



Dynamics of bank capital structure around the world in light of triple crises

Boodeo Nem^{a,*}, Indranarain Ramlall^b

^a Business School, Middlesex University Mauritius, Uniciti, Flic-en-Flac, 90502, Mauritius

^b Faculty of Social Studies and Humanities, University of Mauritius, Réduit, 80837, Mauritius

ARTICLE INFO

Keywords:

Bank capital structure
Two-step GMM
Global financial crisis
COVID-19
Ukraine crisis
Financial persistence
Debt dynamics

ABSTRACT

Purpose: This study seeks to analyse banks' capital structure around the world by incorporating the impact of three major crises: the Global Financial Crisis (GFC), the COVID-19 pandemic, and the Russia-Ukraine war. Using a Two-Step Generalized Method of Moments (GMM) model, our study examines the determinants of six key financial variables for banks, including total debt (TD), short-term debt (STD), long-term debt (LTD), total liabilities (TL), interest-bearing liabilities (IBL), and non-interest-bearing liabilities (NIBL) and how these were affected by the triple crises.

Results: The results document strong persistence in all bank liability configurations, with coefficients ranging from 0.591 to 0.872, confirming substantial path dependence in banks' financing decisions. Asset growth rates are found to have mixed results while liquidity measures register significant negative relationship with most debt variables, supporting the Pecking Order Theory. On the other hand, profitability posts mixed effects. Across all three crises, evidence is found in favour of non-interest-bearing liabilities declining consistently while interest-bearing obligations increasing. Such a crisis-period funding hierarchy suggests a fundamental inversion of the pecking order under stress, as depositors flee non-interest-bearing accounts and banks reluctantly substitute toward higher-cost, contractually committed debt. We also document that the GFC and Russia – Ukraine war positively and more significantly impacts debt accumulation, as compared to the COVID-19.

Conclusion: Our findings carry critical implications for global regulators: although current rules assume non-interest-bearing deposits remain stable during crises, we show that customers consistently withdraw these funds when uncertainty hits, forcing banks to replace their cheapest funding source with costly debt. Regulators should therefore recognize that under crisis conditions, these deposits are less stable than assumed and adjust liquidity requirements accordingly. We also show that systemic financial shocks (GFC) as well as endemic geopolitical tensions (Russia – Ukraine war) trail behind significantly more impact as compared to unexpected global temporal pandemics (COVID-19).

1. Introduction

Understanding the capital structure of banks is vital due to the critical role these financial institutions play in ensuring economic stability and facilitating credit flow. Banks' capital structure decisions directly impact their ability to absorb losses, maintain liquidity, and continue lending during periods of economic uncertainty.

However, different studies point towards diverging views on bank capital structure. Some studies explore the impact of capital regulations on bank capital structure (Berger and Bouwman, 2013; Kořak et al., 2015) while others focus on firm specific factors claiming that these are also relevant to banks (Gropp and Heider, 2010; Berg and Gider, 2017). Yet, it is still unclear how banks determine their capital structure, and

more so, during periods of distress.

This study takes a more holistic approach by analysing the capital structure of banks under different crises the world has witnessed in the last 20 years. Banks' role becomes particularly crucial during crisis conditions when external shocks, such as financial downturns or geopolitical events, severely disrupt financial systems. In times of crises, banks' reliance on different forms of liabilities, short-term versus long-term, interest-bearing versus non-interest-bearing, influence their resilience and capacity to mitigate risks. Analysing the determinants of bank capital structure under such conditions provides insights into how financial institutions adapt their strategies to maintain stability and meet regulatory requirements while supporting economic recovery.

The literature on bank capital structure during crises is scant and

* Corresponding author.

E-mail addresses: b.nem@mdx.ac.mu (B. Nem), i.ramlall@uom.ac.mu (I. Ramlall).

<https://doi.org/10.1016/j.dsef.2026.100152>

Received 9 August 2025; Received in revised form 25 April 2026; Accepted 23 June 2026

Available online 25 June 2026

2950-5240/© 2026 The Author(s). Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

therefore the objective of this study is to simultaneously include three specific crises³ within a single dynamic panel Generalised Method of Moment (GMM) framework to analyse their impact on leverage choices⁴ of banks across the world. In so doing, the study not only examines the persistence of financial structures under different macroeconomic conditions but also evaluates how firm-specific factors such as asset growth rate, liquidity, profitability, and size interact with external shocks to shape capital structure decisions for banks.

As an outcome, this study makes several contributions to the literature on capital structure. First, it extends existing research by focusing on the banking sector during multiple global crises, offering novel empirical insights into how crises interact with firm-specific characteristics. The findings provide robust evidence supporting the Pecking Order Theory (Myers and Majluf, 1984), demonstrating that banks prioritize internal financing and carefully manage external debt. Second, the research enhances understanding of the dynamic and persistent nature of bank capital structures, bridging gaps in prior studies that largely overlook the combined influence of historical financial decisions and external economic disruptions. Last but not the least, the paper attempts to elucidate whether banks' reaction to external shocks are standardised or coordinated and acclimatised, i.e., do banks react in the same way to systemic shocks, geopolitical shocks and pandemics?

This paper is structured as follows. Section two focuses on the literature review while section three deals with data and methodology. Eventually, section four probes into the results part of the analysis and finally, section five concludes.

2. Literature review

While capital structure has been a highly debated topic in the corporate finance literature, the same does not apply for the capital structure of banks. In fact, several studies still postulate that capital structure in general is still not fully understood, and bystanding the dearth of research on capital of banking institutions, bank capital structure largely remains, an under-explored territory (Mohammad, 2022). Nonetheless, more recently, the capital structure of banks has been a focal point in financial research, given its critical role in ensuring economic stability and facilitating credit flow.

2.1. Capital structure theories

In the corporate finance literature, the early theoretical foundations of capital structure were laid by Modigliani and Miller (1958), who posited that, in a frictionless market, a firm's capital structure is irrelevant to its value. However, the unique nature of banks, characterized by regulatory oversight and the necessity for financial intermediation, challenges the direct application of this theorem. Subsequent studies have explored how factors such as taxes, bankruptcy costs, and agency problems influence banks' financing decisions. The pecking order theory of capital structure, introduced by Myers and Majluf (1984), posits that firms follow a hierarchical approach when choosing financing sources due to information asymmetry between managers and external investors. According to this theory, firms prioritize internal financing (retained earnings) because it does not require external scrutiny and minimizes adverse selection problems. It is only when internal funds are insufficient that firms prefer debt financing over equity issuance due to the lower information costs and the perception that issuing equity signals that the firm is overvalued, potentially leading to a decline in share prices. This theory challenges the traditional Modigliani and Miller

(1958) irrelevance proposition by highlighting how real-world frictions influence capital structure decisions.

In the banking sector, the pecking order theory holds particular relevance, as banks with higher internal liquidity are less likely to rely on external debt. Empirical studies, such as those by Frank and Goyal (2003), provide robust evidence supporting the pecking order theory across various industries, showing that firms with substantial cash flows exhibit lower leverage. In times of economic distress, such as financial crises, the theory becomes even more pertinent as firms increasingly depend on internal resources to avoid the risks associated with raising external capital in volatile markets.

2.2. Bank capital structure

Research on bank capital structure is split between capital regulations as determinants of bank capital structure and firm-specific characteristics (Berger and Bouwman, 2013; Kořak et al., 2015; Gropp and Heider, 2010; Ghosh and Chatterjee, 2018; Alraheb et al., 2019). Empirically, Gropp and Heider (2010) analyzed large publicly traded banks and found that traditional corporate finance determinants, like profitability and market-to-book ratios, significantly influence banks' equity levels. Their findings suggest that, despite regulatory constraints, banks' capital structures are shaped by market forces similar to non-financial firms. Further, Berger et al. (1995) show that well-capitalized banks are perceived as safer by depositors, leading to a lower cost of capital and enhanced financial stability.

2.2.1. Banks and the Global Financial Crisis (GFC), 2007 – 2010

Some key studies have analysed the impact of financial crises, particularly the GFC, on banks (Brunnermeier, 2009; Adrian and Shin, 2010; Ivashina and Scharfstein, 2010; Demirgüç-Kunt and Huizinga, 2010). As Brunnermeier (2009) argues, the GFC was a direct result of securitization and the fact that banks were financing their assets with shorter term liabilities, in an attempt to take advantage of higher spread. On their part, Adrian and Shin (2010), postulate that the procyclicality of leverage has implications for financial system volatility and risk pricing, ultimately leading to the GFC. Consequently, the GFC prompted banks to reassess their leverage and liquidity positions, as evidenced by Ivashina and Scharfstein (2010) who documented a significant contraction in bank lending during the GFC, attributing it to heightened uncertainty and capital constraints. The main causes which exposed banks towards such a demise can be associated to the heavy reliance on non-deposit funding and non-interest income (Demirgüç-Kunt and Huizinga, 2010).

These studies underscore the procyclical nature of bank lending and the necessity for robust capital buffers to withstand economic shocks. Following the GFC, regulatory responses to financial crises have further influenced bank capital structures. Basel Accords, particularly Basel III, introduced stricter capital requirements to enhance banks' resilience. Some studies (Admati et al., 2013; Greenbaum et al., 2019) argue that higher equity requirements can mitigate the risk of bank failures without adversely affecting lending. However, implementing these regulations has been met with debates concerning potential impacts on banks' profitability and credit availability.

2.2.2. Banks and the COVID–19 pandemic, 2020 – 2021

According to Levine et al. (2021), COVID–19 spurred the fear for financial fragility and both households and firms in the U.S. responded by increasing bank deposits during 2020. These increases were mostly associated with future uncertainties about jobs and market conditions.

On the other hand, Dursun-de Neef and Schandlbauer (2021) associate increased savings and bank deposits during the COVID–19 pandemic to mobility restrictions due to the lockdown. They also find evidence of accumulated deposits resulting in increased lending by banks, mostly for real estate financing.

³ These include: (i) the Global Financial Crisis (GFC); (ii) the COVID–19 pandemic; and (iii) the Russia – Ukraine war.

⁴ As given by key financial variables, including total debt (TD), short-term debt (STD), long-term debt (LTD), total liabilities (TL), interest-bearing liabilities (IBL), and non-interest-bearing liabilities (NIBL).

2.2.3. Banks and the Russia-Ukraine War, 2022 onwards

Both Russia and Ukraine have been heavily affected by the war, which triggered several sanctions on Russia by the international community. Russian businesses, including banks, have consequently attracted several downgrades by rating agencies (OECD, 2022). Ukrainian banks, on their part, have experienced significant disruption to their operations resulting in significant deterioration of their credit profiles. International banks with linkages to Russia and Ukraine are facing higher risk of non-performing loans (OECD, 2022). The war has resulted in a reduction in the number of banks in Ukraine as a result of closures and foreign banks leaving the country due to economic and political instability (Stoika, 2023). According to Yudaruddin and Lesmana (2024), the announcement of the war has resulted in severe negative sentiments by bank market investors, especially in the NATO region.

In summary, the literature highlights that banks' capital structures are influenced by a confluence of market dynamics, regulatory frameworks, and macroeconomic conditions. Understanding these factors is crucial, especially during periods of financial turmoil, to inform policies that promote banking sector stability and economic resilience.

2.3. Theoretical framework: crisis types and bank capital structure

This study distinguishes among three qualitatively distinct types of macroeconomic shocks: financial crises, health pandemics, and geopolitical conflicts. The theoretical rationale for expecting differential bank responses rests on three channels: (i) the transmission mechanism of the shock, (ii) the direct impact on bank solvency and liquidity, and (iii) the policy response environment.

2.3.1. Impact of the GFC

Following from Brunnermeier (2009) who postulate that financial crises are characterized by liquidity spirals, fire sales, and a sudden halt in interbank lending and Adrian and Shin (2010) who demonstrate that financial intermediaries actively manage leverage in response to changes in asset values, creating procyclical dynamics, this study theorizes that during financial crises, banks face simultaneous shocks: asset write-downs, frozen wholesale funding markets, and depositor runs. Consequently, the *a priori* expectation is that banks will increase long-term debt and interest-bearing liabilities to replace lost funding, while non-interest-bearing deposits will decline due to flight to safety.

2.3.2. Impact of COVID-19

Temporal pandemic shocks operate primarily through real economy channels such as supply-chain disruptions, collapsing consumer demand, and labour market dislocations. Unlike financial crises, pandemics do not directly impair bank solvency or trigger interbank market freezes. Moreover, unprecedented monetary and fiscal interventions (rate cuts, liquidity facilities, forbearance) actively support bank funding conditions. Theory therefore predicts that banks will not increase total leverage during pandemics, though compositional shifts toward interest-bearing liabilities may occur as depositors reallocate.

2.3.3. Impact of geopolitical conflicts (Russia-Ukraine war)

Geopolitical shocks (postulated as endemic in nature as they usually incorporate a rich history trail) introduce persistent uncertainty about sanctions, counterparty risks, and future access to capital markets. According to the precautionary motive literature, firms increase liquidity buffers and lock-in committed funding when geopolitical risk rises (Bloom, 2009). Banks facing geopolitical uncertainty are predicted to increase interest-bearing liabilities as a precautionary measure, even without immediate solvency threats, while non-interest-bearing deposits decline due to heightened risk aversion.

2.3.4. Testable hypotheses

Based on the above discussions, we test the following hypotheses:

H1. : Financial crises (GFC) increase total debt and long-term debt, whereas health crises (COVID-19) do not.

H2. : Geopolitical crises (Ukraine) increase interest-bearing liabilities more than financial or health crises due to precautionary demand for committed funding.

H3. : Non-interest-bearing liabilities decline systematically across all three crisis types, but most severely during financial crises when bank solvency concerns are greatest.

3. Data and methodology

To analyse the impact of the above-mentioned global crises on the capital structure of banks around the world, the study employs a comprehensive dataset sourced from Refinitiv and the World Bank Development Indicators (WBDI). The dataset includes a wide range of bank-specific and macroeconomic variables, covering multiple years, to capture both cross-sectional and time-series variations. Bank-specific variables are derived from standardized financial statements and include measures of leverage, liquidity, profitability, tangibility, solvency, and asset growth. Macroeconomic variables, such as GDP growth, inflation, and digitization, are included to account for external economic conditions. Additionally, crisis conditions, including the Global Financial Crisis (GFC), COVID-19, and the Russia-Ukraine conflict, are incorporated as dummy variables to assess their impact on banks' financial decisions.

3.1. Model specification

For the purpose of this study, the model is specified in the following form:

$$L_{it} = \beta_0 + \delta L_{it-1} + \beta_1 GROTA_{it} + \beta_2 GROEAR_{it} + \beta_3 LIQCFO_{it} + \beta_4 LIQCFI_{it} + \beta_5 LIQFCF_{it} + \beta_6 TANG_{it} + \beta_7 ICR_{it} + \beta_8 ITS_{it} + \beta_9 SZTA_{it} + \beta_{10} SZMA_{it} + \beta_{11} EBIT_{it} + \beta_{12} ZSCORE_{it} + \beta_{13} INTAN_{it} + \beta_{14} PROEB_{it} + \beta_{15} PROOM_{it} + \beta_{16} TAX_{it} + \beta_{17} AGE_{it} + \beta_{18} CAPEX_{it} + \beta_{19} DIV_{it} + \beta_{20} LOA_{it} + \beta_{21} DEPO_{it} + \beta_{22} INV_{it} + \beta_{23} DEPOCU_{it} + \beta_{24} ESG_{it} + \beta_{25} GDPGR_{it} + \beta_{26} GDPCAP_{it} + \beta_{27} CPI_{it} + \beta_{28} DIGIT100_{it} + \beta_{29} AGING_{it} + \beta_{30} GFC_t + \beta_{31} COVID_t + \beta_{32} UKRAINE_t + \alpha_i + \varepsilon_{it}$$

In the above model, the dependent variable (L_{it}) is denoted by various measures of leverage, including total debt to total assets (TDTA), short-term debt to total assets (STDTA), long-term debt to total assets (LTDTA), total liabilities to total assets (TLTA), interest-bearing liabilities to total assets (IBLTA), and non-interest-bearing liabilities to total assets (NIBLTA), as shown in Table 1. These variables are computed using data from Refinitiv and are scaled by total assets to ensure comparability across firms. Following from Ramlall (2022) the variable for digital literacy and aging has been added as control variables. L_{it-1} are the lagged dependent variables and δ captures the persistence of leverage over time, while α_i represents the unobserved firm-specific fixed effects and ε_{it} is the idiosyncratic error term.

3.2. Two-step system generalised method of moments (GMM)

In what follows, a dynamic panel data analysis is adopted to control for country level fixed effects. Use of dynamic panel analysis is advocated when the independent variables may be correlated with the past and current error term and when the existence of heteroscedasticity and autocorrelation is suspected (Roodman, 2009). The fact that country level fixed effects are also present in our case makes a genuine case for using dynamic panel data estimators (Kalemli-Ozcan et al., 2012). In addition, the inclusion of L_{it-1} as a regressor gives rise to the issue of endogeneity as past leverage is correlated with firm fixed effects α_i . This motivates the use of system GMM estimator following Blundell and Bond

Table 1

List of variables.

<i>Dependent variable</i>		
Leverage	Computation	Source
TDTA	Total debt scaled by Total assets	Refinitiv
LTDTA	Long term debt scaled by Total assets	Refinitiv
STDTA	Short term debt scaled by Total assets	Refinitiv
TLTA	Total liabilities scaled by Total assets	Refinitiv
IBLTA	Interest bearing liabilities over Total assets	Refinitiv
NIBLTA	Total liabilities minus interest bearing liabilities, difference scaled by total assets	Refinitiv
Independent variable: Bank-specific forces under capital structure		
Growth		
GROTA	Growth rate in Total assets	Refinitiv
GROEAR	Growth rate in EBIT	Refinitiv
Liquidity		
LIQCFO	Cash flow from operating activities over total assets	Refinitiv
LIQCFI	Cash flow from investing activities over total assets	Refinitiv
LIQCFF	Cash flow from financing activities over total assets	Refinitiv
LIQFCF	Free cash flow over total assets	Refinitiv
Tangibility		
TANG	Net property, plant and equity over total assets	Refinitiv
Solvency		
ICR	Interest coverage ratio	Refinitiv
Interest Tax shield		
ITS	(Interest expense x Tax rate) scaled by total assets	Refinitiv
Size		
SZTA	Natural log of Total assets	Refinitiv
SZMA	Natural log of Market capitalization	Refinitiv
Risk		
EBIT_ZScore	EBIT Zscore	Refinitiv
Intangibles		
INTAN	Intangible assets over total assets	Refinitiv
Profitability		
PROEB	EBIT scaled by Total assets	Refinitiv
PROOM	Operating margin (EBIT over revenue)	Refinitiv
Tax rate		
TAX	Tax rate	Refinitiv
Age		
Age	Natural log of number of days since incorporated	Refinitiv
Others		
CAPEX	Capital expenditures scaled by total assets	Refinitiv
DIV	Dividends paid scaled by total assets	Refinitiv
Independent variable: Bank-specific forces under Balance Sheet structure		
LOA	Gross total loans scaled by total assets	Refinitiv
DEPO	Gross total deposits scaled by total assets	Refinitiv
INV	Investment Securities - Available for Sale, HTM & HFT, scaled by total assets	Refinitiv
DEPOCU	Gross total deposits from customers scaled by total assets	Refinitiv
DEPOCO	Gross total deposits from corporates scaled by total assets	Refinitiv
Independent variable: Bank-specific green forces under Balance Sheet structure		
ESG	ESG Score over median score for whole sample	Refinitiv
EMS	Emissions Score over median score for whole sample	Refinitiv
Independent variable: Macroeconomic-specific forces		
GDPGR	GDP growth rate	WBDI
GDPCAP	GDP per capita	WBDI
CPI	Inflation rate	WBDI
DIGIT100	Digitization, mobile cellular subscription per 100 people	WBDI
AGING	Aging population, percentage population comprising above 65 years old people	WBDI
Crisis conditions		
GFC	Global Financial Crisis (2007–2010)	Computed
COVID–19	COVID–19 for period 2020–2021	Computed
Ukraine	Year 2022 as dummy variable	Computed

Source: Authors' illustration

(1998), which instruments the lagged dependent variable using lagged levels and differences to produce consistent estimates.

This approach allows for a robust examination of how historical financial decisions influence current financial strategies, while also accounting for the dynamic nature of corporate financing behaviour. The use of GMM ensures that the model is well-suited to handle the complexities of the data, providing reliable and insightful results for

understanding the determinants of banking financial structures. Overall, the two-step GMM model strikes a balance between consistency and efficiency, making it a robust tool for empirical research in areas such as macroeconomics and finance.

3.3. Data and variables

At the outset, 1529 banks' fundamentals data were downloaded from the Refinitiv database but after cleaning and aligning the data, only 391 banks were obtained for a full-fledged analysis relating to the impacts of the three crises on banks' capital structure. For the purpose of this analysis, data from 2005 till 2022 were employed.

Macroeconomic data such as GDP growth, inflation, and digitization were obtained from the World Bank Development Indicators, while year dummies were included for the crises period as follows; Global Financial Crisis (GFC) from 2007 to 2010; COVID–19 pandemic from 2020 to 2021, and the Ukraine conflict for 2022. It is to be noted that the Ukraine crisis is still ongoing at the time of writing this paper. ESG score and sustainability data were obtained from the Refinitiv database.

The independent variables are categorized into bank-specific forces under capital structure, bank-specific forces under balance sheet structure, bank-specific green forces under balance sheet structure, and macroeconomic-specific forces (refer to Table 1). Bank-specific forces under capital structure include growth rates in total assets (GROTA) and EBIT (GROEAR), liquidity measures such as cash flow from operating, investing, and financing activities (LIQCFO, LIQCFI, LIQCFF), and free cash flow (LIQFCF). Tangibility is measured by net property, plant, and equipment to total assets (TANG), while solvency is captured by the interest coverage ratio (ICR). The interest tax shield (ITS) and size variables (SZTA and SZMA) reflect the bank's ability to leverage tax benefits and economies of scale. Risk is assessed using the EBIT Z-score (EBIT_ZScore)⁵ and intangibles are measured by intangible assets to total assets (INTAN). Profitability is captured by EBIT to total assets (PROEB) and operating margin (PROOM), while the tax rate (TAX) and age of the bank (Age) are also considered.

Additional variables include capital expenditures (CAPEX) and dividends paid (DIV) scaled by total assets. Bank-specific forces under balance sheet structure include gross total loans to total assets (LOA), gross total deposits to total assets (DEPO), investment securities to total assets (INV), and deposits from customers and corporates to total assets (DEPOCU and DEPOCO). These variables highlight the composition of the bank's balance sheet and its reliance on different funding sources. Bank-specific green forces under balance sheet structure are captured by the ESG score (ESG) and emissions score (EMS) relative to the median score for the sample, reflecting the bank's commitment to environmental and sustainability practices.

4. Results and discussions

4.1. Descriptive statistics

The final analysis dataset contains 7038 firm-year observations across 42 variables, providing a comprehensive foundation for empirical analysis. Following data cleaning and outlier treatment (winsorization at the 1st and 99th percentiles), the descriptive statistics in Table 2 above, summarizes the central tendencies, dispersion, and ranges of all variables, offering reliable insights into their distribution and variability. Key financial variables such as total debt to total assets (TDTA) exhibit a mean of 0.126 with a standard deviation of 0.107, indicating moderate leverage with reasonable cross-firm variation. Long-term debt to total assets (LTDTA) and short-term debt to total assets (STDTA) display mean values of 0.084 and 0.044, respectively, with standard

⁵ Measured by the number of standard deviations that a bank's EBIT must fall for the bank to become insolvent.

Table 2
Summary Statistics.

VARIABLES	N	mean	sd	min	max
id	7038	196	112.9	1	391
year	7038	2014	5.188	2005	2022
tdta	7038	0.126	0.107	0	0.739
ltdta	7038	0.0840	0.0926	0	0.770
stdta	7038	0.0438	0.0574	0	0.392
tlta	7038	0.905	0.0339	0.714	0.976
ibltta	7038	0.857	0.104	0.134	1.718
nibltta	7038	0.0560	0.0793	0	0.774
grota	7038	0.132	0.850	−0.983	28.73
groear	7038	0.0856	0.224	−0.553	0.733
liqcf	7038	0.0152	0.0327	−0.137	0.179
liqcfi	7038	−0.0283	0.0502	−0.288	0.168
liqcff	7038	0.0207	0.0512	−0.171	0.310
liqfcf	7038	0.00562	0.00729	−0.0564	0.0430
tang	7038	0.0127	0.00918	0.000329	0.0802
icr	7038	2.073	3.982	−2.549	93.30
ebit_zscore	7038	0.557	1.061	−1.977	1.970
its	7038	0.00375	0.00471	−0.0332	0.0257
szta	7038	9.932	2.077	5.497	14.97
intan	7038	0.00341	0.00601	0	0.0746
proeb	7038	0.0171	0.0104	−0.0471	0.0608
proom	7038	0.380	0.138	−0.00215	0.766
tax	7038	0.223	0.170	−2.527	0.788
age	7038	9.127	1.003	4.600	10.92
capex	7038	0.00182	0.00249	−0.00857	0.0241
div	7038	0.00424	0.00492	0	0.0753
loa	7038	0.672	0.225	0.00196	3.123
depo	7038	0.736	0.144	0.234	1.562
inv	7038	0.225	0.160	0.00562	1.961
depocu	7038	0.650	0.311	0	4.487
depoco	7038	0.107	0.176	0	0.833
esg	7038	1.065	0.530	0	2.306
ems	7038	2.495	2.828	0	8.701
gdpgr	7038	0.0287	0.0323	−0.109	0.150
gdpcap	7038	39,741	24,632	710.5	108,798
cpi	7038	0.0316	0.0353	−0.0449	0.723
digit100	7038	103.4	31.66	7.759	319.4
aging	7038	12.49	5.316	1.366	29.40
gfc	7038	0.222	0.416	0	1
covid19	7038	0.111	0.314	0	1
ukraine	7038	0.0556	0.229	0	1

Source: Authors' illustration

deviations of 0.093 and 0.057. These figures confirm that firms in the sample rely more heavily on long-term financing, and importantly, both debt ratios are bounded within the [0, 1] interval.

Profitability and liquidity measures reveal meaningful patterns. The mean growth rate in total assets (GROTA) stands at 0.132 with a standard deviation of 0.850, and a maximum of 28.73. While the distribution remains positively skewed, extreme outliers have been successfully contained. Similarly, growth in earnings (GROEAR) shows a mean of 0.086 with a standard deviation of 0.224, ranging from −0.553–0.733, indicating moderate performance disparities across firms. Liquidity variables (LIQCF, LIQCFI, LIQCF, and LIQCF) maintain small means reflecting modest cash flow levels, with negative minimum values capturing cases of cash outflows or financial distress. Indicator variables for the global financial crisis (GFC), COVID-19 pandemic (COVID19), and the Russia – Ukraine conflict (UKRAINE) are coded as binary, with means of 0.222, 0.111, and 0.056, respectively, revealing the proportion of observations affected by these significant global events.

The dataset also includes measures of firm-specific characteristics. The average firm age (AGE) is approximately 9.13 years, indicating a relatively young sample. Firm size, proxied by the natural logarithm of total assets (SZTA), averages 9.93 with a standard deviation of 2.08, signifying meaningful variation in asset bases. The ratio of intangible assets over total assets (INTAN) presents a mean of 0.0034 with a maximum of 0.075, suggesting that intangible resources constitute a small fraction of total assets for most banks. Macroeconomic variables provide additional context. GDP per capita (GDPCAP) averages \$39,741

with a standard deviation of \$24,632, reflecting economic diversity across countries, while GDP growth (GDPGR) averages 2.87%, indicating modest economic expansion during the sampled period. Consumer price index (CPI) fluctuations range from −0.045–0.723, capturing both deflationary and inflationary environments.

A deeper examination of the dataset reveals important insights regarding the financial health of banks in the sample. The interest coverage ratio (ICR) displays a mean of 2.07 with a standard deviation of 3.98, ranging from −2.55–93.30. Unlike the raw data, which contained implausible extremes, the winsorized distribution indicates that most firms maintain sufficient earnings to cover interest expenses, though some exhibit financial distress. Non-interest-bearing liabilities to total assets (NIBLTA) has a mean of 0.056 with a standard deviation of 0.079, and ranges from 0 to 0.774, indicating that the vast majority of firms maintain positive non-interest-bearing liabilities at manageable levels relative to their assets.

Finally, the dataset captures firms' capital investment and shareholder distribution patterns. Capital expenditures (CAPEX) show a mean of 0.0018 with a range from −0.0086–0.0241, suggesting generally low capital reinvestment levels with limited negative adjustments (asset sales). Dividend payments (DIV) remain modest, with a mean of 0.0042 and a maximum of 0.075, indicating that a small minority of banks prioritize substantial shareholder returns. The tangible assets ratio (TANG) averages 0.0127 with a maximum of 0.080, confirming that banks in the sample rely predominantly on financial and intangible assets, a characteristic consistent with the banking industry's business model. This composition, while standard for financial institutions, underscores the importance of controlling asset structure when analyzing bank capital structure dynamics during crisis periods.

4.2. Correlation among variables

The correlation analysis (Table 3) reveals several theoretically consistent relationships among the key financial variables. Total debt to total assets (TDTA) exhibits a strong positive correlation with long-term debt to total assets (LTDTA) at 0.799, indicating that firms with higher total debt levels rely predominantly on long-term financing. This is expected, as long-term debt constitutes a major component of total debt. The correlation between TDTA and short-term debt to total assets (STDTA) is moderately positive at 0.539, suggesting that short-term debt also contributes to total leverage, though to a lesser extent. Notably, the correlation between LTDTA and STDTA is near zero at 0.005, confirming that firms do not systematically balance long-term and short-term debt in a compensatory manner. This pattern suggests that short-term and long-term debt serve distinct financing purposes rather than functioning as substitutes for the sample of banks studied.

Total liabilities to total assets (TLTA) shows a moderate positive correlation with firm size (SZTA) at 0.368, suggesting that larger firms maintain higher liability ratios, likely reflecting their enhanced access to credit markets and greater financing capacity. Furthermore, TLTA exhibits a notable negative correlation with profit before interest and tax (PROEB) at −0.340, implying that firms with higher liability burdens tend to report lower profitability, possibly due to elevated interest expenses or financial distress.

The liquidity-related variables, cash flow from operations (LIQCF), investing activities (LIQCFI), and financing activities (LIQCF), display theoretically expected patterns. LIQCFI and LIQCF show a strong negative correlation of −0.760, indicating that firms generating liquidity from financing activities tend to have negative or lower liquidity from investing activities. This reflects a fundamental trade-off: banks that raise external funds may simultaneously divest assets or reduce capital expenditures. Conversely, firms with high investing outflows typically require financing inflows. To mitigate multicollinearity concerns, we exclude LIQCF from the regression analysis. Similarly, we exclude the variable Emissions score (EMS) due to its high correlation with Environmental, Social and Governance score (ESG) at 0.787, which

Table 3
Pairwise correlations.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
(1) tdta	1																		
(2) ltdta	0.799	1																	
(3) stdta	0.539	0.005	1																
(4) tlta	0.153	0.133	0.076	1															
(5) iblta	0.072	0.032	0.08	0.072	1														
(6) niblta	0.12	0.117	0.038	0.307	−0.72	1													
(7) grotat	−0.01	−0	0.002	0.033	−0.02	0.035	1												
(8) groear	−0.06	−0.04	−0.04	−0.04	0.044	−0.08	0.054	1											
(9) liqcf	−0.13	−0.12	−0.02	−0.07	−0	−0.04	0.019	0.002	1										
(10) liqcfi	0.014	0.056	−0.06	0.038	−0.13	0.165	−0.06	−0.1	−0.2	1									
(11) liqcff	0.04	0.008	0.058	−0	0.128	−0.14	0.075	0.118	−0.18	−0.76	1								
(12) liqcf	−0.09	−0.07	−0.04	−0.27	−0.09	−0.03	0.028	0.199	0.078	−0.11	0.074	1							
(13) tang	−0.18	−0.14	−0.09	−0.27	0.096	−0.17	−0.01	0.028	0.118	−0.07	0.001	−0.01	1						
(14) icr	−0.2	−0.19	−0.07	−0.18	0.032	−0.14	−0	0.084	0.023	−0.14	0.15	0.166	0.032	1					
(15) ebit_zscore	−0.12	−0.09	−0.06	−0.11	0.041	−0.12	0.047	0.584	0.004	−0.17	0.181	0.423	0.034	0.176	1				
(16) its	0.126	0.133	0.027	0.116	0.007	0.079	0.002	0.005	0.026	0.002	−0.04	0.07	0.016	−0.24	0.015	1			
(17) szta	0.136	0.073	0.113	0.368	−0.32	0.533	0.03	−0.06	−0.02	0.239	−0.22	−0.05	−0.37	−0.08	−0.08	0.001	1		
(18) intan	0.122	0.095	0.098	−0.05	0.016	0.025	0.03	0.025	0.022	−0.07	0.073	−0.02	0.143	−0.03	−0.01	0.021	−0.03	1	
(19) proeb	0.127	0.122	0.044	−0.34	−0.1	0.025	0.026	0.172	0.108	−0.09	0.031	0.674	0.115	0.061	0.395	0.268	−0.08	0.087	1
(20) proom	−0.01	0.043	−0.06	−0.15	−0.01	−0.06	0.024	0.223	0.051	−0.08	0.07	0.29	−0.11	0.16	0.319	0.035	−0.01	−0.04	0.393
(21) tax	0.022	0.027	0.008	0.09	0.041	−0.01	0	0.049	−0.01	−0.09	0.075	−0.02	−0	0.048	0.075	0.519	−0.03	−0.02	0.093
(22) age	−0.06	−0.06	−0.02	0.1	−0.12	0.092	−0.05	−0.03	−0.01	0.126	−0.12	0.06	−0.11	0.025	−0	0.04	0.214	−0.04	0.007
(23) capex	−0.01	0.013	−0.01	−0.14	0.003	0.005	0.022	0.024	0.148	−0.11	0.07	0.014	0.468	−0.07	0.055	0.153	−0.14	0.167	0.288
(24) div	0.018	0.069	−0.01	−0.31	−0.01	−0.06	0.005	0.013	0.086	−0	−0.05	0.14	0.178	0.04	0.054	0.024	−0.12	0.099	0.366
(25) loa	0.067	0.132	−0.09	−0.1	0.315	−0.28	−0.04	0.03	−0.09	−0.05	0.09	−0.03	0.055	−0.03	0.023	0.019	−0.27	0.033	−0.01
(26) depo	−0.63	−0.51	−0.32	−0.08	0.614	−0.53	−0.01	0.074	0.1	−0.12	0.074	0.02	0.239	0.171	0.114	−0.07	−0.34	−0.04	−0.13
(27) inv	0.013	−0.05	0.103	0.082	−0.03	0.139	0.025	−0	0.076	−0.03	−0.02	0.052	0.072	0.023	−0.02	0.072	0.04	−0.01	0.05

(continued on next page)

Table 3 (continued)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
(28) depocu	−0.3	−0.23	−0.16	−0.08	0.282	−0.24	−0.01	0.033	0.079	−0.11	0.078	0.038	0.202	0.085	0.049	0.007	−0.26	−0.03	−0.04
(29) depoco	−0	−0.02	0.01	0.098	0.011	0.05	0.01	0.012	−0	0.047	−0.03	−0.04	−0.02	−0.04	0.009	−0	0.097	0.037	−0.01
(30) esg	0.095	0.032	0.114	0.234	−0.26	0.425	0.01	−0.05	−0.01	0.124	−0.11	−0.04	−0.23	−0.06	−0.08	−0.02	0.647	0.02	−0.02
(31) ems	0.143	0.106	0.084	0.293	−0.33	0.504	0.01	−0.08	−0.01	0.206	−0.17	−0.04	−0.22	−0.11	−0.12	0.01	0.679	0.003	−0.03
(32) gdpgr	−0.17	−0.09	−0.12	0.015	0.006	−0.03	0.043	0.132	0.131	−0.01	0.025	0.171	−0.01	0.013	0.094	0.054	0.05	−0.07	0.088
(33) gdpcap	0.14	0.117	0.036	−0.09	0.109	−0.19	−0.02	−0	−0.15	−0.15	0.217	−0.13	−0.09	0.262	0.025	−0.37	−0.22	−0	−0.21
(34) cpi	−0.07	−0.02	−0.08	−0.07	−0.04	0.015	0.011	0.063	0.149	−0.03	0.012	0.212	0.132	0.029	0.047	0.264	−0.05	−0	0.291
(35) digit100	−0.03	−0.01	−0.09	−0.09	−0.17	0.119	−0.07	−0.08	−0.08	0.163	−0.13	−0.04	−0.18	0.06	−0.06	−0.25	0.276	−0.06	−0.11
(36) aging	0.158	0.094	0.111	0.236	0.027	0.057	−0.03	−0.07	−0.13	−0.01	0.058	−0.25	−0.13	0.152	−0.1	−0.27	0.143	−0.02	−0.37
(37) gfc	0.136	0.123	0.065	0.098	0.1	0.007	0.01	−0.05	−0.01	−0.02	0.035	−0.12	0.081	−0.18	−0.08	0.2	−0.09	0.118	0.029
(38) covid19	−0.07	−0.07	−0.03	−0.08	−0.05	−0.02	−0.01	−0.11	0.029	−0.01	0.049	0.001	−0.03	0.052	−0.03	−0.09	0.09	−0.06	−0.04
(39) ukraine	−0.08	−0.07	−0.05	−0.02	−0.02	−0.02	−0.01	0.067	0.053	−0.02	0.035	0.062	−0.06	0.236	0.032	−0.1	0.079	−0.05	−0.03
Variables	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
(20) proom	1																		
(21) tax	0.058	1																	
(22) age	−0.02	−0.04	1																
(23) capex	−0.01	0.021	−0.07	1															
(24) div	0.243	−0.05	−0.06	0.24	1														
(25) loa	0.044	0.012	−0.08	0.015	0.046	1													
(26) depo	0.021	0.006	−0.04	0.042	0.018	0.247	1												
(27) inv	−0.01	−0.02	0.051	0.074	0.008	−0.2	0.041	1											
(28) depocu	−0.01	0.036	−0.09	0.084	0.008	0.176	0.493	0.081	1										
(29) depoco	0.028	−0.03	0.019	0.011	0.005	0.011	0.022	0.006	−0.59	1									
(30) esg	−0.04	−0.02	0.17	−0.08	−0.02	−0.18	−0.27	0.049	−0.19	0.069	1								
(31) ems	−0.06	−0.04	0.146	−0.03	−0.04	−0.2	−0.35	0.034	−0.24	0.092	0.787	1							
(32) gdpgr	0.131	−0.03	−0	0.04	0.081	−0.07	0.156	0.155	0.065	0.068	−0.01	−0.01	1						
(33) gdpcap	0.036	0.009	−0.12	−0.25	−0.11	0.162	−0.04	−0.21	0.041	−0.17	−0.15	−0.2	−0.32	1					
(34) cpi	0.105	0.002	0.082	0.206	0.088	−0.06	0.038	0.153	0.053	−0	−0.02	0.025	0.272	−0.28	1				

(continued on next page)

Table 3 (continued)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
(35) digit100	0.021																		
(36) aging	-0.12	0.142	-0.18	-0.04	-0.02	-0.12	-0.28	-0.12	-0.02	0.193	0.287	-0.23	0.172	-0.22	1				
(37) gfc	0.117	-0.09	-0.24	-0.24	0	-0.13	-0.13	-0.05	-0.07	0.138	0.168	-0.38	0.537	-0.33	0.219	1			
(38) covid19	-0.02	-0.13	0.133	0.053	0.078	-0.01	0.038	0	0.031	-0.07	-0.08	-0.1	-0.09	0.021	-0.22	-0.13	1		
(39) ukraine	-0.05	0.118	-0.06	-0.03	-0.01	0.011	-0.07	-0.01	-0.02	0.106	0.113	-0.15	0.082	-0.02	0.153	0.131	-0.19	1	
	-0.03	0.093	-0.07	-0.05	-0.04	0.042	-0.01	0.006	-0	0.098	0.121	0.053	0.124	0.353	0.136	0.114	-0.13	-0.09	1

Source: Author's illustration

exceeds conventional multicollinearity thresholds.

Tangibility of assets (TANG) exhibits a moderate positive correlation with capital expenditures (CAPEX) at 0.468, confirming that firms with more tangible assets invest more heavily in capital expenditures. This finding is consistent with the theoretical view that tangible assets serve as collateral, facilitating access to investment financing. TANG also shows a negative correlation with firm size (SZTA) at -0.370 , indicating that larger firms maintain a lower proportion of tangible assets, likely due to a greater share of intangible assets such as intellectual property, brand value, or goodwill.

The interest coverage ratio (ICR), a key measure of a firm's ability to meet interest obligations, exhibits meaningful correlations with several variables. ICR correlates negatively with TDTA (-0.200) and LTDTA (-0.190), confirming that higher leverage is associated with reduced interest coverage capacity. Additionally, ICR shows a positive correlation with GDP per capita (GDPCAP) at 0.262, suggesting that banks in higher-income economies maintain stronger interest coverage. Also, ICR is moderately positive with the Russia – Ukraine crisis indicator (UKRAINE) at 0.236. This could be associated with banks bulking up their repayment capability in response to uncertainties created by the conflict.

The macroeconomic variables display several notable correlations with firm-level outcomes. GDP growth (GDPGR) correlates positively with profit before interest and tax (PROEB) at 0.088 and with earnings growth (GROEAR) at 0.132, indicating that firms perform better during economic expansions, as expected. GDP growth also correlates with free cash flow (LIQFCF) at 0.171, suggesting that macroeconomic conditions positively influence firm-level cash generation. The consumer price index (CPI) shows a positive correlation with earnings growth (GROEAR) at 0.063 and with free cash flow (LIQFCF) at 0.212, potentially reflecting the pass-through of inflation to nominal revenues and cash flows. Notably, the Russia-Ukraine crisis variable (UKRAINE) exhibits a substantial positive correlation with CPI at 0.353, capturing the inflationary shock associated with the conflict.

The interest tax shield (ITS) demonstrates several theoretically expected relationships. ITS correlates positively with profit before interest and tax (PROEB) at 0.268, with capital expenditures (CAPEX) at 0.153, and with the global financial crisis indicator (GFC) at 0.200. These patterns suggest that profitable, investing firms derive greater tax benefits from debt financing, and that the post-crisis period saw increased tax shield utilization. However, ITS shows a negative correlation with GDP per capita (GDPCAP) at -0.370 , which may reflect cross-country differences in corporate tax regimes.

Finally, the environmental, social, and governance (ESG) score correlates positively with firm size (SZTA) at 0.647 and with non-interest-bearing liabilities to total assets (NIBLTA) at 0.425, indicating that larger firms with higher net leverage tend to have stronger ESG performance. This relationship may reflect the greater disclosure and formal sustainability reporting practices of large, publicly traded firms.

4.3. Discussion

4.3.1. Capital structure variables

Table 4 presents the estimation results from the Two-Step Generalized Method of Moments (GMM) models examining the determinants of six bank financial structure variables: total debt to total assets (TD), short-term debt to total assets (STD), long-term debt to total assets (LTD), total liabilities to total assets (TL), interest-bearing liabilities to total assets (IBL) and non-interest-bearing liabilities to total assets (NIBL). The models demonstrate strong statistical validity, as evidenced by the significance levels of the lagged dependent variables and the overall pattern of coefficients.

4.3.1.1. Persistence of bank financial structures. The lagged dependent variables are statistically significant at the one percent level across all six

Table 4
Results from Two-Step GMM model.

Variables	TD_Two-Step GMM	STD_Two-Step GMM	LTD_Two-Step GMM	TL_Two-Step GMM	IBL_Two-Step GMM	NIBL_Two-Step GMM
L.tdta	0.700*** (0.0344)					
grota	−0.0109 (0.0118)	−0.0169* (0.00907)	−0.00777 (0.00921)	0.0183*** (0.00352)	−0.00379 (0.0146)	0.0162 (0.0122)
groear	−0.0186** (0.00852)	−0.0188*** (0.00595)	0.00724 (0.00857)	−0.00804*** (0.00223)	−0.00792 (0.0114)	−0.0136 (0.00863)
liqcfo	−0.259*** (0.0632)	−0.118** (0.0520)	−0.173*** (0.0487)	0.0283 (0.0189)	−0.0450 (0.0866)	−0.198*** (0.0698)
liqcfi	−0.0885** (0.0451)	−0.0826*** (0.0308)	−0.0671* (0.0357)	−0.0441*** (0.0121)	−0.0493 (0.0689)	0.00159 (0.0286)
liqcf	0.0131 (0.366)	−0.211 (0.273)	0.150 (0.358)	−0.459*** (0.106)	−0.965** (0.473)	−0.114 (0.309)
proeb	−0.114 (0.370)	0.306 (0.272)	−0.128 (0.412)	0.172 (0.128)	0.532 (0.547)	−0.0225 (0.374)
proom	−0.0450** (0.0180)	−0.0208* (0.0123)	−0.0108 (0.0166)	−0.00990** (0.00475)	−0.0365* (0.0219)	0.00788 (0.0145)
ebit_zscore	0.00369*** (0.00142)	0.00338*** (0.000985)	−0.000249 (0.00118)	0.000304 (0.000381)	−0.000443 (0.00152)	0.000571 (0.00104)
szta	−0.00146 (0.00213)	−0.000395 (0.00129)	−0.000528 (0.00174)	0.000888** (0.000376)	−0.00528* (0.00308)	0.00229* (0.00132)
icr	−0.000516* (0.000275)	−0.000415** (0.000199)	−0.000275 (0.000195)	0.000157** (7.77e−05)	0.000227 (0.000322)	−0.000309 (0.000206)
its	0.806 (0.501)	−0.376 (0.319)	0.0573 (0.431)	0.323** (0.140)	0.812 (0.689)	0.314 (0.452)
intan	−0.259 (0.424)	0.206 (0.258)	−0.617* (0.330)	−0.0754 (0.0797)	0.0197 (0.427)	0.161 (0.178)
loa	−0.0157 (0.0116)	−0.00351 (0.00695)	−0.00431 (0.00929)	−0.000771 (0.00273)	−0.00472 (0.0182)	0.0107 (0.00880)
depo	−0.182*** (0.0315)	−0.0388*** (0.0138)	−0.117*** (0.0265)	−0.000740 (0.00475)	0.150*** (0.0570)	−0.0458* (0.0276)
esg	−0.00746 (0.00809)	0.00253 (0.00434)	−0.00201 (0.00579)	0.00197 (0.00126)	−0.00267 (0.00864)	0.0171** (0.00679)
div	2.086** (0.865)	−0.146 (0.683)	1.785** (0.826)	−0.157 (0.228)	−1.320 (1.359)	0.0694 (0.738)
tang	−1.104 (0.696)	−0.740** (0.377)	−0.307 (0.546)	−0.0425 (0.115)	−1.716* (0.977)	0.998** (0.472)
tax	0.0142 (0.0118)	0.00585 (0.0102)	0.0103 (0.0112)	−0.00230 (0.00336)	0.00336 (0.0147)	−0.00731 (0.00915)
age	−0.0142*** (0.00398)	−0.00216 (0.00234)	−0.00570 (0.00352)	−0.00278*** (0.000993)	−0.0155*** (0.00553)	0.00166 (0.00262)
inv	−0.00189 (0.0225)	0.0439*** (0.0138)	−0.00325 (0.0179)	−0.000500 (0.00599)	−0.0441 (0.0348)	0.0469* (0.0273)
capex	0.980 (1.486)	1.241 (1.050)	−0.858 (1.300)	−0.473 (0.432)	2.538 (2.806)	−2.159 (1.338)
gfc	0.00573** (0.00274)	0.00115 (0.00170)	0.00844*** (0.00252)	−0.00148** (0.000613)	0.00827** (0.00362)	−0.00539** (0.00246)
covid19	−0.000479 (0.00219)	−0.00274* (0.00152)	0.00123 (0.00184)	0.000561 (0.000468)	0.00485** (0.00238)	−0.00374** (0.00184)
ukraine	0.00810*** (0.00295)	0.000866 (0.00194)	0.00142 (0.00213)	0.00286*** (0.000720)	0.0110*** (0.00276)	−0.00332* (0.00189)
L.stdta		0.736*** (0.0262)				
L.ltdta			0.741*** (0.0310)			
L.tlta				0.872*** (0.0219)		
L.iblta					0.591*** (0.0679)	
L.niblta						0.779*** (0.0563)
Constant	0.351*** (0.0692)	0.0656** (0.0328)	0.170*** (0.0556)	0.132*** (0.0272)	0.475*** (0.0918)	−0.0347 (0.0354)
Observations*	6647	6647	6647	6647	6647	6647
Number of ids	391	391	391	391	391	391

Standard errors in parentheses

*** $p < 0.01$

** $p < 0.05$

* $p < 0.1$

Source: Authors' illustration

*Note: The number of observations reported in Table 4, i.e. (n = 6, 647) is due to losing one time-period following the inclusion of lagged dependent variables. The 7038 observations noted in Table 2 can be reconciled by taking the sum of observations reported in Table 4 and the number of Ids.

specifications. The coefficient for lagged total debt to total assets ($L.tdta = 0.700$) indicates that seventy percent of the previous period's leverage ratio persists into the current period. Lagged short-term debt to total assets ($L.stdta$) exhibits a coefficient of 0.736, while lagged long-term debt to total assets ($L.ltdta$) shows a coefficient of 0.741. The highest persistence is observed for lagged total liabilities to total assets ($L.lta$), with a coefficient of 0.872, implying that nearly eighty-seven percent of the prior period's liability ratio carries over to the current period. Lagged interest-bearing liabilities to total assets ($L.iblta$) and lagged non-interest-bearing liabilities to total assets ($L.niblta$) yield coefficients of 0.591 and 0.779, respectively. These large and statistically significant coefficients confirm the strong path dependence of bank financial structures, suggesting that historical financing decisions exert a substantial and lasting influence on current period debt and liability configurations. This also indicates that banks maintain remarkably stable overall liability structures over time.

4.3.1.2. Growth rate in total assets. The growth rate in total assets ($GROTA$), exhibits a negative and marginally significant effect on short-term debt, with a coefficient of -0.0169 . This finding suggests that banks experiencing asset expansion reduce their short-term leverage by approximately 1.7 %age points. In economic terms, a one standard deviation increase in asset growth (0.850 from the descriptive statistics) would be associated with a reduction in short-term debt of roughly 0.014 %age points, a modest but non-trivial adjustment. Conversely, $GROTA$ demonstrates a positive and statistically significant effect on total liabilities, with a coefficient of 0.0183, indicating that expanding banks increase their overall liability base by approximately 1.8 %age points to support growth initiatives. Nonetheless, this result may be misleading since in the banking sector, total liabilities include deposits. Thus, rather than capturing debt behaviour per se, total liabilities may be capturing deposit behaviour. Hence, the moderate significance of STD is still relevant in this case, implying the use of internal financing to support asset growth.

Growth in earnings ($GROEAR$) shows negative and significant effects on total debt, short-term debt, and total liabilities, with coefficients of -0.0186 , -0.0188 , and -0.00804 , respectively. Economically, a one standard deviation increase in earnings growth (0.224) would reduce total debt by approximately 0.42 %age points, representing a meaningful decline given the mean total debt ratio of 0.126. This pattern suggests that banks experiencing earnings expansion reduce their reliance on debt financing, potentially using retained earnings to fund growth. Thus, both $GROTA$ and $GROEAR$ are consistent with the Pecking Order Theory (Myers and Majluf, 1984) and also aligned with Frank and Goyal (2009), who find a negative relationship between asset growth and leverage.

4.3.1.3. Internal liquidity and cash flow measures. Internal liquidity plays a substantial and economically meaningful role in shaping bank financial structures. Cash flow from operations ($LIQCF0$) exhibits negative coefficients that are statistically significant across four of the six specifications. For total debt, the coefficient of -0.259 implies that a one standard deviation increase in operating cash flow (0.0327) reduces the total debt ratio by approximately 0.85 %age points, equivalent to nearly seven percent of the mean total debt ratio. The effect on long-term debt is similarly pronounced, with a coefficient of -0.173 , while short-term debt shows a coefficient of -0.118 . These magnitudes indicate that banks generating stronger operational cash flows reduce their reliance on external debt financing by economically significant amounts, highlighting the role of internal financing in support of the Pecking Order Theory.

Cash flow from investing ($LIQCFI$) demonstrates negative coefficients for -0.0885 for total debt, -0.0826 for short-term debt, -0.0671 for long-term debt, and -0.0441 for total liabilities. A one standard deviation increase in investing cash flow (0.0502) would

reduce total debt by approximately 0.44 %age points, representing an economically meaningful adjustment given the average total debt ratio. The negative relationship between investing cash flows and debt suggests that banks with higher divestment or asset sale proceeds use those funds to reduce outstanding obligations.

Free cash flow ($LIQFCF$) exhibits negative associations with total liabilities and interest-bearing liabilities, with coefficients of -0.459 and -0.965 , respectively. The latter coefficient is particularly substantial: a one standard deviation increase in free cash flow (0.00729) would reduce interest-bearing liabilities by approximately 0.70 %age points, a considerable effect relative to the mean interest-bearing liabilities ratio of 0.857. This finding indicates that banks with abundant discretionary cash flows preferentially reduce their interest-bearing obligations.

4.3.1.4. Profitability. Profitability measures present mixed impacts. Profit margin ($PROOM$) yields negative coefficients for total debt (-0.0450), short-term debt (-0.0208), total liabilities (-0.00990), and interest-bearing liabilities (-0.0365). A one standard deviation increase in profit margin (0.138) would reduce total debt by approximately 0.62 %age points, representing roughly five percent of the mean total debt ratio. This pattern indicates that banks with higher operational efficiency tend to utilize less debt financing, consistent with a preference for internal capital generation over external borrowing. This again aligns with the Pecking Order Theory (Myers and Majluf, 1984) which predicts a negative relationship between profitability and debt.

The earnings before interest and taxes ($EBIT$) z-score, while statistically significant for total debt and short-term debt, produces economically modest coefficients of 0.00369 and 0.00338, respectively. A one standard deviation increase in this measure (1.061) would increase total debt by only 0.39 %age points, suggesting that while earnings capacity facilitates some debt accumulation, the economic magnitude is limited. Profit before interest and taxes does not achieve conventional levels of statistical significance in any specification.

4.3.1.5. Bank size and structural characteristics. Bank size demonstrates differential effects across liability types. The coefficient for total liabilities is 0.000888, while non-interest-bearing liabilities show a coefficient of 0.00229. A one standard deviation increase in bank size (2.077) would increase total liabilities by approximately 0.18 %age points and non-interest-bearing liabilities by 0.48 %age points. These economically modest effects suggest that while larger banks carry more liabilities, possibly due to their ability to access a broader range of financing options and their higher creditworthiness, the magnitude of the size effect is relatively small. Conversely, the negative coefficient for interest-bearing liabilities (-0.00528) indicates that larger banks reduce their interest-bearing obligations, with a one standard deviation increase in size reducing such liabilities by approximately 1.10 %age points. This finding suggests that larger banks fund themselves disproportionately through non-interest-bearing deposit franchises rather than through interest-bearing debt instruments.

4.3.1.6. Bank solvency. The interest coverage ratio exhibits small but statistically discernible effects. The coefficient of -0.000516 for total debt implies that a one standard deviation increase in the interest coverage ratio (3.982) would reduce total debt by only 0.21 %age points, an economically negligible adjustment. However, the positive coefficient for total liabilities (0.000157) suggests that banks with stronger coverage capacity may incrementally increase their overall liability base.

4.3.1.7. Tangibility. Tangibility of assets ($TANG$) produces coefficients of -0.740 for short-term debt, -1.716 for interest-bearing liabilities, and 0.998 for non-interest-bearing liabilities. A one standard deviation increase in tangibility (0.00918) would reduce short-term debt by approximately 0.68 %age points and interest-bearing liabilities by 1.58

%age points, while increasing non-interest-bearing liabilities by 0.92 %age points. These economically meaningful magnitudes suggest that banks with more tangible asset bases, including branch networks, physical infrastructure, and real estate holdings, maintain different liability structures. The positive association with non-interest-bearing liabilities may reflect that depositors prefer banks with visible, tangible collateral.

4.3.1.8. ESG. While Azmi et al. (2021) report that low levels of ESG have a positive impact on bank value in their sample of 251 banks from 44 emerging countries, they find no impact of ESG on the cost of debt. Di Tommaso and Thornton (2020) find that, in fact, high ESG scores decrease bank value for European banks due to overinvestment. Contrarily, Chiaramonte et al. (2022) find strong evidence that banks with high ESG ratings experience lower fragility during a financial turmoil.

This study does not find any impact of ESG on leverage of banks across the world. This could be due to the fact that while ESG by firms plays an important role in determining leverage, banks do not need to satisfy these conditions for debt and/or equity financing.

4.3.1.9. Bank-specific liability components. Deposits exhibit a strong negative relationship with total debt (−0.182), short-term debt (−0.0388), and long-term debt (−0.117). A one standard deviation increase in total deposits (0.144) would reduce total debt by approximately 2.62 %age points, an economically substantial effect representing nearly 21% of the mean total debt ratio. This finding suggests that deposit-rich banks rely substantially less on traditional debt financing, as customer deposits provide a stable and typically lower-cost funding source. However, the positive coefficient for interest-bearing liabilities (0.150) indicates that deposits simultaneously increase specific interest-bearing obligations, as expected, with a one standard deviation increase raising such liabilities by 2.16 %age points.

4.3.2. Macroeconomic crises: economic significance for banks

The three crisis indicators, the global financial crisis, the COVID–19 pandemic, and the Russia – Ukraine conflict, reveal distinct patterns of economic significance in shaping bank financial structures.

4.3.2.1. Bank capital structure and the GFC. The coefficient for GFC is 0.00573 for total debt and 0.00844 for long-term debt. These values imply that during the crisis period, banks increased their total debt ratio by approximately 0.57 %age points and their long-term debt ratio by 0.84 %age points relative to non-crisis periods. Given the mean total debt ratio of 0.126, this represents a 4.5 % relative increase in total leverage. The coefficient of 0.00827 for interest-bearing liabilities indicates a 0.83 %age point increase during the crisis, representing a 0.97 % relative increase given the mean interest-bearing liabilities ratio of 0.857. These findings corroborate with the procyclical nature of debt financing as evidenced by Adrian and Shin (2010).

Nevertheless, the literature contains some mixed results regarding bank leverage following the GFC. For instance, Greenbaum et al. (2019) postulate that banks with more capital, which could be due to high leverage, create more liquidity, lend more and are better prepared in times of crises thereby achieving higher market share. On their part, Ghosh and Chatterjee (2018) found evidence that large banks in India reduced their debt levels following the GFC. However, the current study provides a more comprehensive and international outlook of the impact of GFC on banks.

Furthermore, Berg and Gider (2017) found that financial crises impact larger banks to a greater extent as compared to smaller and medium-sized banks. They concur with Berger and Bouwman (2013) in their findings that larger banks are more undercapitalised during financial crises than during normal times. This could be a major reason for banks to increase their leverage.

Yet, Kořak et al. (2015) analysed how the capital structure of banks affects lending growth during the GFC and found that smaller banks are mostly affected during this period as compared to larger banks. Also, large multinational banks can better ride the crisis tide since they have better access to international capital markets. Banks with high tier 1, as opposed to high tier 2 capital ratio, faced lower credit risk and were able to continue lending during the GFC compared to banks with low tier 1 capital (Kořak et al., 2015). This can again be associated with a higher leverage of larger banks during the GFC compared to leverage under normal conditions.

Finally, ownership structure is also found to have a major impact of banks during crises periods. Both Kořak et al. (2015) and Ghosh and Chatterjee (2018) find a positive relationship between government ownership of banks and lending growth during the GFC. This is mostly true as government grants and supports are readily available to these banks during crisis times.

Conversely, the negative coefficients for total liabilities (−0.00148) and non-interest-bearing liabilities (−0.00539) suggest that banks reduced these obligations by economically modest margins of 0.15 and 0.54 %age points, respectively. The reduction in non-interest-bearing liabilities is particularly noteworthy, as it likely reflects demand-depositors' flight from non-interest-bearing demand deposits during the financial crisis.

Overall, the global financial crisis induced a moderate but discernible shift toward long-term, interest-bearing debt while banks simultaneously experienced reductions in non-interest-bearing deposit funding. This pattern is consistent with the well-documented contraction in deposit bases and the simultaneous expansion of wholesale funding during the 2007–2009 crisis period (Demirgüç-Kunt and Huizinga, 2010).

4.3.2.2. Bank capital structure and the COVID–19 Pandemic. The COVID–19 indicator yields a coefficient of −0.00274 for short-term debt and −0.00374 for non-interest-bearing liabilities, indicating reductions of 0.27 and 0.37 %age points, respectively, during the pandemic period. The positive coefficient for interest-bearing liabilities (0.00485) suggests a 0.49 %age point increase. Relative to their respective means, these changes represent a 6.2 % reduction in short-term debt (mean 0.044), a 6.5 % reduction in non-interest-bearing liabilities (mean 0.056), and a 0.57 % increase in interest-bearing liabilities (mean 0.857). The economic magnitudes suggest that the pandemic prompted banks to restructure their liability composition away from short-term debt and non-interest-bearing deposits toward interest-bearing liabilities. This restructuring may reflect several factors: first, the flight to safety that led depositors to shift from non-interest-bearing accounts; second, the unprecedented monetary policy interventions that lowered interest rates; and third, the regulatory forbearance measures that encouraged banks to maintain liquidity buffers.

Notably, the total debt coefficient for COVID–19 (−0.000479) is not statistically significant, indicating that unlike the global financial crisis, the pandemic did not induce a net increase in overall bank leverage, suggesting that their effects on banks' financial structures may be more nuanced and context-dependent. This is consistent with Mohammad (2022) who also finds that COVID–19 had a lesser impact on bank capital structure. Moreover, this could point towards the in-built systemic risk of financial instability versus ex-ante economic shocks such as the COVID–19 pandemic. It can be concluded that systemic financial shocks weigh significantly more and are more impactful as compared to other type of shocks.

The dampened impact on bank capital structure following the COVID–19 pandemic can also be explained by looking at the surge in retail deposits by bank customers, as previously evidenced by Levine et al. (2021) and Dursun-de Neef and Schandlbauer (2021). While these studies point more towards European banks, a similar pattern can be traced worldwide as the impact of COVID–19 spanned over the globe. Increases in deposits were thereafter used for real-estate financing

and zombie lending (Dursun-de Neef and Schandlbauer, 2021). This points to a strikingly interesting result whereby non-financial shocks are not found to trigger financial panic by the market and hence do not require major financial-driven policies.

4.3.2.3. Bank capital structure and Russia – Ukraine conflict. The Russia – Ukraine crisis indicator demonstrates the most economically substantial effects among the three crises. The coefficient for total debt is 0.00810, implying a 0.81 %age point increase in the total debt ratio during the conflict period, representing a 6.4 % relative increase from the mean of 0.126. Total liabilities increased by 0.00286 %age points, a modest 0.3 % relative increase from the mean of 0.905. Most importantly, interest-bearing liabilities increased by 0.0110 %age points, representing a 1.28 % relative increase from the mean of 0.857. The negative coefficient for non-interest-bearing liabilities (−0.00332) indicates a 0.33 %age point reduction, a 5.9 % relative decline from the mean of 0.056.

This means that the Russia – Ukraine conflict induced a reallocation of bank liability structures away from non-interest-bearing deposits toward interest-bearing debt, with the magnitude of the increase in interest-bearing liabilities (1.10 basis points) exceeding that observed during either the global financial crisis or the COVID–19 pandemic. Such pronounced response may reflect several factors: first, heightened geopolitical uncertainty prompting banks to secure stable, contractually committed funding sources; second, central bank policy responses that altered the relative cost of different funding instruments; and third, regulatory expectations regarding liquidity resilience during geopolitical crises.

4.4. Comparative crisis analysis

The global financial crisis prompted increases across total debt, long-term debt, and interest-bearing liabilities, with the long-term debt response being the most pronounced. This pattern reflects the well-documented shift toward longer-maturity wholesale funding following the collapse of short-term interbank markets in 2008. The COVID–19 pandemic generated a more mixed response, characterized by reductions in short-term debt and non-interest-bearing liabilities alongside a modest increase in interest-bearing liabilities. The absence of a significant total debt response distinguishes the pandemic from the other two crises, potentially reflecting the different nature of the shock, a public health crisis rather than a financial or geopolitical one. The Russia – Ukraine conflict produced the largest increase in total debt and interest-bearing liabilities among all three crises, suggesting that geopolitical instability may induce stronger bank demand for debt financing than either financial or health crises. This finding is consistent with the view that geopolitical shocks generate more persistent uncertainty about future funding conditions, prompting banks to lock in committed funding sources.

Across all three crises, the consistent reduction in non-interest-bearing liabilities reveals a systematic and economically meaningful pattern where banks experience net deposit outflows from non-interest-bearing demand accounts during periods of heightened uncertainty. Such a finding is striking not merely for its statistical consistency, but for what it implies about depositor behaviour and bank liability management under stress.

The mechanism underlying this phenomenon likely operates through two channels. First, on the depositor side, uncertainty triggers a precautionary reassessment of liquidity needs. Non-interest-bearing demand deposits offer no remuneration and provide no contractual claim of interest, yet they remain fully withdrawable at par. During crises, the opportunity cost of holding zero-interest liquidity diminishes as alternative safe assets, such as interest-bearing deposits, money market funds, or government securities, may offer positive returns with comparable or even higher safety. Rational depositors, therefore, reallocate

their portfolios away from non-interest-bearing accounts toward interest-bearing instruments or, in more extreme cases, toward physical currency or foreign denominated assets. Such a behavioural response is amplified when crises are accompanied by actual or perceived risks to bank solvency, as depositors become more attentive to deposit insurance limits and the relative safety of different account types.

Second, on the bank side, the composition of the deposit base shifts in ways that alter funding costs and liquidity risk profiles. Non-interest-bearing deposits represent the cheapest source of bank funding, effectively zero marginal cost, but are also the most flight-prone, as depositors face no interest penalty for withdrawal. As these deposits flee, banks face a funding gap that must be filled through alternative sources. The results indicate that banks systematically substitute toward formal, interest-bearing debt instruments, including wholesale funding, inter-bank borrowings, and issued debt securities. Such a substitution, however, comes at a cost. Interest-bearing liabilities carry explicit interest expenses, may require collateral, and are subject to rollover risk during precisely those periods when wholesale funding markets are most likely to seize.

The magnitude of this substitution effect varies meaningfully across crises. During the global financial crisis, the reduction in non-interest-bearing liabilities (0.54 %age points) was largest, reflecting the severity of depositor flight from zero-interest accounts amid widespread concerns about bank counterparty risk. Coupled with the latter, the Global Financial Crisis directly affected banks which held securitized mortgage securities, let alone the events of frozen interbank markets. The COVID–19 pandemic produced a smaller reduction (0.37 %age points), consistent with the observation that pandemic-related uncertainty, while severe, did not trigger the same degree of bank-specific solvency concerns as the 2007–2009 crisis. Depositors did not flee the banking system entirely during the pandemic, rather, they reallocated within it, shifting from non-interest-bearing to interest-bearing accounts. The Russia – Ukraine conflict generated the smallest reduction in non-interest-bearing liabilities (0.33 %age points), suggesting that geopolitical uncertainty, while economically disruptive, may pose less direct threat to depositor confidence in bank solvency than either a financial crisis or a global pandemic.

An important implication emerges from these patterns. The stability of a bank's overall deposit base may mask significant compositional shifts that have real consequences for funding costs and risk exposure. A bank that maintains a constant total deposit volume while experiencing a migration from non-interest-bearing to interest-bearing deposits has, in economic terms, experienced a funding cost increase and a liquidity risk transformation. These results suggest that during crises, banks accept this trade-off, higher funding costs in exchange for greater liability stability, as they substitute away from flight-prone non-interest-bearing deposits toward more contractually committed funding sources. Such a state of affairs entails vital policy implications for bank liquidity regulation. Regulatory frameworks such as the Liquidity Coverage Ratio and the Net Stable Funding Ratio assign different run-off rates to different deposit categories, with non-interest-bearing retail deposits

Table 5
Diagnostic Statistics.

Diagnostic	TD	STD	LTD	TL	IBL	NIBL
AR(1) (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
AR(2) (p-value)	0.114	0.054	0.632	0.248	0.113	0.088
Hansen J-test (p-value)	0.385	0.486	0.296	0.279	0.301	0.237
Number of instruments	379	379	379	379	379	379
Number of groups	391	391	391	391	391	391
Observations	6647	6647	6647	6647	6647	6647

Source: Author's illustration

Notes: AR(1) and AR(2) refer to Arellano-Bond tests for first- and second-order autocorrelation in first-differenced errors. Hansen J-test evaluates instrument validity (overidentifying restrictions). TD, STD, LTD, TL, IBL and NIBL represent the various versions of dependent variables for the model under scrutiny.

typically receiving higher assumed stability than they may exhibit during severe crises. The empirical evidence presented here suggests that non-interest-bearing deposits are, in fact, highly sensitive to crisis conditions, with outflows occurring systematically across three distinct types of shocks. Regulators and bank risk managers may therefore wish to reconsider the assumed stability of non-interest-bearing deposit funding, particularly for banks with concentrated exposure to such accounts.

Thus, from a theoretical perspective, this analysis extends the pecking order framework to incorporate deposit flight dynamics. In normal times, non-interest-bearing deposits represent a highly coveted funding source after retained earnings, costless, stable, and relationship-based. During crises, however, such a hierarchy inverts, depositors withdraw, forcing banks down the funding pecking order toward more expensive, more contractually binding, and potentially more risky interest-bearing debt. The crisis-period funding hierarchy, therefore, may differ fundamentally from the pecking order observed in tranquil periods, with banks reluctantly accepting higher-cost funding to maintain liability levels. Such an observation suggests that corporate finance theories applied to banking institutions must incorporate state-dependent funding hierarchies, where the relative attractiveness of different funding sources varies systematically with macroeconomic and geopolitical conditions.

Table 5 below reports the GMM diagnostic statistics. The results demonstrate that the Hansen J-test fails to reject the null of instrument validity across all six models (p-values ranging from 0.237 to 0.486), indicating that the instruments are not correlated with the error term.

The Arellano-Bond AR(2) test (Arellano and Bond, 1991) fails to reject the null of no second-order autocorrelation in five of the six models at conventional significance levels, thus confirming that there is no second-order autocorrelation in the differenced residuals at the 10% level. All models satisfy the necessary condition of significant AR(1) tests ($p < 0.01$), confirming that there is first-order autocorrelation in the differenced residuals and hence the representation using a dynamic panel structure is appropriate.

5. Conclusion

This study provides a comprehensive analysis of global bank capital structures incorporating the effects of three major macroeconomic crises: the Global Financial Crisis (GFC), the COVID-19 pandemic, and the Russia-Ukraine war. Using a two-step system GMM model, it examines the determinants of six key financial variables, total debt (TD), short-term debt (STD), long-term debt (LTD), total liabilities (TL), interest-bearing liabilities (IBL), and non-interest-bearing liabilities (NIBL), while evaluating the persistence of financial structures and the relevance of the Pecking Order Theory (Myers and Majluf, 1984) within the banking sector.

The findings reveal that banks' asset growth rates are negatively associated with debt, indicating that banks with greater realised investments rely less on external financing. Liquidity measures, particularly cash flow from operations and investing, exhibit a consistent negative relationship with most debt variables, reinforcing the Pecking Order Theory's predictions. Profitability shows mixed effects: while profit before tax positively influences debt levels, higher profit margins reduce reliance on external financing. Larger banks maintain higher total and non-interest-bearing liabilities, reflecting their ability to access diverse funding sources. Among the macroeconomic factors, the GFC and the Russia-Ukraine (geopolitical) crises are associated with increased debt accumulation, whereas the COVID-19 pandemic displays more nuanced and context-dependent effects.

These findings carry important policy implications. During periods of political and economic instability, targeted liquidity support can mitigate excessive debt accumulation and enhance financial stability. Moreover, regulatory frameworks should account for the interaction between firm-specific dynamics and macroeconomic shocks to enable a

more comprehensive assessment of systemic risk and banking sector resilience. A particularly critical insight for regulators concerns the behaviour of non-interest-bearing deposits during crises. Current regulatory frameworks, including liquidity coverage ratios, assume these deposits remain stable and reliable even under stress. This study demonstrates otherwise: when uncertainty rises, depositors systematically withdraw funds from non-interest-bearing accounts, forcing banks to replace their cheapest funding source with costly, contractually committed debt. Demirgüç-Kunt and Huizinga (2010) specifically caution against such behaviour. Therefore, banks must recalibrate their assumptions, under crisis conditions, as these instruments are demonstrably less stable than currently presumed. Adjusting liquidity requirements through currently established regulatory frameworks to reflect this reality would enhance the banking system's resilience and prevent banks from relying on a funding source that effectively disappears precisely when it is most needed as also evidenced by Adrian and Shin (2010).

Nonetheless, several limitations warrant acknowledgment. First, the Russia-Ukraine war remains ongoing, and our dataset extends only through 2022; thus, the full impact of the conflict may not yet be fully reflected in the variables examined, even though a statistically significant impact of this conflict has already been evidenced. Notwithstanding this claim, future research should extend the time horizon to enable more accurate assessment of bank leverage dynamics during such geopolitical tensions. Second, the inclusion of global banks operating under different reporting regimes (IFRS versus GAAP) introduces certain data discrepancies, particularly regarding the treatment of financial instruments, lease capitalization, and off-balance-sheet items. While an attempt to address this issue is made through the use of standardized as compared to point-in-time data, still, the results should be interpreted with this context in mind. Third, future research could extend this analysis to other financial institutions to assess how crises shape leverage decisions across the broader financial sector, thereby enabling evaluation of the long-term effects of emerging economic disruptions on capital structure choices of banks.

Despite these limitations, this study makes several contributions to the capital structure literature. It extends existing research by focusing on the banking sector across multiple global crises, offering novel empirical insights into how macroeconomic shocks interact with firm-specific characteristics. The findings provide robust evidence supporting the Pecking Order Theory (Myers and Majluf, 1984), demonstrating that banks prioritize internal financing while carefully managing external debt. Furthermore, the research enhances understanding of the dynamic and persistent nature of bank capital structures, bridging gaps in prior studies that largely overlook the combined influence of historical financial decisions and external economic disruptions. Notably, bank capital structure exhibits strong persistence, with lagged financial variables significantly influencing current debt and liability levels across all six measures examined. Last but not the least, systemic (GFC) and endemic (geopolitical tensions) crises have far-reaching devastating impacts on the global financial system, as compared to temporal pandemics (COVID-19).

CRedit authorship contribution statement

Boodeo Nem: Writing – review & editing, Writing – original draft, Software, Methodology, Data curation, Conceptualization. **Indranarain Ramlall:** Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

- Admati, A.R., DeMarzo, P.M., Hellwig, M.F., Pfleiderer, P.C., 2013. Fallacies, irrelevant facts, and myths in the discussion of capital regulation: why bank equity is not socially expensive. Stanford University Graduate School of Business Research Paper.
- Adrian, T. and Shin, H.S., (2010), "Financial intermediaries and monetary economics", FRB of New York Staff Report, No. 398, Available at SSRN: (<https://ssrn.com/abstract=1491603>) or (<https://doi.org/10.2139/ssrn.1491603>).
- Alraheb, T.H., Nicolas, C., Tarazi, A., 2019. Institutional environment and bank capital ratios. *J. Financ. Stab.* 43, 1–24. (<https://doi.org/10.1016/j.jfs.2019.05.0161572-3089>).
- Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Rev. Econ. Stud.* 28, 277–297.
- Azmi, W., Hassan, M.K., Houston, R., Karim, M.S., 2021. ESG activities and banking performance: International evidence from emerging economies. *J. Int. Financ. Mark. Inst. Money* 70. <https://doi.org/10.1016/j.intfin.2020.101277>.
- Berg, T., Gider, J., 2017. What explains the difference in leverage between banks and nonbanks. *J. Financ. Quant. Anal.* 52 (6), 2677–2702.
- Berger, A.N., Bouwman, C.H.S., 2013. How does capital affect bank performance during financial crises? *J. Financ. Econ.* 109, 146–176.
- Berger, A.N., Herring, R.J., Szegö, G.P., 1995. The role of capital in financial institutions. *J. Bank. Financ.* 19 (3–4), 393–430.
- Bloom, N., 2009. The impact of uncertainty shocks. *Econometrica* 77 (3), 623–685.
- Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. *J. Econ.* 87, 115–143.
- Brunnermeier, M.K., 2009. Deciphering the liquidity and credit crunch 2007 – 2008. *J. Econ. Perspect.* 23 (1), 77–100.
- Chiaromonte, L., Dreassi, A., Girardone, C., Piserà, S., 2022. Do ESG strategies enhance bank stability during financial turmoil? *Eur. J. Financ.* 28 (12), 1173–1211. <https://doi.org/10.1080/1351847X.2021.1964556>.
- Demirgüç-Kunt, A., Huizinga, H., 2010. Bank activity and funding strategies: The impact on risk and returns. *J. Financ. Econ.* 98, 626–650. <https://doi.org/10.1016/j.jfineco.2010.06.004>.
- Di Tommaso, C., Thornton, J., 2020. Do ESG scores effect bank risk taking and value? Evidence from European banks. *Corp. Social. Responsib. Environ. Manag.* 27, 2286–2298. DOI: 10.1002/csr.1964.
- Dursun-de Neef, H.Ö. and Schandlbauer, A. (2021) "COVID-19 and Lending Responses of European Banks, *Journal of Banking and Finance*, Forthcoming, Available at SSRN: (<https://ssrn.com/abstract=3681937>) or (<https://doi.org/10.2139/ssrn.3681937>).
- Frank, M.Z., Goyal, V.K., 2003. Testing the pecking order theory of capital structure. *J. Financ. Econ.* 67 (2), 217–248.
- Frank, M.Z., Goyal, V.K., 2009. Capital structure decisions: which factors are reliably important? *Financ. Manag.* 38 (1), 1–37.
- Ghosh, S., Chatterjee, G., 2018. Capital Structure, ownership and crisis: how different are banks? *J. Financ. Regul.* 26 (2), 300–330.
- Greenbaum, S.I., Thakor, A.V., Boot, A.W., 2019. *Contemporary Financial Intermediation*, fourth ed. Elsevier Publishing.
- Gropp, R., Heider, F., 2010. The determinants of bank capital structure. *Rev. Financ.* 14 (4), 587–622.
- Ivashina, V., Scharfstein, D., 2010. Bank lending during the financial crisis of 2008. *J. Financ. Econ.* 97 (3), 319–338.
- Kalemli-Ozcan, S., Sorensen, B., Yesiltas, S., 2012. Leverage across firms, banks and countries. *J. Int. Econ.* 88, 284–298.
- Košak, M., Li, S., Lončarski, I., Marinč, M., 2015. Quality of bank capital and bank lending behaviour during the global financial crisis. *Int. Rev. Financ. Anal.* 37, 168–183. <https://doi.org/10.1016/j.irfa.2014.11.008>.
- Levine, R., Lin, C., Tai, M., 2021. How did depositors respond to COVID-19? *Rev. Financ. Stud.* 34 (11), 5438–5473.
- Modigliani, F., Miller, M.H., 1958. The cost of capital, corporation finance, and the theory of investment. *Am. Econ. Rev.* 48 (3), 261–297.
- Mohammad, K.U., 2022. How bank capital structure decision-making change in recessions: COVID-19 evidence from Pakistan. *Asian J. Econ. Bank.* 6 (2), 255–269. <https://doi.org/10.1108/AJEB-04-2021-0049>.
- Myers, S.C., Majluf, N.S., 1984. Corporate financing and investment decisions when firms have information that investors do not have. *J. Financ. Econ.* 13, 187–221.
- OECD, 2022. Impacts of the Russian Invasion of Ukraine on Financial Market Conditions and Resilience: Assessment of Global Financial Markets. OECD Publishing, Paris. <https://doi.org/10.1787/879c9322-en>.
- Ramlall, I., 2022. Does geographical proximity matter in determining the profitability of banks? *J. Policy Model.* 44 (6), 1251–1279. <https://doi.org/10.1016/j.jpolmod.2022.07.003>.
- Roodman, D., 2009. How to do xtabond2: An introduction to difference and system GMM in STATA. *Stata J.* 9 (1), 86–136.
- Stoika, V., 2023. The impact of the war on banking in Ukraine. *Cent. Eur. Rev. Econ. & Financ.* 43 (2), 52–64. <https://doi.org/10.24136/ceref.2023.009>.
- Yudaruddin, R., Lesmana, D., 2024. Banking sector's reaction during the Russian invasion of Ukraine: who reacted the most? *J. Econ. Stud.* 51 (5), 1011–1035. <https://doi.org/10.1108/JES-04-2023-0206>.