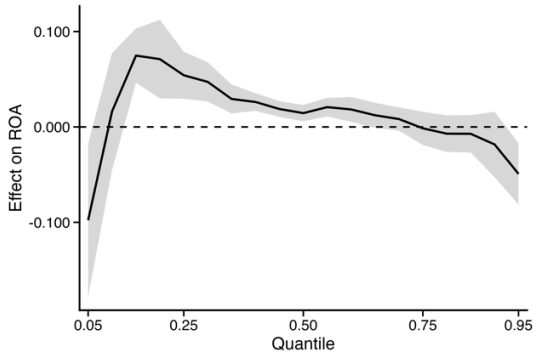

Figure 16. Quantile regression estimates of the effect of Real GDP growth on ROA; created by the author using R.

Chapter 5. Discussion

The main objective of this paper was to examine the impact of credit, market, liquidity, and operational risks on banks' profitability in Ukraine. The results indicate that these effects vary substantially across banks with different levels of profitability. In fact, less profitable banks appear to be more sensitive to risks compared to more profitable banks.

The results show that for banks in lower quantiles of the profitability distribution, the impact of different types of risk is considerably stronger. Since the level of their income may be characterized by lower efficiency, several factors may influence on performance of such banks. In particular, they may have an inefficient business model, including low interest margins, low diversification of income sources, riskier lending, and inefficient balance sheet structures. In addition, such banks are associated with high operating costs, reflecting their inefficiency. Consequently, risks affect profitability of weaker banks more strongly in comparison with high-profit institutions. The relationship between risks and profitability is nonlinear, reflecting disproportionately larger losses for low-profitability banks.

In contrast, institutions with higher profitability demonstrate better resilience to risks. Sufficient level of capital, better provisioning, and higher operational efficiency help banks to absorb potential financial losses. In addition, more profitable banks usually have more diversified sources of income and are more active in foreign exchange and securities operations.

The findings of this study are consistent with the results of recent stress testing conducted by the National Bank of Ukraine. Specifically, interest rate risk is one of the most significant risk factors during periods of vulnerability (*Financial Stability Report: December 2025* 39). Moreover, the results of local projections support previous findings of Shmygel and Ongena, which demonstrate the dynamic impact of risks on banks' profitability. Furthermore, this study also emphasizes the importance of local projections in analyzing risk effects (Shmygel and Ongena 13–14).

Credit risk also plays a significant role in stressful conditions. An increase in the share of non-performing loans and the need to form larger provisions reduce banks' profitability and capital reserves. This is consistent with the quantile regression results shown in Figure 2, which demonstrate that credit risk has a disproportionately negative impact on low-profit banks, reflecting their weaker ability to cover credit losses.

Meanwhile, liquidity risk is another important factor affecting banks' performance. During periods of financial stress, funding becomes more expensive and less stable, which limits banks' ability to expand lending. This effect arises due to higher funding costs and imbalances in the maturity structure of assets and liabilities. In particular, increased reliance on short-term funding together with long-term lending can expose banks to liquidity risks, resulting in higher refinancing costs and lower profitability. Empirical data confirm that a higher level of perceived liquidity risk is associated with lower profitability among institutions with weaker financial stability.

As for operational risk, it has become increasingly important, especially in the wartime. The results of this study show that operational risk has a significant negative impact on profitability. Disruptions in business processes, damage to infrastructure, and cyber risks can significantly influence banks' performance.

In addition, macrofinancial shocks, specifically the financial stress index, show that increased financial stress has a significant negative impact on return on assets, particularly in the short term. This reflects a deterioration in overall economic conditions and greater uncertainty. Furthermore, financial stress intensifies the impact of other risks. During periods of elevated stress, credit risk rises due to a deterioration of borrowers' solvency and higher funding costs. Simultaneously, market volatility intensifies, affecting the dynamics of interest and exchange rates. As a result, the overall impact of risks on banks' profitability becomes more prominent, especially for weak institutions.

5.1 LIMITATIONS

Despite providing economically meaningful results, the study has several limitations. Some of the risks are proxied by survey-based measures of risk perception, which are subjective and may not fully reflect the actual banks' performance. In addition, the scores are weighted by banks' assets, thereby reflecting greater impact of larger banks. Moreover, the analysis is based on panel data on the Ukrainian banking sector, which includes certain specific features, such as a large number of banks, a significant proportion of which have a big share of non-performing loans. Furthermore, the periods examined were associated with extreme macroeconomic instability, including crisis and wartime conditions. These factors may limit the applicability of the findings to other countries or more stable economic conditions.

Chapter 6. Conclusions

This study focuses on the significance of credit, market, liquidity, and operational risks in affecting profitability of Ukrainian banks. The analysis was conducted using both financial indicators capturing these types of risks and banks' risk perception from 2014 to 2025. Therefore, each risk and macroeconomic variable were expected to have a significant impact on determining banks' profitability. Firstly, the panel linear regression model was analyzed to reveal the effect of explanatory variables on the bank's profitability conditioned on mean. Secondly, for a better analysis the local projection model was used to capture the impact of different types of risks depending on time. Thirdly, the quantile regression helped to count for the differences in effects for banks with lower or higher profitability.

A key finding of the study is heterogeneity in relationships between risks and profitability. For low-profit institutions, materialization of risks leads to unproportionally larger losses, reflecting their weaker ability to take risks. Lower operational efficiency may not allow such banks to absorb risks efficiently. In contrast, more profitable banks demonstrate stronger resilience. Moreover, the analysis highlights the importance of time. In particular, the effect of certain indicators may appear more significant in subsequent time horizons. In this case, such variables are the key policy rate, interest rate risk, financial stress index, and real GDP growth. In addition, financial distress in the country intensifies the impact of risks, especially for banks that have low efficiency.

In conclusion, the findings emphasize the need to focus on weak banks, as they are more vulnerable to adverse conditions and may pose a risk to country's financial stability. This confirms the role of stress testing as a key tool for identifying vulnerabilities in the banking system. As for the banks, the results highlight the importance of improving operational efficiency, diversifying income sources, and enhancing risk management systems to improve resilience.

To develop the analysis of the obtained findings regarding differences in effects on banking institutions with different levels of profitability, future research may be focused specifically on low-profit banks. In particular, building local projections will allow observing the dynamic impact of risks over time. Additionally, it would be worth to investigate whether the impact of risks on bank profitability has changed since the beginning of the full-scale invasion. Furthermore, future research should explore more unexpected results, in particular a negative relationship between NIM and ROA for less profitable banks. This effect may indicate that low-profit banks may have riskier assets. Consequently, a future study should incorporate additional controls for assets composition. Additionally, the positive effect of FX risk on profitability may be caused by currency revaluation. Therefore, future research should control for the share of foreign assets in total assets.

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APPENDIX A

CORRELATION MATRIX

Table A1. Correlation matrix of analyzed variables

Variable	ROA	NIM	NPL	CoR	FSI	GDP	KPR	UAH/USD	CR	IR	FX	LR	OR
ROA	1.00												
NIM	-0.11	1.00											
NPL	-0.20	-0.09	1.00										
CoR	-0.14	0.00	0.08	1.00									
FSI	-0.13	0.34	-0.09	-0.02	1.00								
GDP	0.05	-0.07	0.14	0.02	-0.50	1.00							
KPR	-0.03	0.11	0.07	0.01	0.48	-0.06	1.00						
UAH/USD	-0.08	0.33	-0.03	0.01	0.64	-0.07	0.60	1.00					
CR	-0.05	0.07	-0.06	-0.02	0.48	-0.61	0.18	0.01	1.00				
IR	-0.05	0.07	-0.12	-0.02	0.55	-0.59	0.07	-0.01	0.69	1.00			
FX	-0.09	0.17	-0.10	-0.02	0.51	-0.58	-0.16	-0.17	0.64	0.70	1.00		
LR	-0.07	0.08	-0.10	-0.03	0.38	-0.44	-0.26	-0.13	0.43	0.62	0.60	1.00	
OR	0.01	-0.09	-0.03	0.02	0.09	-0.40	0.07	-0.16	0.71	0.57	0.37	0.19	1

Source: Calculated by the author using R.

APPENDIX B

MODEL DIAGNOSTICS

Table B1. Variance Inflation Factors (VIF)

Variable	VIF
NIM	1.24
NPL	1.05
CoR	1.01
FSI	9.01
GDP	1.95
KPR	2.54
UAH/USD	4.61
CR	3.92
IR	3.89
FX	4.57
LR	2.34
OR	3.09

Source: Calculated by the author using R.

Note: VIF values above 10 are indicate strong multicollinearity.

Table B2. Breusch-Pagan test for heteroskedasticity

Test	Statistic	Degrees of freedom	p-value
Breusch-Pagan test	133.426	13	0

Source: Calculated by the author using R.

Note: The null hypothesis of the Breusch–Pagan test assumes homoskedasticity. The null hypothesis is rejected.

Table B3. Hausman test results

Test	Statistic	p-value
Hausman test	1,407.226	0

Source: Calculated by the author using R.

Note: H0 assumes that the random effects estimator is consistent. The null hypothesis is rejected.

APPENDIX C

LOCAL PROJECTION RESULTS

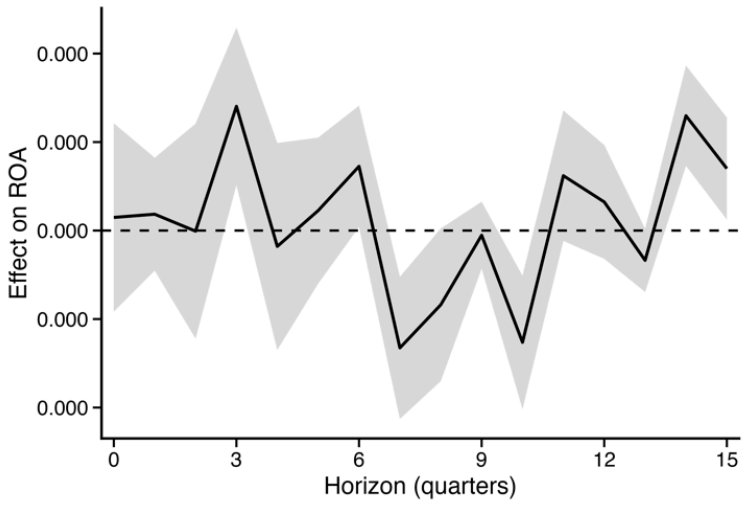

Figure C1. Impulse response of ROA on credit risk; created by the author using R.

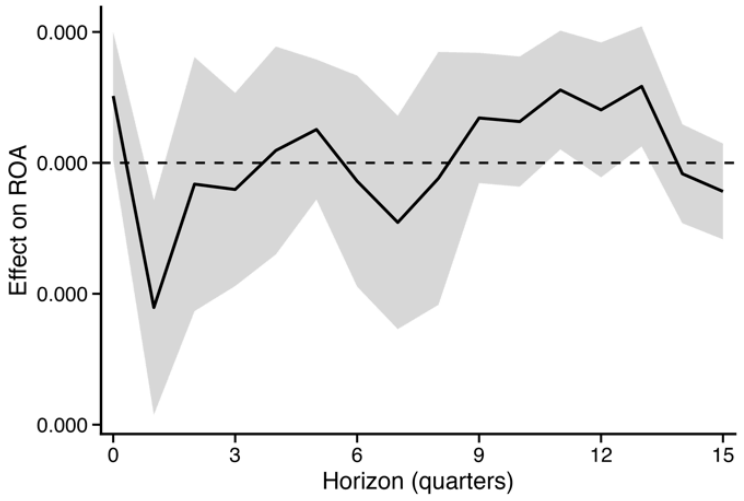

Figure C2. Impulse response of ROA on FX risk; created by the author using R.

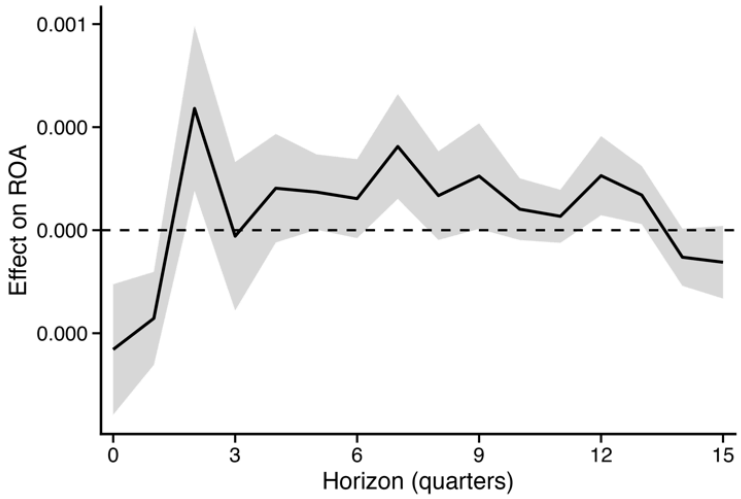

Figure C3. Impulse response of ROA on liquidity risk; created by the author using R.

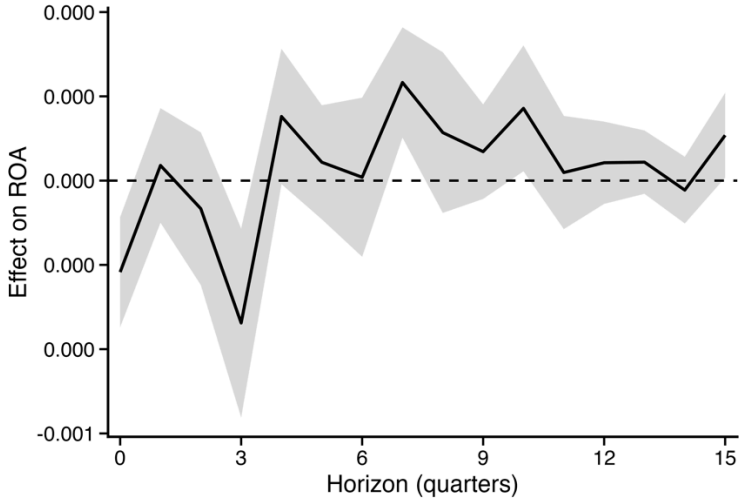

Figure C4. Impulse response of ROA on operational risk; created by the author using R.

APPENDIX D

QUANTILE REGRESSION RESULTS

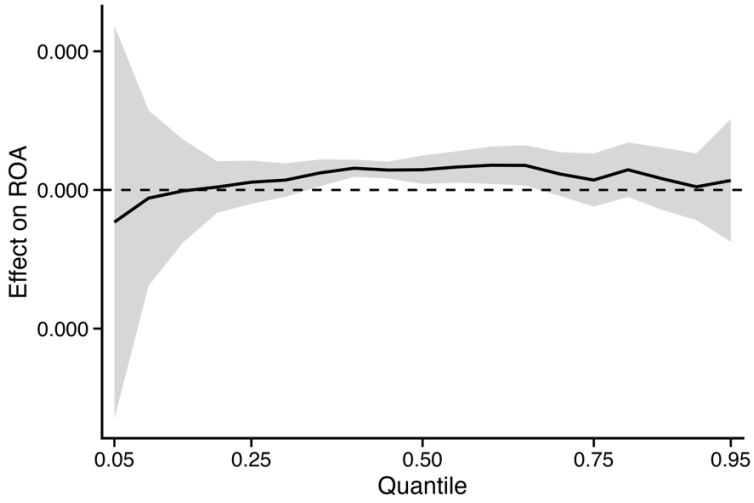

Figure D1. Quantile regression estimates of the effect of credit risk on ROA; created by the author using R.

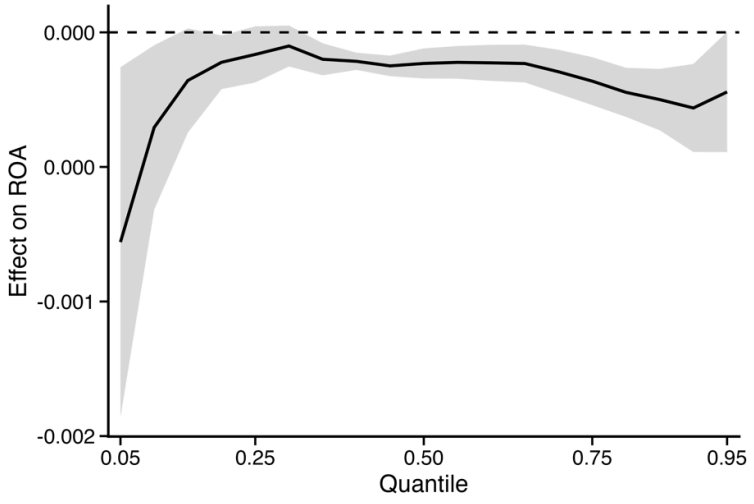

Figure D2. Quantile regression estimates of the effect of FX risk on ROA; created by the author using R.

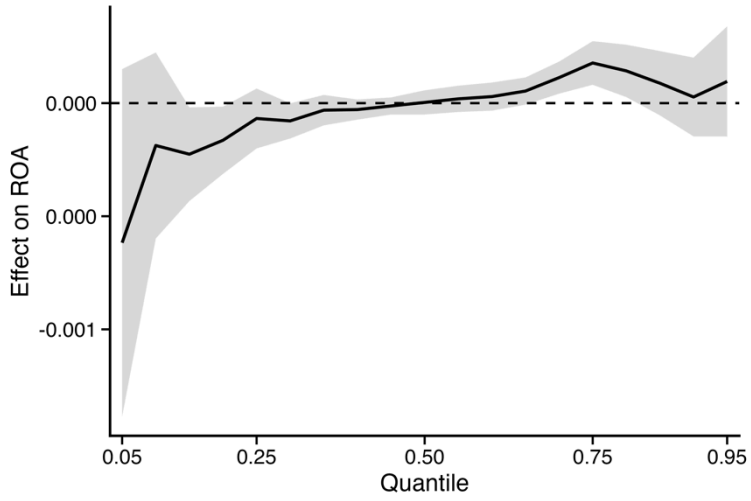

Figure D3. Quantile regression estimates of the effect of liquidity risk on ROA; created by the author using R.

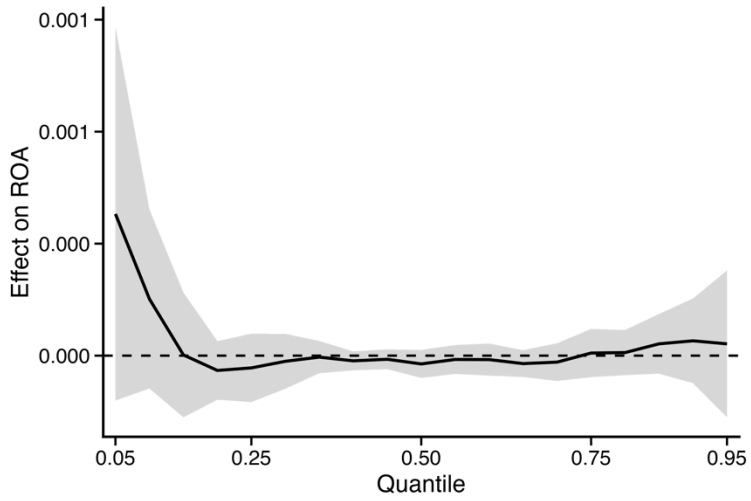

Figure D4. Quantile regression estimates of the effect of operational risk on ROA; created by the author using R.